

**SP-157019
(New)**



**SPECIAL PROVISIONS
FOR
DOWNTOWN SKYWALK**

**Linn County
STP-U-1187(781)--70-57**

**Effective Date
December 20, 2016**

THE STANDARD SPECIFICATIONS, SERIES 2015, ARE AMENDED BY THE FOLLOWING MODIFICATIONS AND ADDITIONS. THESE ARE SPECIAL PROVISIONS AND THEY SHALL PREVAIL OVER THOSE PUBLISHED IN THE STANDARD SPECIFICATIONS.

TABLE OF CONTENTS

DIVISION 03 - CONCRETE

03 3000	CAST-IN-PLACE CONCRETE
03 4100	PRECAST STRUCTURAL CONCRETE

DIVISION 04 - MASONRY

04 2000	UNIT MASONRY
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DIVISION 05 - METALS

05 1200	STRUCTURAL STEEL FRAMING
05 3100	STEEL DECKING
05 4000	COLD-FORMED METAL FRAMING
05 7000	DECORATIVE METAL

DIVISION 06 - WOOD, PLASTICS, AND COMPOSITES

06 1000	ROUGH CARPENTRY
06 1063	EXTERIOR ROUGH CARPENTRY

DIVISION 07 - THERMAL AND MOISTURE PROTECTION

07 1800	TRAFFIC COATINGS
07 2100	THERMAL INSULATION
07 2119	FOAMED-IN-PLACE INSULATION
07 2200	ROOF AND DECK INSULATION
07 2500	WEATHER BARRIERS
07 4213	METAL WALL PANELS
07 4214	INSULATED METAL WALL PANELS
07 4264	METAL COMPOSITE MATERIAL WALL PANELS
07 5323	ETHYLENE-PROPYLENE-DIENE-MONOMER ROOFING – FULLY ADHERED
07 6200	SHEET METAL FLASHING AND TRIM
07 8205	BOARD AND BLANKET FIREPROOFING
07 8400	FIRESTOPPING
07 9005	JOINT SEALERS
07 9513	EXPANSION JOINT COVER ASSEMBLIES

DIVISION 08 - OPENINGS

08 1113	HOLLOW METAL DOORS AND FRAMES
08 1116	ALUMINUM DOORS AND FRAMES
08 4313	ALUMINUM-FRAMED STOREFRONTS
08 4413	GLAZED ALUMINUM CURTAIN WALLS
08 7100	DOOR HARDWARE
08 8000	GLAZING

DIVISION 09 - FINISHES

09 2116 GYPSUM BOARD ASSEMBLIES
09 2116.13 NON-STRUCTURAL PLASTIC FURRING
09 5100 ACOUSTICAL CEILINGS
09 6500 RESILIENT FLOORING
09 6813 TILE CARPETING
09 9113 EXTERIOR PAINTING
09 9123 INTERIOR PAINTING

DIVISION 10 - SPECIALTIES

10 2601 WALL AND CORNER GUARDS
10 4400 FIRE PROTECTION SPECIALTIES

DIVISION 22 - PLUMBING

22 0500 COMMON WORK RESULTS FOR PLUMBING
22 0529 HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT
22 0533 HEAT TRACING FOR PLUMBING PIPING
22 0548 VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT
22 0700 PLUMBING INSULATION
22 1316 SANITARY WASTE AND VENT PIPING
22 1319 SANITARY WASTE PIPING SPECIALTIES
22 1413 FACILITY STORM DRAINAGE PIPING
22 1423 STORM DRAINAGE PIPING SPECIALTIES

DIVISION 23 - HEATING, VENTILATING, AND AIR-CONDITIONING (HVAC)

23 0500 COMMON WORK RESULTS FOR HVAC
23 0529 HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT
23 0548 VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT
23 0553 IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
23 0593 TESTING, ADJUSTING, AND BALANCING FOR HVAC
23 0700 HVAC INSULATION
23 1123 FACILITY NATURAL GAS PIPING
23 2300 REFRIGERANT PIPING
23 3113 METAL DUCTS
23 3300 AIR DUCT ACCESSORIES
23 3713 DIFFUSERS, REGISTERS, AND GRILLES
23 5400 FURNACES

DIVISION 26 - ELECTRICAL

26 0500 COMMON WORK RESULTS FOR ELECTRICAL
26 0501 MINOR ELECTRICAL DEMOLITION
26 0519 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
26 0526 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
26 0529 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
26 0534 CONDUIT
26 0537 BOXES
26 0923 LIGHTING CONTROL DEVICES
26 2416 PANELBOARDS
26 2717 EQUIPMENT WIRING
26 2726 WIRING DEVICES
26 2818 ENCLOSED SWITCHES
26 5100 INTERIOR LIGHTING
26 5600 EXTERIOR LIGHTING

DIVISION 27 - COMMUNICATIONS

27 0528 PATHWAYS FOR COMMUNICATIONS SYSTEMS

DIVISION 28 - ELECTRONIC SAFETY AND SECURITY

28 0528 PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY

28 3111 DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

DIVISION 31 - EARTHWORK

31 6615 MICRO PILES

DIVISION 32 - EXTERIOR IMPROVEMENTS

32 3113 CHAIN LINK FENCES AND GATES

SECTION 03 3000
CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes, for the following:
 - 1. Pile caps
 - 2. Concrete building elements
 - 3. Concrete toppings on hollowcore slabs

1.2 DEFINITIONS

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

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - 1. Indicate amounts of mixing water to be withheld for later addition at Project site.
- C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, and grade, bar schedules, stirrup spacing, bent bar diagrams, bar arrangement, splices and laps, mechanical connections, tie spacing, hoop spacing, and supports for concrete reinforcement.
- D. Construction Joint Layout: Indicate proposed construction joints required to construct the structure.
 - 1. Location of construction joints is subject to approval of the Engineer.
- E. Samples: For waterstops and vapor barrier.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installer and manufacturer.
- B. Welding certificates.
- C. Material Certificates: For each of the following, signed by manufacturers:
 - 1. Cementitious materials.
 - 2. Admixtures.
 - 3. Form materials and form-release agents.
 - 4. Steel reinforcement and accessories.
 - 5. Fiber reinforcement.

6. Waterstops.
 7. Floor and slab treatments.
 8. Bonding agents.
 9. Adhesives.
 10. Joint-filler strips.
 11. Repair materials.
- D. Material Test Reports: For the following, from a qualified testing agency, indicating compliance with requirements:
1. Aggregates. Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.
- E. Floor surface flatness and levelness measurements indicating compliance with specified tolerances.
- F. Field quality-control reports.
- G. Minutes of preinstallation conference.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C94 (C94M) requirements for production facilities and equipment.
1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."
- C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.
 2. Personnel performing laboratory tests shall be ACI-certified Concrete Strength Testing Technician and Concrete Laboratory Testing Technician - Grade I. Testing Agency laboratory supervisor shall be an ACI-certified Concrete Laboratory Testing Technician - Grade II.
- D. Source Limitations: Obtain each type or class of cementitious material of the same brand from the same manufacturer's plant, obtain aggregate from single source, and obtain admixtures from single source from single manufacturer.
- E. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4, "Structural Welding Code - Reinforcing Steel."
- F. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:
1. ACI 301, "Specifications for Structural Concrete, Sections 1 through 5.

2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
- G. Preinstallation Conference: Conduct conference at Project site.
1. Before submitting design mixtures, review concrete design mixture and examine procedures for ensuring quality of concrete materials. Require representatives of each entity directly concerned with cast-in-place concrete to attend, including the following:
 - a. Contractor's superintendent.
 - b. Independent testing agency responsible for concrete design mixtures.
 - c. Ready-mix concrete manufacturer.
 - d. Concrete subcontractor.
 - e. Special concrete finish subcontractor.
 2. Review the following items:
 - a. Special inspection and testing and inspecting agency procedures for field quality control
 - b. Concrete finishes and finishing
 - c. Cold- and hot- weather concreting procedures
 - d. Curing procedures
 - e. Construction contraction and isolation joints, and joint filler strips
 - f. Forms and form removal limitations
 - g. Vapor barrier installation
 - h. Anchor rod and anchorage device installation tolerances
 - i. Steel reinforcement installation
 - j. Floor and slab flatness and levelness measurement
 - k. Concrete repair procedures
 - l. Concrete protection

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage. Avoid damaging coatings on steel reinforcement.
- B. Waterstops: Store waterstops under cover to protect from moisture, sunlight, dirt, oil, and other contaminants.

PART 2 PRODUCTS

2.1 FORM-FACING MATERIALS

- A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.
 1. Plywood, metal, or other approved panel materials.

- B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.
- C. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that will produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.
- D. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.
- E. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 inch by 3/4 inch, minimum.
- F. Rustication Strips: Wood, metal, PVC, or rubber strips, kerfed for ease of form removal.
- G. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and will not impair subsequent treatments of concrete surfaces.
 - 1. Formulate form-release agent with rust inhibitor for steel form-facing materials.
- H. Form Ties: Factory-fabricated, removable or snap-off metal or glass-fiber-reinforced plastic form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.
 - 1. Furnish units that will leave no corrodible metal closer than 1 inch to the plane of exposed concrete surface.
 - 2. Furnish ties that, when removed, will leave holes no larger than 1 inch in diameter in concrete surface.
 - 3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.2 STEEL REINFORCEMENT

- A. Reinforcing Bars: ASTM A615, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A706, deformed.
- C. Plain-Steel Welded Wire Reinforcement: ASTM A185, plain, fabricated from as-drawn steel wire into flat sheets.

2.3 REINFORCEMENT ACCESSORIES

- A. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice," of greater compressive strength than concrete and as follows:
 - 1. For concrete surfaces exposed to view where legs of wire bar supports contact forms, use CRSI Class 1 plastic-protected steel wire or CRSI Class 2 stainless-steel bar supports.
 - 2. Supporting reinforcement on clay brick supports is not acceptable.

2.4 CONCRETE MATERIALS

- A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:
 - 1. Portland Cement: ASTM C 150, Type I, gray. Supplement with the following:

- a. Fly Ash: ASTM C 618, Class F or Class C.
- B. Normal-Weight Aggregates: ASTM C 33, Class 3S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.
 - 1. Maximum Coarse-Aggregate Size: 1 inch nominal.
 - 2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement. For slabs on grade and suspended slabs, fine aggregate with a proven history of not being susceptible to popouts, imported sand if necessary.
- C. Water: ASTM C94 and potable.

2.5 ADMIXTURES

- A. Air-Entraining Admixture: ASTM C 260.
- B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
 - 1. Water-Reducing Admixture: ASTM C494, Type A.
 - 2. Retarding Admixture: ASTM C494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C494, Type D.
 - 4. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
 - 5. High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.
 - 6. Plasticizing and Retarding Admixture: ASTM C1017, Type II.

2.6 FIBER REINFORCEMENT

- A. Synthetic Macro-Fiber: Polyolefin macro-fibers engineered and designed for use in concrete, complying with ASTM C1116 Type III, 1 to 2 1/4 inches long.

2.7 WATERSTOPS

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

2.8 CURING MATERIALS

- A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.
- B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 ounces per square yard when dry.
- C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.
- D. Water: Potable.

2.9 RELATED MATERIALS

- A. Expansion- and Isolation-Joint-Filler Strips: Flexible, closed-cell polyethylene with tear off strip for sealant installation.
- B. Bonding Agent: ASTM C1059, Type II, non-redispersible, acrylic emulsion or styrene butadiene.
- C. Epoxy Bonding Adhesive: ASTM C 881, two component epoxy resin, capable of humid curing and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:
 - 1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.10 REPAIR MATERIALS

- A. Repair Underlayment: Cement-based, polymer-modified, self-leveling product that can be applied in thicknesses from 1/8 inch and that can be feathered at edges to match adjacent floor elevations.
 - 1. Cement Binder: ASTM C 150, portland cement or hydraulic or blended hydraulic cement as defined in ASTM C 219.
 - 2. Primer: Product of underlayment manufacturer recommended for substrate, conditions, and application.
 - 3. Aggregate: Well-graded, washed gravel, 1/8 inch to 1/4 inch or coarse sand as recommended by underlayment manufacturer.
 - 4. Compressive Strength: Not less than 4100 psi at 28 days when tested according to ASTM C109.

2.11 CONCRETE MIXTURES, GENERAL

- A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.
 - 1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures.
- B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:
 - 1. Fly Ash: 25%.
- C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30% by weight of cement.
- D. Admixtures: Use admixtures according to manufacturer's written instructions.
 - 1. Use water-reducing or high-range water-reducing admixture in concrete, as required, for placement and workability.
 - 2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
 - 3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

2.12 CONCRETE MIXTURES FOR BUILDING ELEMENTS

- A. Footings: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Slump Limit: Concrete mix shall be proportioned to achieve a maximum slump of 9 inches for concrete containing high range water reducing admixture, 6 inches for concrete containing a mid-range water reducing admixture, or 4 inches for other concrete. All mixes shall have a water slump of 2 inches to 3 inches.
 - 4. Air Content: 6%, +/- 1.5% at point of delivery for 1 inch nominal maximum aggregate size.
- B. Concrete Building Elements: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
 - 3. Slump Limit: Concrete mix shall be proportioned to achieve a maximum slump of 9 inches for concrete containing high range water reducing admixture, 6 inches for concrete containing a mid-range water reducing admixture, or 4 inches for other concrete. All mixes shall have a water slump of 2 inches to 3 inches.
 - 4. Air Content: 6%, +/- 1.5% at point of delivery for 1 inch nominal maximum aggregate size.
- C. Concrete Toppings on hollowcore slabs: Proportion normal-weight concrete mixture as follows:
 - 1. Minimum Compressive Strength: 4000 psi at 28 days.
 - 2. Minimum Water Cementitious Materials Content: 520 pounds per cubic yards.
 - 3. Slump Limit: Concrete mix shall be proportioned to achieve a maximum slump of 9 inches for concrete containing high range water reducing admixture, 6 inches for concrete containing a mid-range water reducing admixture, or 4 inches for other concrete. All mixes shall have a water slump of 2 inches to 3 inches.
 - 4. Air Content: Do not allow air content of trowel-finished floors to exceed 3%.
 - 5. Synthetic Macro-Fiber: Uniformly disperse in concrete mixture at manufacturer's recommended rate, but not less than 4.0 pounds per cubic yard.

2.13 FABRICATING REINFORCEMENT

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

2.14 CONCRETE MIXING

- A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C94 and ASTM C1116, and furnish batch ticket information.
 - 1. When air temperature is between 85°F and 90°F, reduce mixing and delivery time from 1 1/2 hours to 75 minutes; when air temperature is above 90°F, reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.1 FORMWORK

- A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.
- B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.
- C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:
 - 1. Class A, 1/8 inch for smooth-formed finished surfaces.
 - 2. Class B, 1/4 inch for rough-formed finished surfaces.
- D. Construct forms tight enough to prevent loss of concrete mortar.
- E. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces steeper than 1.5 horizontal to 1 vertical.
 - 1. Install keyways, reglets, recesses, and the like, for easy removal.
 - 2. Do not use rust-stained steel form-facing material.
- F. Set edge forms, bulkheads, and intermediate screed strips for slabs to achieve required elevations and slopes in finished concrete surfaces. Provide and secure units to support screed strips; use strike-off templates or compacting-type screeds.
- G. Provide temporary openings for cleanouts and inspection ports where interior area of formwork is inaccessible. Close openings with panels tightly fitted to forms and securely braced to prevent loss of concrete mortar. Locate temporary openings in forms at inconspicuous locations.
- H. Chamfer exterior corners and edges of permanently exposed concrete.
- I. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.
- J. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.
- K. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.
- L. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.

3.2 EMBEDDED ITEMS

- A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 1. Install anchor rods, accurately located, to elevations required and complying with tolerances in Section 7.5 of AISC's "Code of Standard Practice for Steel Buildings and Bridges."

3.3 REMOVING AND REUSING FORMS

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

3.4 STEEL REINFORCEMENT

- A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.
 - 1. Do not cut or puncture vapor barrier. Repair damage and reseal vapor barrier before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other foreign materials that would reduce bond to concrete.
- C. Accurately position, support, and secure reinforcement against displacement. Locate and support reinforcement with bar supports to maintain minimum concrete cover. Do not tack weld crossing reinforcing bars.
 - 1. Weld reinforcing bars according to AWS D1.4, where indicated.
- D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.5 JOINTS

- A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.
- B. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Engineer.
 - 1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 - 2. Form keyed joints as indicated. Embed keys at least 1 1/2 inches into concrete.
 - 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.

4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls at distance needed for construction sequencing. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
- C. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least 1/4 of concrete thickness as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8 inch wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- D. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.
 2. Terminate full-width joint-filler strips not less than 1/2 inch or more than 1 inch below finished concrete surface where joint sealants, specified in Division 07 section "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

3.6 WATERSTOPS

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

3.7 CONCRETE PLACEMENT

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing mixture constituents to segregate.

- D. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- E. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40°F for 3 successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- F. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90°F at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.8 FINISHING FORMED SURFACES

- A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces not exposed to public view.
- B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.
 - 1. Apply to concrete surfaces exposed to public view, to receive a rubbed finish, or to be covered with a coating or covering material applied directly to concrete.
- C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:
 - 1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform

color and texture. Do not apply cement grout other than that created by the rubbing process.

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

3.9 FINISHING FLOORS AND SLABS

- A. General: Comply with ACI 302.1R recommendations for screeding, restraighening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.
- B. Float Finish: Consolidate surface with power-driven floats or by hand floating if area is small or inaccessible to power driven floats. Restraighten, cut down high spots, and fill low spots. Repeat float passes and restraighening until surface is left with a uniform, smooth, granular texture.
 1. Apply float finish to surfaces to receive trowel finish or to be covered with fluid-applied or sheet waterproofing, built up or membrane roofing.
- C. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.
 1. Apply a trowel finish to surfaces exposed to view or to be covered with resilient flooring, carpet, and ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.
 2. Finish surfaces to the following tolerances, according to ASTM E1155, for a randomly trafficked floor surface:
- D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.
 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.

3.10 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and by steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations:
 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 4 inches high unless otherwise indicated; and extend base not less than 6 inches in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated.
 3. Minimum Compressive Strength: 4000 psi at 28 days.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18 inches centers around the full perimeter of concrete base.
 5. Set anchor bolts for machines and equipment at correct elevations, complying with diagrams or templates from manufacturer furnishing machines and equipment.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads, landings, and associated items. Cast-in inserts and accessories as shown on Drawings. Screed, tamp, and trowel finish concrete surfaces.

3.11 CONCRETE PROTECTING AND CURING

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
- B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 pounds per square foot per hour before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- C. Formed Surfaces: Cure formed concrete surfaces, including underside of beams, supported slabs, and other similar surfaces. If forms remain during curing period, moist cure after loosening forms. If removing forms before end of curing period, continue curing for the remainder of the curing period.
- D. Unformed Surfaces: Begin curing immediately after finishing concrete. Cure unformed surfaces, including floors and slabs, concrete floor toppings, and other surfaces.
- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than 7 days with the following materials:
 - a. Water.
 - b. Continuous water-fog spray.
 - c. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12 inches lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.

3.12 LIQUID FLOOR TREATMENTS

- A. Penetrating Liquid Floor Treatment: Prepare, apply, and finish penetrating liquid floor treatment according to manufacturer's written instructions.
1. Remove curing compounds, sealers, oil, dirt, laitance, and other contaminants and complete surface repairs.
 2. Do not apply to concrete that is less than 28 days' old.
 3. Apply liquid until surface is saturated, scrubbing into surface until a gel forms; rewet; and repeat brooming or scrubbing. Rinse with water; remove excess material until surface is dry. Apply a second coat in a similar manner if surface is rough or porous.

3.13 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 - 1. Defer joint filling until concrete has aged at least 1 month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

3.14 CONCRETE SURFACE REPAIRS

- A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.
- B. Patching Mortar: Mix dry-pack patching mortar, consisting of one part portland cement to 2 1/2 parts fine aggregate passing a No. 16 sieve, using only enough water for handling and placing.
- C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.
 - 1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch in any dimension to solid concrete. Limit cut depth to 3/4 inch. Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
 - 2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar will match surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
 - 3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Engineer.
- D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.
 - 1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
 - 2. After concrete has cured at least 14 days, correct high areas by grinding.
 - 3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
 - 4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
 - 5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch to match adjacent floor

elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.

6. Repair defective areas, except random cracks and single holes 1 inch or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4 inch clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
 7. Repair random cracks and single holes 1 inch or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.
- E. Perform structural repairs of concrete, subject to Engineer's approval, using epoxy adhesive and patching mortar.
- F. Repair materials and installation not specified above may be used, subject to Engineer's approval.

3.15 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports.
- B. Inspections:
1. Steel reinforcement placement.
 2. Steel reinforcement welding.
 3. Headed bolts and studs.
 4. Verification of use of required design mixture.
 5. Concrete placement, including conveying and depositing.
 6. Curing procedures and maintenance of curing temperature.
 7. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
1. Testing Frequency: Obtain at least one composite sample for each 100 cubic yards or fraction thereof of each concrete mixture placed each day.
 - a. When frequency of testing will provide fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.
 2. Slump: ASTM C143; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.

3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 4. Concrete Temperature: ASTM C1064; one test hourly when air temperature is 40°F and below and when 80°F and above, and one test for each composite sample.
 5. Compression Test Specimens: ASTM C31.
 - a. Cast and laboratory cure two sets of two standard 6 inches by 12 inches cylinder specimens for each composite sample or two sets of three standard 4 inches by 8 inches cylinder specimens for each composite sample.
 6. Compressive-Strength Tests: ASTM C39; test one set of laboratory-cured specimens at 7 days and one set of specimens at 28 days.
 - a. A compressive-strength test shall be the average compressive strength from a set of two specimens for 6 inches by 12 inches cylinders or three specimens for 4 inch by 8 inch cylinders obtained from same composite sample and tested at age indicated.
 7. Strength of each concrete mixture will be satisfactory if every average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi.
 8. Test results shall be reported in writing to Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7 and 28 day tests.
 9. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Engineer but will not be used as sole basis for approval or rejection of concrete.
 10. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Engineer. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C42 or by other methods as directed by Engineer.
 11. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 12. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.
- D. Measure floor and slab flatness and levelness according to ASTM E1155 within 72 hours of finishing.

END OF SECTION

**SECTION 03 4100
PRECAST STRUCTURAL CONCRETE**

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Precast structural hollowcore slabs

1.2 PREINSTALLATION MEETINGS

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

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Design precast structural concrete, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.
- B. Design Standards: Comply with ACI 318 and with design recommendations in PCI MNL 120, "PCI Design Handbook - Precast and Prestressed Concrete," applicable to types of precast structural concrete units indicated.
- C. Fire-Resistance Calculations: Where indicated, provide precast structural concrete units whose fire resistance meets prescriptive requirements of authorities having jurisdiction or has been calculated according to ACI 216.1 and is acceptable to authorities having jurisdiction.
- D. Structural Performance: Precast structural concrete units and connections shall withstand design loads indicated within limits and under conditions indicated.
- E. Structural Performance: Provide precast structural concrete units and connections capable of withstanding the following design loads within limits and under conditions indicated:
1. Loads: as indicated on drawings.
 2. Design precast structural concrete framing system and connections to maintain clearances at openings, to allow for fabrication and construction tolerances, to accommodate live-load deflection, shrinkage and creep of primary building structure, and other building movements. Maintain precast structural concrete deflections within limits of ACI 318.
 - a. Thermal Movements: Allow for in-plane thermal movements resulting from annual ambient temperature changes of minus -18°F to +120°F.
 3. Fire-Resistance Rating: Select material and minimum thicknesses to provide indicated fire rating. Hollowcore panels for Skywalk A require a 2-hour system rating.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Design Mixtures: For each precast concrete mixture. Include compressive strength and, if required, water-absorption tests.
- C. Shop Drawings:
1. Include member locations, plans, elevations, dimensions, shapes and sections, openings, support conditions, and types of reinforcement, including special reinforcement.

2. Detail fabrication and installation of precast structural concrete units, including connections at member ends and to adjoining construction.
 3. Indicate joints, reveals, drips, chamfers, and extent and location of each surface finish.
 4. Indicate separate face and backup mixture locations and thicknesses.
 5. Indicate type, size, and length of welded connections by AWS standard symbols.
 6. Detail loose and cast-in hardware, lifting and erection inserts, connections, and joints.
 7. Indicate locations, tolerances, and details of anchorage devices to be embedded in or attached to structure or other construction.
 8. Include and locate openings larger than 10 inches. Where additional structural support is required, include header design.
 9. Indicate location of each precast structural concrete unit by same identification mark placed on panel.
 10. Indicate relationship of precast structural concrete units to adjacent materials.
 11. Indicate estimated camber for precast floor slabs with concrete toppings.
 12. Indicate shim sizes and grouting sequence.
 13. If design modifications are proposed to meet performance requirements and field conditions, submit design calculations and Shop Drawings. Do not adversely affect the appearance, durability, or strength of units when modifying details or materials and maintain the general design concept.
- D. Delegated-Design Submittal: For precast structural concrete indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer licensed the State in which the Project is located responsible for their preparation.
1. Show precast structural concrete unit types, connections, types of reinforcement, including special reinforcement, and concrete cover on reinforcement. Indicate location, type, magnitude, and direction of loads imposed on the building structural frame from precast structural concrete.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For installer and fabricator.
- B. Welding certificates.
- C. Material Certificates: For the following:
 1. Cementitious materials.
 2. Reinforcing materials and prestressing tendons.
 3. Admixtures.
 4. Bearing pads.
 5. Insulation.
 6. Structural-steel shapes and hollow structural sections.
- D. Material Test Reports: For aggregates, by a qualified testing agency.

- E. Preconstruction test reports.
- F. Source quality-control reports.
- G. Field quality-control and special inspection reports.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: A firm that assumes responsibility for engineering precast structural concrete units to comply with performance requirements. Responsibility includes preparation of Shop Drawings and comprehensive engineering analysis by a qualified professional engineer.
 - 1. Designated as a PCI-certified plant as follows:
 - a. Group C, Category C3 - Prestressed Straight Strand Structural Members.
- B. Installer Qualifications: A precast concrete erector qualified and designated by PCI's Certificate of Compliance, to erect Category S1 - Simple Structural Systems at time of bidding.
- C. Testing Agency Qualifications: Qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.
- D. Quality-Control Standard: For manufacturing procedures, testing requirements, and quality-control recommendations for types of units required, comply with PCI MNL 116, "Manual for Quality Control for Plants and Production of Structural Precast Concrete Products."
- E. Welding Qualifications: Qualify procedures and personnel according to the following:
 - 1. AWS D1.1, "Structural Welding Code - Steel."
 - 2. AWS D1.4, "Structural Welding Code - Reinforcing Steel."

1.7 COORDINATION

- A. Furnish loose connection hardware and anchorage items to be embedded in or attached to other construction before starting that Work. Provide locations, setting diagrams, templates, instructions, and directions, as required, for installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Support units during shipment on nonstaining shock-absorbing material in same position as during storage.
- B. Store units with adequate bracing and protect units to prevent contact with soil, to prevent staining, and to prevent cracking, distortion, warping or other physical damage.
 - 1. Store units with dunnage across full width of each bearing point unless otherwise indicated.
 - 2. Place adequate dunnage of even thickness between each unit.
 - 3. Place stored units so identification marks are clearly visible, and units can be inspected.
- C. Handle and transport units in a manner that avoids excessive stresses that cause cracking or damage.
- D. Lift and support units only at designated points indicated on Shop Drawings.

PART 2 PRODUCTS

2.1 MOLD MATERIALS

- A. Molds: Rigid, dimensionally stable, non-absorptive material, warp and buckle free, that provides continuous precast concrete surfaces within fabrication tolerances indicated; nonreactive with concrete and suitable for producing required finishes.
 - 1. Mold-Release Agent: Commercially produced form-release agent that does not bond with, stain, or adversely affect precast concrete surfaces and does not impair subsequent surface or joint treatments of precast concrete.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A615, Grade 60, deformed.
- B. Low-Alloy-Steel Reinforcing Bars: ASTM A706, deformed.
- C. Steel Bar Mats: ASTM A184, fabricated from ASTM A615, Grade 60, deformed bars, assembled with clips.
- D. Plain-Steel Welded Wire Reinforcement: ASTM A185, fabricated from as-drawn steel wire into flat sheets.
- E. Deformed-Steel Welded Wire Reinforcement: ASTM A497 or ASTM A1064, flat sheet.
- F. Supports: Suspend reinforcement from back of mold or use bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place according to PCI MNL 116.

2.3 PRESTRESSING TENDONS

- A. Pretensioning Strand: ASTM A416, Grade 250 or Grade 270, uncoated, seven-wire or ASTM A886, Grade 270, indented, seven-wire, low-relaxation strand.
- B. Unbonded Post-Tensioning Strand: ASTM A416, Grade 270, uncoated, seven-wire, low-relaxation strand.
- C. Post-Tensioning Bars: ASTM A722, uncoated high-strength steel bar.

2.4 CONCRETE MATERIALS

- A. Portland Cement: ASTM C150, Type I or Type III, gray, unless otherwise indicated.
 - 1. For surfaces exposed to view in finished structure, use gray or white cement, of same type, brand, and mill source.
- B. Supplementary Cementitious Materials:
 - 1. Fly Ash: ASTM C 618, Class C or F, with maximum loss on ignition of 3%.
- C. Normal-Weight Aggregates: Except as modified by PCI MNL 116, ASTM C33, with coarse aggregates complying with Class 4S. Stockpile fine and coarse aggregates for each type of exposed finish from a single source (pit or quarry) for Project.
- D. Water: Potable; free from deleterious material that may affect color stability, setting, or strength of concrete and complying with chemical limits of PCI MNL 116.
- E. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.

- F. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and to not contain calcium chloride, or more than 0.15% chloride ions or other salts by weight of admixture.
 - 1. Water-Reducing Admixtures: ASTM C494, Type A.
 - 2. Retarding Admixture: ASTM C494, Type B.
 - 3. Water-Reducing and Retarding Admixture: ASTM C494, Type D.
 - 4. Water-Reducing and Accelerating Admixture: ASTM C494, Type E.
 - 5. High-Range, Water-Reducing Admixture: ASTM C494, Type F.
 - 6. High-Range, Water-Reducing and Retarding Admixture: ASTM C494, Type G.
 - 7. Plasticizing Admixture: ASTM C1017, Type I.
 - 8. Plasticizing and Retarding Admixture: ASTM C1017, Type II.
 - 9. Corrosion-Inhibiting Admixture: ASTM C1582.

2.5 STEEL CONNECTION MATERIALS

- A. Carbon-Steel Shapes and Plates: ASTM A36.
- B. Carbon-Steel-Headed Studs: ASTM A 108, Grade 1010 through 1020, cold finished, AWS D1.1, Type A or B, with arc shields and with minimum mechanical properties of PCI MNL 116.
- C. Carbon-Steel Plate: ASTM A283, Grade C.
- D. Malleable-Iron Castings: ASTM A47, Grade 32510 or Grade 35028.
- E. Carbon-Steel Castings: ASTM A27, Grade 60-30 (Grade 415-205).
- F. High-Strength, Low-Alloy Structural Steel: ASTM A572.
- G. Carbon-Steel Structural Tubing: ASTM A500, Grade B.
- H. Wrought Carbon-Steel Bars: ASTM A675, Grade 65.
- I. Deformed-Steel Wire or Bar Anchors: ASTM A496 or ASTM A706.
- J. Carbon-Steel Bolts and Studs: ASTM A307, Grade A; carbon-steel, hex-head bolts and studs; carbon-steel nuts, ASTM A563; and flat, unhardened steel washers, ASTM F 844.
- K. High-Strength Bolts and Nuts: ASTM A325 or ASTM A490 Type 1, heavy hex steel structural bolts; heavy hex carbon-steel nuts, ASTM A563; and hardened carbon-steel washers, ASTM F436.
 - 1. Do not zinc coat ASTM A490 bolts.
- L. Zinc-Coated Finish: For all exterior steel items, apply zinc coating by hot-dip process according to ASTM A 123 or ASTM A 153.
 - 1. For steel shapes, plates, and tubing to be galvanized, limit silicon content of steel to less than 0.03% or to between 0.15% and 0.25% or limit sum of silicon and 2.5 times phosphorous content to 0.09%.
 - 2. Galvanizing Repair Paint: High-zinc-dust-content paint with dry film containing not less than 94% zinc dust by weight, and complying with DOD-P-21035B or SSPC-Paint 20.

- M. Shop-Primed Finish: Prepare surfaces of nongalvanized-steel items, except those surfaces to be embedded in concrete, according to requirements in SSPC-SP 3, and shop apply lead- and chromate-free, rust-inhibitive primer, complying with performance requirements in MPI 79 according to SSPC-PA 1.
- N. Welding Electrodes: Comply with AWS standards.

2.6 BEARING PADS

- A. Provide one of the following bearing pads for precast structural concrete units as recommended by precast fabricator for application:
 1. Elastomeric Pads: AASHTO M 251, plain, vulcanized, 100% polychloroprene (neoprene) elastomer, molded to size or cut from a molded sheet, 50 to 70 Shore, Type A durometer hardness, ASTM D 2240; minimum tensile strength 2250 psi, ASTM D 412.
 2. Random-Oriented-Fiber-Reinforced Elastomeric Pads: Preformed, randomly oriented synthetic fibers set in elastomer. 70 to 90 Shore, Type A durometer hardness, ASTM D 2240; capable of supporting a compressive stress of 3000 psi with no cracking, splitting, or delaminating in the internal portions of pad. Test one specimen for every 200 pads used in Project.
 3. Cotton-Duck-Fabric-Reinforced Elastomeric Pads: Preformed, horizontally layered cotton-duck fabric bonded to an elastomer; 80 to 100 Shore, Type A durometer hardness, ASTM D 2240; complying with AASHTO's "AASHTO LRFD Bridge Design Specifications," Division II, Section 18.10.2; or with MIL-C-882E.
 4. Frictionless Pads: PTFE, glass-fiber reinforced, bonded to stainless- or mild-steel plate, or random-oriented-fiber-reinforced elastomeric pads; of type required for in-service stress.
 5. High-Density Plastic: Multimonomer, nonleaching, plastic strip.

2.7 ACCESSORIES

- A. Precast Accessories: Provide clips, hangers, plastic or steel shims, and other accessories required to install precast structural concrete units.

2.8 GROUT MATERIALS

- A. Sand-Cement Grout: Portland cement, ASTM C150, Type I, and clean, natural sand, ASTM C 144 or ASTM C 404. Mix at ratio of one part cement to 2 1/2 to 3 parts sand, by volume, with minimum water required for placement and hydration. Water-soluble chloride ion content less than 0.06% by weight of cement when tested according to ASTM C1218.
- B. Nonmetallic, Nonshrink Grout: Packaged, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, Portland cement, shrinkage-compensating agents, plasticizing and water-reducing agents, complying with ASTM C1107, Grade A for drypack and Grades B and C for flowable grout and of consistency suitable for application within a 30-minute working time. Water-soluble chloride ion content less than 0.06% by weight of cement when tested according to ASTM C1218.

2.9 CONCRETE MIXTURES

- A. Prepare design mixtures for each type of precast concrete required.
- B. Design mixtures may be prepared by a qualified independent testing agency or by qualified precast plant personnel at precast structural concrete fabricator's option.
- C. Limit water-soluble chloride ions to maximum percentage by weight of cement permitted by ACI 318 or PCI MNL 116 when tested according to ASTM C1218.

- D. Normal-Weight Concrete Mixtures: Proportion face and backup mixtures by either laboratory trial batch or field test data methods according to ACI 211.1, with materials to be used on Project, to provide normal-weight concrete with the following properties:
 - 1. Compressive Strength (28 Days): 5000 psi.
 - 2. Maximum Water-Cementitious Materials Ratio: 0.45.
- E. Water Absorption: For structural precast concrete with an architectural finish, limit water absorption to 6% by weight or 14% by volume, tested according to ASTM C 642, except for boiling requirement.
- F. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having an air content complying with PCI MNL 116.
- G. When included in design mixtures, add other admixtures to concrete mixtures according to manufacturer's written instructions.
- H. Concrete Mix Adjustments: Concrete mix design adjustments may be proposed if characteristics of materials, Project conditions, weather, test results, or other circumstances warrant.

2.10 MOLD FABRICATION

- A. Molds: Accurately construct molds, mortar tight, of sufficient strength to withstand pressures due to concrete-placement operations and temperature changes and for prestressing and detensioning operations. Coat contact surfaces of molds with release agent before reinforcement is placed. Avoid contamination of reinforcement and prestressing tendons by release agent.
- B. Maintain molds to provide completed precast structural concrete units of shapes, lines, and dimensions indicated, within fabrication tolerances specified.
 - 1. Edge and Corner Treatment: Uniformly chamfered.

2.11 FABRICATION

- A. Cast-in Anchors, Inserts, Plates, Angles, and Other Anchorage Hardware: Fabricate anchorage hardware with sufficient anchorage and embedment to comply with design requirements. Accurately position for attachment of loose hardware, and secure in place during precasting operations. Locate anchorage hardware where it does not affect position of main reinforcement or concrete placement.
 - 1. Weld-headed studs and deformed bar anchors used for anchorage according to AWS D1.1 and AWS C5.4, "Recommended Practices for Stud Welding."
- B. Furnish loose hardware items including steel plates, clip angles, seat angles, anchors, dowels, cramps, hangers, and other hardware shapes for securing precast structural concrete units to supporting and adjacent construction.
- C. Cast-in reglets, slots, holes, and other accessories in precast structural concrete units as indicated on the Contract Drawings.
- D. Cast-in openings larger than 10 inches in any dimension. Do not drill or cut openings or prestressing strand without Engineer's approval.
- E. Reinforcement: Comply with recommendations in PCI MNL 116 for fabricating, placing, and supporting reinforcement.

1. Clean reinforcement of loose rust and mill scale, earth, and other materials that reduce or destroy the bond with concrete. When damage to epoxy-coated reinforcement exceeds limits specified in ASTM A775, repair with patching material compatible with coating material and epoxy coat bar ends after cutting.
 2. Accurately position, support, and secure reinforcement against displacement during concrete-placement and consolidation operations. Completely conceal support devices to prevent exposure on finished surfaces.
 3. Place reinforcing steel and prestressing strand to maintain at least 3/4 inch minimum concrete cover. Increase cover requirements for reinforcing steel to 1 1/2 inches when units are exposed to corrosive environment or severe exposure conditions. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position while placing concrete. Direct wire tie ends away from finished, exposed concrete surfaces.
 4. Install welded wire fabric in lengths as long as practicable. Lap adjoining pieces at least one full mesh spacing and wire tie laps, where required by design. Offset laps of adjoining widths to prevent continuous laps in either direction.
- F. Reinforce precast structural concrete units to resist handling, transportation, and erection stresses and specified in-place loads.
- G. Prestress tendons for precast structural concrete units by either pretensioning or post-tensioning methods. Comply with PCI MNL 116.
1. Delay detensioning or post-tensioning of precast, prestressed structural concrete units until concrete has reached its indicated minimum design release compressive strength as established by test cylinders cured under same conditions as concrete unit.
 2. Detension pretensioned tendons either by gradually releasing tensioning jacks or by heat cutting tendons, using a sequence and pattern to prevent shock or unbalanced loading.
 3. If concrete has been heat cured, detension while concrete is still warm and moist to avoid dimensional changes that may cause cracking or undesirable stresses.
 4. Protect strand ends and anchorages with bituminous, zinc-rich, or epoxy paint to avoid corrosion and possible rust spots.
 5. Protect strand ends and anchorages with a minimum of 1 inch thick, nonmetallic, nonshrink, grout mortar and sack rub surface. Coat or spray the inside surfaces of pocket with bonding agent before installing grout.
- H. Comply with requirements in PCI MNL 116 and in this Section for measuring, mixing, transporting, and placing concrete. After concrete batching, no additional water may be added.
- I. Place face mixture to a minimum thickness after consolidation of the greater of 1 inch or 1.5 times the maximum aggregate size, but not less than the minimum reinforcing cover specified.
- J. Place concrete in a continuous operation to prevent cold joints or planes of weakness from forming in precast concrete units.
1. Place backup concrete mixture to ensure bond with face-mixture concrete.
- K. Thoroughly consolidate placed concrete by vibration without dislocating or damaging reinforcement and built-in items, and minimize pour lines, honeycombing, or entrapped air voids on surfaces. Use equipment and procedures complying with PCI MNL 116.
1. Place self-consolidating concrete without vibration according to PCI TR-6, "Interim Guidelines for the Use of Self-Consolidating Concrete in Precast/Prestressed Concrete

Institute Member Plants." Ensure adequate bond between face and backup concrete, if used.

- L. Comply with PCI MNL 116 procedures for hot- and cold-weather concrete placement.
- M. Identify pickup points of precast structural concrete units and orientation in structure with permanent markings, complying with markings indicated on Shop Drawings. Imprint or permanently mark casting date on each precast structural concrete unit on a surface that does not show in finished structure.
- N. Cure concrete, according to requirements in PCI MNL 116, by moisture retention without heat or by accelerated heat curing using live steam or radiant heat and moisture. Cure units until compressive strength is high enough to ensure that stripping does not have an effect on performance or appearance of final product.
- O. Discard and replace precast structural concrete units that do not comply with requirements, including structural, manufacturing tolerance, and appearance, unless repairs meet requirements in PCI MNL 116 and meet Engineer's approval.

2.12 FABRICATION TOLERANCES

- A. Fabricate precast structural concrete units to shapes, lines, and dimensions indicated so each finished unit complies with PCI MNL 116 product dimension tolerances as well as position tolerances for cast-in items.

2.13 COMMERCIAL FINISHES

- A. Standard Grade: Normal plant-run finish produced in molds that impart a smooth finish to concrete. Surface holes smaller than 1/2 inch caused by air bubbles, normal color variations, form joint marks, and minor chips and spalls are permitted. Fill air holes greater than 1/4 inch in width that occur more than once per 2 square inches. Major or unsightly imperfections, honeycombs, or structural defects are not permitted. Limit joint offsets to 1/8 inch.
- B. Screed or float finish unformed surfaces. Strike off and consolidate concrete with vibrating screeds to a uniform finish. Hand screed at projections. Normal color variations, minor indentations, minor chips, and spalls are permitted. Major imperfections, honeycombing, or defects are not permitted.
- C. Apply roughened surface finish according to ACI 318 to precast concrete units that receive concrete topping after installation.

2.14 SOURCE QUALITY CONTROL

- A. Testing Agency: Contracting Authority will engage a qualified testing agency to evaluate precast structural concrete fabricator's quality-control and testing methods.
 - 1. Allow testing agency access to material storage areas, concrete production equipment, concrete placement, and curing facilities. Cooperate with testing agency and provide samples of materials and concrete mixtures as may be requested for additional testing and evaluation.
- B. Testing: Test and inspect precast structural concrete according to PCI MNL 116 requirements and ASTM C1610, ASTM C1611, ASTM C1621, and ASTM C1712.
 - 1. Test and inspect self-consolidating concrete according to PCI TR-6.
- C. Strength of precast structural concrete units is considered deficient if units fail to comply with ACI 318 requirements for concrete strength.

- D. If there is evidence that strength of precast concrete units may be deficient or may not comply with ACI 318 requirements, employ a qualified testing agency to obtain, prepare, and test cores drilled from hardened concrete to determine compressive strength according to ASTM C42.
1. A minimum of three representative cores shall be taken from units of suspect strength, from locations directed by Engineer.
 2. Test cores in an air-dry condition or, if units are wet under service conditions, test cores after immersion in water in a wet condition.
 3. Strength of concrete for each series of three cores is considered satisfactory if average compressive strength is equal to at least 85% of 28-day design compressive strength and no single core is less than 75% of 28-day design compressive strength.
 4. Report test results in writing on same day that tests are performed, with copies to Engineer, Contractor, and precast concrete fabricator. Test reports include the following:
 - a. Project identification name and number.
 - b. Date when tests were performed.
 - c. Name of precast concrete fabricator.
 - d. Name of concrete testing agency.
 - e. Identification letter, name, and type of precast concrete unit(s) represented by core tests; design compressive strength; type of break; compressive strength at breaks, corrected for length-diameter ratio; and direction of applied load to core in relation to horizontal plane of concrete as placed.
- E. Patching: If core test results are satisfactory and precast structural concrete units comply with requirements, clean and dampen core holes and solidly fill with same precast concrete mixture that has no coarse aggregate, and finish to match adjacent precast concrete surfaces.
- F. Defective Units: Discard and replace precast structural concrete units that do not comply with requirements, including strength, manufacturing tolerances, and color and texture range. Chipped, spalled, or cracked units may be repaired, subject to Engineer's approval. Engineer reserves the right to reject precast units that do not match approved samples, sample panels, and mockups. Replace unacceptable units with precast concrete units that comply with requirements.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine supporting structural frame or foundation and conditions for compliance with requirements for installation tolerances, bearing surface tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
- C. Do not install precast concrete units until supporting, cast-in-place concrete has attained minimum allowable design compressive strength and until supporting steel or other structure is structurally ready to receive loads from precast concrete units.

3.2 INSTALLATION

- A. Install clips, hangers, bearing pads, and other accessories required for connecting precast structural concrete units to supporting members and backup materials.

- B. Erect precast structural concrete level, plumb, and square within specified allowable tolerances. Provide temporary structural framing, shoring, and bracing as required to maintain position, stability, and alignment of units until permanent connections are complete.
 - 1. Install temporary steel or plastic spacing shims or bearing pads as precast structural concrete units are being erected. Tack weld steel shims to each other to prevent shims from separating.
 - 2. Maintain horizontal and vertical joint alignment and uniform joint width as erection progresses.
 - 3. Remove projecting lifting devices and use plastic patch caps or sand-cement grout to fill voids within recessed lifting devices flush with surface of adjacent precast surfaces when recess is exposed.
- C. Connect precast structural concrete units in position by bolting, welding, grouting, or as otherwise indicated on Shop Drawings. Remove temporary shims, wedges, and spacers as soon as practical after connecting and grouting are completed.
 - 1. Do not permit connections to disrupt continuity of roof flashing.
- D. Field cutting of precast units is not permitted without approval of Engineer.
- E. Fasteners: Do not use drilled or powder-actuated fasteners for attaching accessory items to precast, prestressed concrete units.
- F. Welding: Comply with applicable requirements in AWS D1.1 and AWS D1.4 for welding, welding electrodes, appearance, quality of welds, and methods used in correcting welding work.
 - 1. Protect precast structural concrete units and bearing pads from damage by field welding or cutting operations, and provide noncombustible shields as required.
 - 2. Clean weld-affected steel surfaces with chipping hammer followed by brushing, and reprime damaged painted surfaces.
 - 3. Visually inspect welds and remove, reweld, or repair incomplete and defective welds.
- G. At bolted connections, use lock washers, tack welding, or other approved means to prevent loosening of nuts after final adjustment.
 - 1. Where slotted connections are used, verify bolt position and tightness. For sliding connections, properly secure bolt but allow bolt to move within connection slot.
 - 2. For slip-critical connections, use one of the following methods to assure proper bolt pretension:
 - a. Turn-of-Nut: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - b. Calibrated Wrench: According to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."
 - c. Twist-off Tension Control Bolt: ASTM F 1852.
 - d. Direct-Tension Control Bolt: ASTM F 1852.
 - 3. For slip-critical connections, use method and inspection procedure approved by Engineer and coordinated with inspection agency.

- H. Grouting or Dry-Packing Connections and Joints: Grout connections and joints and open spaces at keyways, connections, and joints where required or indicated on Shop Drawings. Retain flowable grout in place until hard enough to support itself. Alternatively, pack spaces with stiff dry-pack grout material, tamping until voids are completely filled.
1. Place grout and finish smooth, level, and plumb with adjacent concrete surfaces.
 2. Fill joints completely without seepage to other surfaces.
 3. Trowel top of grout joints on roofs smooth and uniform. Finish transitions between different surface levels not steeper than 1 to 12.
 4. Place grout end cap or dam in voids at ends of hollow-core slabs.
 5. Promptly remove grout material from exposed surfaces before it affects finishes or hardens.
 6. Keep grouted joints damp for not less than 24 hours after initial set.

3.3 ERECTION TOLERANCES

- A. Erect precast structural concrete units level, plumb, square, and in alignment without exceeding the noncumulative erection tolerances of PCI MNL 135.
- B. Minimize variations between adjacent slab members by jacking, loading, or other method recommended by fabricator and approved by Engineer.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Contracting Authority will engage a qualified testing agency to perform tests and inspections.
- B. Visually inspect field welds and test according to ASTM E 165 or to ASTM E 709 and ASTM E 1444. High-strength bolted connections are subject to inspections.
- C. Testing agency will report test results promptly and in writing to Contractor and Engineer.
- D. Repair or remove and replace work where tests and inspections indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contracting Authority's expense, shall be performed to determine compliance of replaced or additional work with specified requirements.
- F. Prepare test and inspection reports.

3.5 REPAIRS

- A. Repair precast structural concrete units if permitted by Engineer.
 1. Repairs may be permitted if structural adequacy, serviceability, durability, and appearance of units have not been impaired.
- B. Mix patching materials and repair units so cured patches blend with color, texture, and uniformity of adjacent exposed surfaces and show no apparent line of demarcation between original and repaired work, when viewed in typical daylight illumination from a distance of 20 feet.
- C. Prepare and repair damaged galvanized coatings with galvanizing repair paint according to ASTM A780.

- D. Wire brush, clean, and paint damaged prime-painted components with same type of shop primer.
- E. Remove and replace damaged precast structural concrete units that cannot be repaired or when repairs do not comply with requirements as determined by Engineer.

3.6 CLEANING

- A. Clean mortar, plaster, fireproofing, weld slag, and other deleterious material from concrete surfaces and adjacent materials immediately.
- B. Clean exposed surfaces of precast concrete units after erection and completion of joint treatment to remove weld marks, other markings, dirt, and stains.
 - 1. Perform cleaning procedures, if necessary, according to precast concrete fabricator's written recommendations. Protect other work from staining or damage due to cleaning operations.
 - 2. Do not use cleaning materials or processes that could change the appearance of exposed concrete finishes or damage adjacent materials.

END OF SECTION

SECTION 04 2000
UNIT MASONRY

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete Masonry Units.
- B. Mortar and Grout.
- C. Reinforcement and Anchorage.
- D. Flashings.
- E. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 07 2100 - Thermal Insulation: Insulation for cavity spaces.
- B. Section 07 9005 - Joint Sealers: Backing rod and sealant at control and expansion joints.

1.3 REFERENCE STANDARDS

- A. ACI 530/530.1/ERTA - Building Code Requirements and Specification for Masonry Structures and Related Commentaries; American Concrete Institute International; 2011.
- B. ASTM A36 - Standard Specifications for Carbon Structural Steel; 2012.
- C. ASTM A153 - Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- D. ASTM A615 - Standard Specifications for Deformed and Plain Carbon Steel Bars for Concrete Reinforcement; 2014.
- E. ASTM A641 - Standard Specifications for Zinc-Coated (Galvanized) Carbon Steel Wire; 2009a.
- F. ASTM A666 - Standard Specifications for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.
- G. ASTM A1064 - Standard Specifications for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2013.
- H. ASTM C91 - Standard Specifications for Masonry Cement; 2012.
- I. ASTM C129 - Standard Specifications for Nonloadbearing Concrete Masonry Units; 2011.
- J. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units and Related Units; 2014.
- K. ASTM C144 - Standard Specifications for Aggregate for Masonry Mortar; 2011.
- L. ASTM C150 - Standard Specifications for Portland cement; 2012.
- M. ASTM C207 - Standard Specifications for Hydrated Lime for Masonry Purposes; 2006 (Reapproved 2011).
- N. ASTM C270 - Standard Specifications for Mortar for Unit Masonry; 2012.
- O. ASTM C404 - Standard Specifications for Aggregates for Masonry Grout; 2011.

- P. ASTM C476 - Standard Specifications for Grout for Masonry; 2010.
- Q. ASTM C780 - Standard Test Method for Preconstruction and Construction Evaluation of Mortars for Plain and Reinforced Unit Masonry; 2012.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene a preinstallation meeting 1 week before starting work of this section; require attendance by all relevant installers.

1.5 SUBMITTALS

- A. Product Data: Provide data for masonry units, fabricated wire reinforcement, mortar, masonry accessories, anchors, and flashings.
- B. Manufacturer's Certificate: Certify that masonry units meet or exceed specified requirements.
- C. Shop Drawings: Indicate reinforcement locations, masonry unit type, special shape locations and detailing.
 - 1. Provide shop drawings with plans and elevations as appropriate for indicating control joint layout, reinforcement locations with size, grade, shapes of bent bars and location of splices. Include quantities, bar schedules supporting and spacing devices and accessories where required.

1.6 QUALITY ASSURANCE

- A. Comply with provisions of ACI 530/530.1/ERTA, except where exceeded by requirements of the contract documents.

1.7 DELIVERY, STORAGE, AND HANDLING

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

PART 2 PRODUCTS

2.1 CONCRETE MASONRY UNITS

- A. Concrete Block: Comply with referenced standards and as follows:
 - 1. Size: Standard units with nominal face dimensions of 16 inches by 8 inches and nominal depths as indicated on the drawings for specific locations.
 - 2. Special Shapes: Provide non-standard blocks configured for corners, lintels, control joint edges, and other detailed conditions.
 - 3. Non-Loadbearing Units: ASTM C129.
 - a. Hollow block.
 - b. Normal weight.

2.2 MORTAR AND GROUT MATERIALS

- A. Masonry Cement: ASTM C91, Types as listed elsewhere in this specification.
- B. Portland Cement: ASTM C150, Type I.
 - 1. Not more than 0.60% alkali.
 - 2. Use Type III high-early-strength as required for laying masonry in cold weather.

- C. Hydrated Lime: ASTM C207, Type S.
- D. Mortar Aggregate: ASTM C144.
- E. Grout Aggregate: ASTM C404.
- F. Water: Clean and potable.

2.3 REINFORCEMENT AND ANCHORAGE

- A. Manufacturers of Joint Reinforcement and Anchors:
 - 1. Blok-Lok Limited: www.blok-lok.com.
 - 2. Hohmann & Barnard, Inc (including Dur-O-Wal brand): www.h-b.com.
 - 3. WIRE-BOND: www.wirebond.com.
 - 4. Or approved equal.
- B. Reinforcing Steel: ASTM A615/A615M, Grade 60 - 60,000 psi, deformed billet bars; uncoated.
- C. Joint Reinforcement: Use ladder type joint reinforcement where vertical reinforcement is involved and truss type elsewhere, unless otherwise indicated.
- D. Single Wythe Joint Reinforcement: Ladder type; ASTM A1064 steel wire, mill galvanized to ASTM A641, Class 3; 0.1483 inch side rods with 0.1483 inch cross rods; width as required to provide not more than 1 inch and not less than 1/2 inch of mortar coverage on each exposure.

2.4 FLASHINGS

- A. Metal Flashing Materials: Stainless Steel, as specified in Section 07 6200.

2.5 ACCESSORIES

- A. Preformed Control Joints: Polyvinyl chloride material. Provide with corner and tee accessories, fused joints.
 - 1. Manufacturers:
 - a. Blok-Lok Limited: www.blok-lok.com.
 - b. Hohmann & Barnard, Inc (including Dur-O-Wal brand): www.h-b.com.
 - c. WIRE-BOND: www.wirebond.com.
 - d. Or approved equal
- B. Cavity Mortar Control: Semi-rigid polyethylene or polyester mesh panels, sized to thickness of wall cavity, and designed to prevent mortar droppings from clogging weeps and cavity vents and allow proper cavity drainage.
 - 1. Mortar Diverter: Semi-rigid mesh designed for installation at flashing locations.
 - a. Manufacturers:
 - 1) Advanced Building Products Inc; Mortar Break: www.advancedflashing.com.
 - 2) Mortar Net Solutions; Mortar Net with Insect Barrier: www.mortarnet.com.
 - 3) Hohmann & Barnard, Inc.; Mortar Trap: www.h-b.com

- 4) Or approved equal
- C. Weeps: Molded PVC grilles, insect resistant.
 - 1. Manufacturers:
 - a. Hohmann & Barnard, Inc; QV - Quadro-Vent: www.h-b.com.
 - b. MasonPro; Cell Vents: www.masonpro.com.
 - c. Manthorpe; Weep Vent: www.manthorpe.co.uk
 - d. Or approved equal
- D. Cavity Vents: Polyester mesh.
 - 1. Manufacturers:
 - a. CavClear/Archovations, Inc: www.cavclear.com.
 - b. Mortar Net Solutions; Mortar Net Weep Vents: www.mortarnet.com.
 - c. South Atlantic Masonry Products; MortarHalt: masonry.southatlanticllc.com
 - d. Or approved equal
- E. Cleaning Solution: Non-acidic, not harmful to masonry work or adjacent materials.

2.6 MORTAR AND GROUT MIXES

- A. Mortar for Unit Masonry: ASTM C270, using the Proportion Specification.
 - 1. Exterior, non-loadbearing masonry: Type S.
- B. Grout: ASTM C476. Consistency required to fill completely volumes indicated for grouting; fine grout for spaces with smallest horizontal dimension of 2 inches or less; coarse grout for spaces with smallest horizontal dimension greater than 2 inches.
- C. Admixtures: Add to mixture at manufacturer's recommended rate and in accordance with manufacturer's instructions; mix uniformly.
- D. Mixing: Thoroughly mix ingredients using mechanical batch mixer in accordance with ASTM C270.
 - 1. Mix only quantities which will be needed for immediate use.
 - 2. Do not use anti-freeze compounds to lower the freezing point of mortar.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive masonry.
- B. Verify that related items provided under other sections are properly sized and located.
- C. Verify that built-in items are in proper location, and ready for roughing into masonry work.

3.2 PREPARATION

- A. Direct and coordinate placement of metal anchors supplied for installation under other sections.

- B. Provide temporary bracing during installation of masonry work. Maintain in place until building structure provides permanent bracing.

3.3 COLD AND HOT WEATHER REQUIREMENTS

- A. Maintain materials and surrounding air temperature to minimum 40°F prior to, during, and 48 hours after completion of masonry work.
- B. Maintain materials and surrounding air temperature to maximum 90°F prior to, during, and 48 hours after completion of masonry work.

3.4 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. Concrete Masonry Units:
 1. Bond: Running.
 2. Coursing: One unit and one mortar joint to equal 8 inches.
 3. Mortar Joints: Flush.

3.5 PLACING AND BONDING

- A. Lay solid masonry units in full bed of mortar, with full head joints, uniformly jointed with other work.
- B. Lay hollow masonry units with face shell bedding on head and bed joints.
- C. Buttering corners of joints or excessive furrowing of mortar joints is not permitted.
- D. Remove excess mortar and mortar smears as work progresses.
- E. Remove excess mortar with water repellent admixture promptly. Do not use acids, sandblasting or high pressure cleaning methods.
- F. Interlock intersections and external corners.
- G. Do not shift or tap masonry units after mortar has achieved initial set. Where adjustment must be made, remove mortar and replace.
- H. Perform job site cutting of masonry units with proper tools to provide straight, clean, unchipped edges. Prevent broken masonry unit corners or edges.
- I. Cut mortar joints flush where resilient base is scheduled or cavity insulation vapor barrier adhesive is applied.
- J. Isolate masonry partitions from vertical structural framing members with a control joint as indicated.
- K. Place precast chimney cap atop chimney masonry; mortar into place; seal to protruding flue.

3.6 WEEPS/CAVITY VENTS

- A. Install weeps in veneer and cavity walls at 24 inches on center horizontally above through-wall flashing, above shelf angles and lintels, and at bottom of walls.

- B. Install cavity vents in veneer and cavity walls at 32 inches on center horizontally below shelf angles and lintels, near top of walls, and [where indicated on the drawings].

3.7 CAVITY MORTAR CONTROL

- A. Do not permit mortar to drop or accumulate into cavity air space or to plug weep/cavity vents.
- B. For cavity walls, build inner wythe ahead of outer wythe to accommodate accessories.
- C. Install cavity mortar diverter at base of cavity and at other flashing locations as recommended by manufacturer to prevent mortar droppings from blocking weep/cavity vents.

3.8 REINFORCEMENT AND ANCHORAGE - GENERAL

- A. Unless otherwise indicated on drawings or specified under specific wall type, install horizontal joint reinforcement 16 inches on center.

3.9 REINFORCEMENT AND ANCHORAGE - SINGLE WYTHER MASONRY

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.

3.10 REINFORCEMENT AND ANCHORAGE - MASONRY VENEER

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of opening.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Masonry Back-Up: Embed anchors to bond veneer at maximum 16 inches on center vertically and 36 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.
- F. Stud Back-Up: Secure veneer anchors to stud framed back-up and embed into masonry veneer at maximum 16 inches on center vertically and 24 inches on center horizontally. Place additional anchors at perimeter of openings and ends of panels, so maximum spacing of anchors is 8 inches on center.

3.11 REINFORCEMENT AND ANCHORAGES - CAVITY WALL MASONRY

- A. Install horizontal joint reinforcement 16 inches on center.
- B. Place masonry joint reinforcement in first and second horizontal joints above and below openings. Extend minimum 16 inches each side of openings.
- C. Place continuous joint reinforcement in first and second joint below top of walls.
- D. Lap joint reinforcement ends minimum 6 inches.
- E. Fasten anchors to structural framing and embed in masonry joints as masonry is laid. Space anchors at maximum of 24 inches horizontally and 16 inches vertically.

3.12 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.
 - 1. Remove or cover protrusions or sharp edges that could puncture flashings.
 - 2. Seal lapped ends and penetrations of flashing before covering with mortar.
- B. Extend metal flashings through exterior face of masonry and turn down to form drip. Install joint sealer below drip edge to prevent moisture migration under flashing.
- C. Lap end joints of flashings at least 6 inches and seal watertight with mastic or elastic sealant.

3.13 GROUTED COMPONENTS

- A. Reinforce bond beams with 2, No. 5 bars, 1 inch from bottom web.
- B. Lap splices minimum 50 bar diameters (31 inches for No. 5 bars).
- C. Support and secure reinforcing bars from displacement. Maintain position within 1/2 inch of dimensioned position.
- D. Place and consolidate grout fill without displacing reinforcing.
- E. At bearing locations, fill masonry cores with grout for a minimum 12 inches either side of opening.

3.14 CONTROL AND EXPANSION JOINTS

- A. Do not continue horizontal joint reinforcement through control and expansion joints.
- B. Install preformed control joint device in continuous lengths. Seal butt and corner joints in accordance with manufacturer's instructions.
- C. Size control joint in accordance with Section 07 9005 for sealant performance.
- D. Form expansion joint as detailed.

3.15 BUILT-IN WORK

- A. As work progresses, install built-in metal door frames, glazed frames, window frames, and wood nailing strips and other items to be built into the work and furnished under other sections.
 - 1. Build masonry around metal frames and install anchoring devices supplied by frame manufacturer. Set masonry units tight against frames. Fill hollow metal frame jambs and heads with grout. Set steel lintels in bed of mortar to adjust height to fit tight to top of frame.
- B. Install built-in items plumb, level, and true to line.
- C. Bed anchors of metal door and glazed frames in adjacent mortar joints. Fill frame voids solid with grout.
 - 1. Fill adjacent masonry cores with grout minimum 12 inches from framed openings.
- D. Do not build into masonry construction organic materials that are subject to deterioration.

3.16 TOLERANCES

- A. Maximum Variation from Unit to Adjacent Unit: 1/16 inch.

- B. Maximum Variation from Plane of Wall: 1/4 inch in 10 feet and 1/2 inch in 20 feet or more.
- C. Maximum Variation from Plumb: 1/4 inch per story non-cumulative; 1/2 inch in 2 stories or more.
- D. Maximum Variation from Level Coursing: 1/8 inch in 3 feet and 1/4 inch in 10 feet; 1/2 inch in 30 feet.
- E. Maximum Variation of Mortar Joint Thickness: Head joint, minus 1/4 inch, plus 3/8 inch.
- F. Maximum Variation from Cross Sectional Thickness of Walls: 1/4 inch.

3.17 CUTTING AND FITTING

- A. Cut and fit for chases, pipes, conduit, sleeves, and steel structure. Coordinate with other sections of work to provide correct size, shape, and location.
- B. Obtain approval prior to cutting or fitting masonry work not indicated or where appearance or strength of masonry work may be impaired.

3.18 FIELD QUALITY CONTROL

- A. Concrete Masonry Unit Tests: Test each variety of concrete unit masonry in accordance with ASTM C140 for conformance to requirements of this specification.
- B. Mortar Tests: Test each type of mortar in accordance with ASTM C780, testing with same frequency as masonry samples.

3.19 CLEANING AND REPAIR

- A. Remove excess mortar, mortar smears and mortar droppings.
- B. Replace defective mortar. Match adjacent work in color and joint profile.
- C. Clean soiled surfaces with cleaning solution. Protect adjacent or dissimilar materials from damage from cleaning activities.
- D. Use non-metallic tools in cleaning operations.

3.20 PROTECTION

- A. Without damaging completed work, provide protective boards at exposed external corners that are subject to damage by construction activities.
- B. During construction of walls, cover tops of walls and any open sills or headers with waterproof sheeting at the end of each day's work. Cover partially completed masonry when construction is not in progress.
 - 1. Extend cover a minimum of 24 inches down face of both sides of wall and hold cover securely in place.
 - 2. Direct cavity and masonry wythe covers to drain to exterior of building or when at interior partitions, to unfinished areas whenever possible.

END OF SECTION

SECTION 05 1200
STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Structural steel.
 - 2. Grout.

1.2 DEFINITIONS

- A. Structural Steel: Elements of the structural frame indicated on Drawings and as described in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."

1.3 COORDINATION

- A. Coordinate selection of shop primers with topcoats to be applied over them. Comply with paint and coating manufacturers' written recommendations to ensure that shop primers and topcoats are compatible with one another.
- B. Coordinate installation of anchorage items to be embedded in or attached to other construction without delaying the Work. Provide setting diagrams, sheet metal templates, instructions, and directions for installation.

1.4 PREINSTALLATION MEETINGS

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

1.5 PERFORMANCE REQUIREMENTS

- A. Simple Shear Connections: Provide details of simple shear connections required by the contract documents to be selected or completed by structural-steel fabricator to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC 360.
 - 2. Use Allowable Stress Design; data are given at service-load level.
- B. Lateral Bracing or Moment Connections: Provide details of lateral bracing or moment connections required by the contract documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer licensed in the State in which the Project is located to withstand loads indicated and comply with other information and restrictions indicated.
 - 1. Select and complete connections using schematic details indicated and AISC 360.
 - 2. Use Allowable Stress Design; data are given at service-load level.

1.6 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: Show fabrication of structural-steel components.
 - 1. Include details of cuts, connections, splices, camber, holes, and other pertinent data.
 - 2. Include embedment drawings.

3. Indicate welds by standard AWS symbols, distinguishing between shop and field welds, and show size, length, and type of each weld. Show backing bars that are to be removed and supplemental fillet welds where backing bars are to remain.
 4. Indicate type, size, and length of bolts, distinguishing between shop and field bolts. Identify pretensioned and slip-critical, high-strength bolted connections.
- C. Delegated-Design Submittal: For simple shear connections indicated to comply with design loads, include analysis data.
- D. Delegated-Design Submittal: For lateral bracing or moment connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.7 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Fabricator.
- B. Product Test Reports: For the following:
1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
 2. Direct-tension indicators.
 3. Tension-control, high-strength, bolt-nut-washer assemblies.
 4. Shear stud connectors.
 5. Shop primers.
 6. Nonshrink grout.
- C. Field quality-control and special inspection reports.

1.8 QUALITY ASSURANCE

- A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD at the time of bidding.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1, "Structural Welding Code - Steel."
- C. Comply with applicable provisions of the following specifications and documents:
1. AISC 303 "Code of Standard Practice for Steel Buildings and Bridges".
 2. AISC 341 "Seismic Provisions for Structural Steel Buildings".
 3. AISC 360 "Specification for Structural Steel Buildings".
 4. RCSC's "Specification for Structural Joints Using High-Strength Bolts".

1.9 DELIVERY, STORAGE, AND HANDLING

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

- B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.
 - 1. Fasteners may be repackaged provided Contracting Authority's testing and inspecting agency observes repackaging and seals containers.
 - 2. Clean and relubricate bolts and nuts that become dry or rusty before use.
 - 3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 PRODUCTS

2.1 STRUCTURAL-STEEL MATERIALS

- A. W-Shapes: ASTM A992.
- B. Channels, Angles, M or S-Shapes: ASTM A36.
- C. Plate and Bar: ASTM A36.
- D. Cold-Formed Hollow Structural Sections: ASTM A500, Grade B, structural tubing.
- E. Steel Pipe: ASTM A53, Type E or Type S, Grade B.
- F. Welding Electrodes: Comply with AWS requirements.

2.2 BOLTS, CONNECTORS, AND ANCHORS

- A. High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade C heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers; all with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959, Type 325, compressible-washer type with plain finish.
- B. High-Strength Bolts, Nuts, and Washers: ASTM A490, Type 1, heavy-hex steel structural bolts or tension-control, bolt-nut-washer assemblies with splined ends; ASTM A563, Grade DH heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers with plain finish.
 - 1. Direct-Tension Indicators: ASTM F959, Type 490, compressible-washer type with plain finish.
- C. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A325, Type 1, heavy-hex steel structural bolts; ASTM A563, Grade DH heavy-hex carbon-steel nuts; and ASTM F436, Type 1, hardened carbon-steel washers.
 - 1. Finish: Hot-dip zinc coating.
 - 2. Direct-Tension Indicators: ASTM F959, Type 325, compressible-washer type with mechanically deposited zinc coating finish.
- D. Tension-Control, High-Strength Bolt-Nut-Washer Assemblies: ASTM F 1852, Type 1, heavy-hex head assemblies consisting of steel structural bolts with splined ends, heavy-hex carbon-steel nuts, and hardened carbon-steel washers.
 - 1. Finish: Plain.
- E. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1, Type B.
- F. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.

1. Nuts: ASTM A563 heavy-hex carbon steel.
 2. Plate Washers: ASTM A36 carbon steel.
 3. Washers: ASTM F436, Type 1, hardened carbon steel.
 4. Finish: Plain.
- G. Threaded Rods: ASTM A36.
1. Nuts: ASTM A563 heavy-hex carbon steel.
 2. Washers: ASTM F436, Type 1, hardened carbon steel.
 3. Finish: Plain.
- H. Clevises and Turnbuckles: Made from cold-finished carbon steel bars, ASTM A 108, Grade 1035.

2.3 PRIMER

- A. Primer: Fabricator's standard lead- and chromate-free, nonasphaltic, rust-inhibiting primer complying with MPI#79 and compatible with topcoat.
- B. Galvanizing Repair Paint: ASTM A780.

2.4 GROUT

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

2.5 FABRICATION

- A. Structural Steel: Fabricate and assemble in shop to greatest extent possible. Fabricate according to AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," and to AISC 360 "Specification for Structural Steel Buildings".
1. Camber structural-steel members where indicated.
 2. Fabricate beams with rolling camber up.
 3. Identify high-strength structural steel according to ASTM A6 and maintain markings until structural steel has been erected.
 4. Mark and match-mark materials for field assembly.
 5. Complete structural-steel assemblies, including welding of units, before starting shop-priming operations.
- B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.
1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1.
- C. Bolt Holes: Cut, drill, or punch standard, oversized, or slotted bolt holes as indicated on drawings, perpendicular to metal surfaces.
- D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.
- E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP1, "Solvent Cleaning"

- F. Shear Connectors: Prepare steel surfaces as recommended by manufacturer of shear connectors. Use automatic end welding of headed-stud shear connectors according to AWS D1.1 and manufacturer's written instructions.
- G. Holes: Provide holes required for securing other work to structural steel and for other work to pass through steel members.
 1. Cut, drill, or punch holes perpendicular to steel surfaces. Do not thermally cut bolt holes or enlarge holes by burning.
 2. Baseplate Holes: Cut, drill, mechanically thermal cut, or punch holes perpendicular to steel surfaces.
 3. Weld threaded nuts to framing and other specialty items indicated to receive other work.

2.6 SHOP CONNECTIONS

- A. High-Strength Bolts: Shop install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 1. Joint Type: Snug tightened, unless indicated otherwise on drawings.
- B. Weld Connections: Comply with AWS D1.1 and AWS D1.8 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 1. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303 for mill material.

2.7 SHOP PRIMING

- A. Shop prime steel surfaces except the following:
 1. Surfaces embedded in concrete or mortar. Extend priming of partially embedded members to a depth of 2 inches.
 2. Surfaces to be field welded.
 3. Surfaces of high-strength bolted, slip-critical connections.
 4. Surfaces to receive sprayed fire-resistive materials (applied fireproofing).
 5. Galvanized surfaces.
- B. Painting: Prepare steel and apply a one-coat, nonasphaltic primer complying with SSPC-PS Guide 7.00, "Painting System Guide 7.00: Guide for Selecting One-Coat Shop Painting Systems," to provide a dry film thickness of not less than 1.5 mils.

2.8 GALVANIZING

- A. Hot-Dip Galvanized Finish: Apply zinc coating by the hot-dip process to structural steel according to ASTM A123.
 1. Fill vent and drain holes that are exposed in the finished Work unless they function as weep holes, by plugging with zinc solder and filing off smooth.
 2. Galvanize lintels and shelf angles attached to structural-steel frame and located in exterior walls.
 3. Galvanize items indicated to be galvanized on contract documents.

2.9 SOURCE QUALITY CONTROL

- A. Owner reserves the right to engage a qualified testing agency to perform shop tests and inspections.
 - 1. Provide testing agency with access to places where structural-steel work is being fabricated or produced to perform tests and inspections.
 - 2. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using High-Strength Bolts".
 - 3. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - a. Liquid Penetrant Inspection: ASTM E 165.
 - b. Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - c. Ultrasonic Inspection: ASTM E 164.
 - d. Radiographic Inspection: ASTM E 94.
 - 4. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1 for stud welding and as follows:
 - a. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
 - b. Conduct tests according to requirements in AWS D1.1 on additional shear connectors if weld fracture occurs on shear connectors already tested.
 - 5. Correct deficiencies in Work that test reports and inspections indicate does not comply with the contract documents.

PART 3 EXECUTION

3.1 EXAMINATION

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

3.2 PREPARATION

- A. Provide temporary shores, guys, braces, and other supports during erection to keep structural steel secure, plumb, and in alignment against temporary construction loads and loads equal in intensity to design loads. Remove temporary supports when permanent structural steel, connections, and bracing are in place unless otherwise indicated.

3.3 ERECTION

- A. Set structural steel accurately in locations and to elevations indicated and according to AISC 303 "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360 "Specification for Structural Steel Buildings".

- B. Baseplates, Bearing Plates, and Leveling Plates: Clean concrete- and masonry-bearing surfaces of bond-reducing materials, and roughen surfaces prior to setting plates. Clean bottom surface of plates.
 - 1. Set plates for structural members on wedges, shims, or setting nuts as required.
 - 2. Weld plate washers to top of baseplate.
 - 3. Snug-tighten anchor rods after supported members have been positioned and plumbed. Do not remove wedges or shims but, if protruding, cut off flush with edge of plate before packing with grout.
 - 4. Promptly pack grout solidly between bearing surfaces and plates so no voids remain. Neatly finish exposed surfaces; protect grout and allow to cure. Comply with manufacturer's written installation instructions for shrinkage-resistant grouts.
- C. Maintain erection tolerances of structural steel within AISC 303, "Code of Standard Practice for Steel Buildings and Bridges."
- D. Align and adjust various members that form part of complete frame or structure before permanently fastening. Before assembly, clean bearing surfaces and other surfaces that are in permanent contact with members. Perform necessary adjustments to compensate for discrepancies in elevations and alignment.
 - 1. Level and plumb individual members of structure.
 - 2. Make allowances for difference between temperature at time of erection and mean temperature when structure is completed and in service.
- E. Splice members only where indicated.
- F. Do not use thermal cutting during erection unless approved by Engineer. Finish thermally cut sections within smoothness limits in AWS D1.1.
- G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

3.4 FIELD CONNECTIONS

- A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using High-Strength Bolts" for type of bolt and type of joint specified.
 - 1. Joint Type: Snug tightened, unless indicated otherwise on drawings.
- B. Weld Connections: Comply with AWS D1.1 for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
 - 1. Comply with AISC 303 "Code of Standard Practice for Steel Buildings and Bridges" and AISC 360 "Specification for Structural Steel Buildings" for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.
 - 2. Remove backing bars or runoff tabs where indicated, back gouge, and grind steel smooth.
 - 3. Assemble and weld built-up sections by methods that maintain true alignment of axes without exceeding tolerances in AISC 303, "Code of Standard Practice for Steel Buildings and Bridges," for mill material.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Contracting Authority will engage a qualified testing agency to perform tests and inspections.
 - 1. Bolted Connections: Inspect and test bolted connections according to RCSC's "Specification for Structural Joints Using High-Strength Bolts".
 - 2. Welded Connections: Visually inspect field welds according to AWS D1.1.
 - a. In addition to visual inspection, test and inspect field welds according to AWS D1.1 and the following inspection procedures, at testing agency's option:
 - 1) Liquid Penetrant Inspection: ASTM E 165.
 - 2) Magnetic Particle Inspection: ASTM E 709; performed on root pass and on finished weld. Cracks or zones of incomplete fusion or penetration are not accepted.
 - 3) Ultrasonic Inspection: ASTM E 164.
 - 4) Radiographic Inspection: ASTM E 94.
 - 3. Correct deficiencies in Work that test reports and inspections indicate does not comply with the Contract Documents.

3.6 REPAIRS AND PROTECTION

- A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A780.
- B. Touchup Painting: Immediately after erection, clean exposed areas where primer is damaged or missing and paint with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.
 - 1. Clean and prepare surfaces by SSPC-SP 2 hand-tool cleaning or SSPC-SP 3 power-tool cleaning.

END OF SECTION

SECTION 05 3100
STEEL DECKING

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Roof deck.

1.2 PERFORMANCE REQUIREMENTS

- A. AISI Specifications: Comply with calculated structural characteristics of steel deck according to AISI's "North American Specification for the Design of Cold-Formed Steel Structural Members."
- B. Fire-Resistance Ratings: Comply with ASTM 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.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of deck, accessory, and product indicated.
- B. Shop Drawings:
1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.4 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Certificates: For each type of steel deck.
- C. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, indicating that each of the following complies with requirements:
1. Power-actuated mechanical fasteners.
- D. Evaluation Reports: For steel deck.
- E. Field quality-control and special inspection reports.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.
- B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

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

1. Protect and ventilate acoustical cellular roof deck with factory-installed insulation to maintain insulation free of moisture.

PART 2 PRODUCTS

2.1 ROOF DECK

- A. Roof Deck: Fabricate panels, without top-flange stiffening grooves, to comply with "SDI Specifications and Commentary for Steel Roof Deck," in SDI Publication No. 31, and with the following:
 1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 33 ksi, G60 zinc coating.
 2. Deck Profile: Type WR, wide rib.
 3. Profile Depth: As indicated.
 4. Design Uncoated-Steel Thickness: As indicated.
 5. Span Condition: Triple span or more.
 6. Side Laps: Overlapped

2.2 NONCOMPOSITE FORM DECK

- A. Noncomposite Form Deck: Fabricate ribbed-steel sheet noncomposite form-deck panels to comply with "SDI Specifications and Commentary for Noncomposite Steel Form Deck," in SDI Publication No. 31, with the minimum section properties indicated, and with the following:
 1. Galvanized-Steel Sheet: ASTM A653, Structural Steel (SS), Grade 33 ksi, G60 zinc coating.
 2. Profile Depth: As indicated.
 3. Design Uncoated-Steel Thickness: As indicated.
 4. Span Condition: Triple span or more.
 5. Side Laps: Overlapped.

2.3 ACCESSORIES

- A. General: Provide manufacturer's standard accessory materials for deck that comply with requirements indicated.
- B. Mechanical Fasteners: Corrosion-resistant, low-velocity, power-actuated or pneumatically driven carbon-steel fasteners; or self-drilling, self-threading screws.
- C. Side-Lap Fasteners: Corrosion-resistant, hexagonal washer head; self-drilling, carbon-steel screws, No. 10 minimum diameter.
- D. Flexible Closure Strips: Vulcanized, closed-cell, synthetic rubber.
- E. Miscellaneous Sheet Metal Deck Accessories: Steel sheet, minimum yield strength of 33,000 psi, not less than 0.0359 inch design uncoated thickness, of same material and finish as deck; of profile indicated or required for application.
- F. Pour Stops and Girder Fillers: Steel sheet, minimum yield strength of 33,000 psi, of same material and finish as deck, and of thickness and profile recommended by SDI Publication No. 31 for overhang and slab depth.

- G. Column Closures, End Closures, Z-Closures, and Cover Plates: Steel sheet, of same material, finish, and thickness as deck unless otherwise indicated.
- H. Flat Sump Plates: Single-piece steel sheet, 0.0747 inch thick, of same material and finish as deck. For drains, cut holes in the field.
- I. Galvanizing Repair Paint: ASTM A 780.
- J. Repair Paint: Manufacturer's standard rust-inhibitive primer of same color as primer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine supporting frame and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

- A. Install deck panels and accessories according to applicable specifications and commentary in SDI Publication No. 31, manufacturer's written instructions, and requirements in this Section.
- B. Install temporary shoring before placing deck panels if required to meet deflection limitations.
- C. Locate deck bundles to prevent overloading of supporting members.
- D. Place deck panels on supporting frame and adjust to final position with ends accurately aligned and bearing on supporting frame before being permanently fastened. Do not stretch or contract side-lap interlocks.
- E. Place deck panels flat and square and fasten to supporting frame without warp or deflection.
- F. Cut and neatly fit deck panels and accessories around openings and other work projecting through or adjacent to deck.
- G. Provide additional reinforcement and closure pieces at openings as required for strength, continuity of deck, and support of other work.
- H. Comply with AWS requirements and procedures for manual shielded metal arc welding, appearance and quality of welds, and methods used for correcting welding work.
- I. Mechanical fasteners may be used in lieu of welding to fasten deck. Locate mechanical fasteners and install according to deck manufacturer's written instructions.

3.3 ROOF-DECK INSTALLATION

- A. Fasten roof-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated or arc seam welds with an equal perimeter that is not less than 1 1/2 inches long, and as follows:
 - 1. Weld Diameter: 3/4 inch, nominal.
 - 2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of 2 welds per deck unit at each support. Space welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of 1/2 of the span or 36 inches, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.

- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1 1/2 inches, with end joints as follows:
 - 1. End Joints: Lapped 2 inches, minimum.
- D. Roof Sump Pans and Sump Plates: Install over openings provided in roof deck and weld or mechanically fasten flanges to top of deck. Space welds or mechanical fasteners not more than 12 inches apart with at least one weld or fastener at each corner.
 - 1. Install reinforcing channels or zees in ribs to span between supports and weld or mechanically fasten.
- E. Miscellaneous Roof-Deck Accessories: Install ridge and valley plates, finish strips, end closures, and reinforcing channels according to deck manufacturer's written instructions. Weld or mechanically fasten to substrate to provide a complete deck installation.
 - 1. Weld cover plates at changes in direction of roof-deck panels unless otherwise indicated.
- F. Flexible Closure Strips: Install flexible closure strips over partitions, walls, and where indicated. Install with adhesive according to manufacturer's written instructions to ensure complete closure.

3.4 FLOOR-DECK INSTALLATION

- A. Fasten floor-deck panels to steel supporting members by arc spot (puddle) welds of the surface diameter indicated and as follows:
 - 1. Weld Diameter: 3/4 inch, nominal.
 - 2. Weld Spacing: Space and locate welds as indicated.
- B. Side-Lap and Perimeter Edge Fastening: Fasten side laps and perimeter edges of panels between supports, at intervals not exceeding the lesser of half of the span or 36 inches, and as follows:
 - 1. Mechanically fasten with self-drilling, No. 10 diameter or larger, carbon-steel screws.
 - 2. Mechanically clinch or button punch.
 - 3. Fasten with a minimum of 1 1/2 inches long welds.
- C. End Bearing: Install deck ends over supporting frame with a minimum end bearing of 1 1/2 inches, with end joints as follows:
 - 1. End Joints: Butted.
- D. Pour Stops and Girder Fillers: Weld steel sheet pour stops and girder fillers to supporting structure according to SDI recommendations unless otherwise indicated.
- E. Floor-Deck Closures: Weld steel sheet column closures, cell closures, and Z-closures to deck, according to SDI recommendations, to provide tight-fitting closures at open ends of ribs and sides of deck.

3.5 FIELD QUALITY CONTROL

- A. Testing Agency: Contracting Authority will engage a qualified testing agency to perform tests and inspections.
- B. Field welds will be subject to inspection.

- C. Testing agency will report inspection results promptly and in writing to Contractor and Engineer.
- D. Remove and replace work that does not comply with specified requirements.
- E. Additional inspecting, at Contractor's expense, will be performed to determine compliance of corrected work with specified requirements.

3.6 PROTECTION

- A. Galvanizing Repairs: Prepare and repair damaged galvanized coatings on both surfaces of deck with galvanized repair paint according to ASTM A 780 and manufacturer's written instructions.
- B. Repair Painting: Wire brush and clean rust spots, welds, and abraded areas on both surfaces of prime-painted deck immediately after installation, and apply repair paint.
 - 1. Apply repair paint, of same color as adjacent shop-primed deck, to bottom surfaces of deck exposed to view.
- C. Provide final protection and maintain conditions to ensure that steel deck is without damage or deterioration at time of Substantial Completion.

END OF SECTION

**SECTION 05 4000
COLD-FORMED METAL FRAMING**

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Exterior non-load-bearing wall framing.
2. Soffit framing.

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.3 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, licensed in the State in which the Project is located, to design cold-formed steel framing.
- B. Structural Performance: Provide cold-formed steel framing capable of withstanding design loads within limits and under conditions indicated.
1. Design Loads: As indicated in structural notes.
 2. Deflection Limits: Design framing systems to withstand design loads without deflections greater than the following:
 - a. Exterior Non-Load-Bearing Framing: Horizontal deflection of 1/600 of the wall height.
 3. Design framing systems to provide for movement of framing members located outside the insulated building envelope without damage or overstressing, sheathing failure, connection failure, undue strain on fasteners and anchors, or other detrimental effects when subject to a maximum ambient temperature change of 120°F.
 4. Design framing system to maintain clearances at openings, to allow for construction tolerances, and to accommodate live load deflection of primary building structure as follows:
 - a. Upward and downward movement of 1 inch.
 5. Design exterior non-load-bearing wall framing to accommodate horizontal deflection without regard for contribution of sheathing materials.
- C. Cold-Formed Steel Framing Design Standards:
1. Wall Studs: AISI S211.
 2. Headers: AISI S212.
 3. Lateral Design: AISI S213.
- D. AISI Specifications and Standards: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.
- E. 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.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of cold-formed steel framing product and accessory.
- 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. Delegated-Design Submittal: For cold-formed steel framing indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

- A. Welding certificates.
- B. Product Test Reports: For each listed product, for tests performed by a qualified testing agency or a manufacturer and witnessed by a qualified testing agency.
 1. Steel sheet.
 2. Expansion anchors.
 3. Power-actuated anchors.
 4. Mechanical fasteners.
 5. Vertical deflection clips.
 6. Horizontal drift deflection clips
 7. Miscellaneous structural clips and accessories.
- C. Research Reports: For non-standard cold-formed steel framing, from ICC-ES.

1.6 QUALITY ASSURANCE

- A. Product Tests: Mill certificates or data from a qualified independent testing agency or in-house testing with calibrated test equipment indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.
- B. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1, "Structural Welding Code - Steel."
 2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Protect cold-formed steel framing from corrosion, moisture staining, deformation, and other damage during delivery, storage, and handling.

PART 2 PRODUCTS

2.1 COLD-FORMED STEEL FRAMING, GENERAL

- A. Steel Sheet: ASTM A1003, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:
 - 1. Grade: ST33H, or as required by structural performance.
 - 2. Coating: G60 or equivalent.
- B. Steel Sheet for Vertical Deflection Clips: ASTM A653, structural steel, zinc coated, of grade and coating as follows:
 - 1. Grade: 50, Class 1, or as required by structural performance.
 - 2. Coating: G90.

2.2 EXTERIOR NON-LOAD-BEARING WALL FRAMING

- A. Steel Studs: Manufacturer's standard C-shaped steel studs, of web depths indicated, punched, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1.625 inches, or wider if required for structural performance.
- B. Steel Track: Manufacturer's standard U-shaped steel track, of web depths indicated, unpunched, with unstiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: Matching steel studs.
 - 2. Flange Width: 1.25 inch.
- C. Vertical Deflection Clips: Manufacturer's standard bypass clips, capable of accommodating upward and downward vertical displacement of primary structure through positive mechanical attachment to stud web.
- D. Single Deflection Track: Manufacturer's single, deep-leg, U-shaped steel track; unpunched, with unstiffened flanges, of web depth to contain studs while allowing free vertical movement, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1 inch plus the design gap for one-story structures and 1 inch plus twice the design gap for other applications.

2.3 SOFFIT FRAMING

- A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:
 - 1. Minimum Base-Metal Thickness: 0.0428 inch.
 - 2. Flange Width: 1.625 inches, minimum.

2.4 FRAMING ACCESSORIES

- A. Fabricate steel-framing accessories from steel sheet, ASTM A1003, Structural Grade, Type H, metallic coated, of same grade and coating weight 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. Web stiffeners.
 4. Anchor clips.
 5. End clips.
 6. Foundation clips.
 7. Gusset plates.
 8. Stud kickers and knee braces.
 9. Joist hangers and end closures.
 10. Hole reinforcing plates.
 11. Backer plates.

2.5 ANCHORS, CLIPS, AND FASTENERS

- A. Steel Shapes and Clips: ASTM A36, zinc coated by hot-dip process according to ASTM A123.
- B. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E 488 conducted by a qualified testing agency.
- C. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E 1190 conducted by a qualified testing agency.
- D. Mechanical Fasteners: ASTM C 1513, corrosion-resistant-coated, self-drilling, self-tapping, steel drill screws.
1. Head Type: Low-profile head beneath sheathing, manufacturer's standard elsewhere.
- E. Welding Electrodes: Comply with AWS standards.

2.6 MISCELLANEOUS MATERIALS

- A. Galvanizing Repair Paint: ASTM A 780.
- B. Nonmetallic, Nonshrink Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout containing selected silica sands, portland cement, shrinkage-compensating agents, and plasticizing and water-reducing agents, complying with ASTM C1107, with fluid consistency and 30-minute working time.
- C. Shims: Load bearing, high-density multimonomer plastic, and nonleaching; or of cold-formed steel of same grade and 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.

2.7 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 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 screw penetrating joined members by no fewer than three exposed screw threads.
 - 4. Fasten other materials to cold-formed steel framing by welding, bolting, pneumatic pin fastening, or screw fastening, according to Shop Drawings.
- B. Reinforce, stiffen, and brace framing assemblies to withstand handling, delivery, and erection stresses. Lift fabricated assemblies to prevent damage or permanent distortion.
- C. Fabrication Tolerances: Fabricate assemblies level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet and as follows:
 - 1. Spacing: Space individual framing members no more than +/- 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 supporting substrates 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 PREPARATION

- A. Before sprayed fire-resistive materials are applied, attach continuous angles, supplementary framing, or tracks to structural members indicated to receive sprayed fire-resistive materials.
- B. After applying sprayed fire-resistive materials, remove only as much of these materials as needed to complete installation of cold-formed framing without reducing thickness of fire-resistive materials below that are required to obtain fire-resistance rating indicated. Protect remaining fire-resistive materials from damage.
- C. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch to ensure a uniform bearing surface on supporting concrete or masonry construction.

- D. Install sealer gaskets at the underside of wall bottom track or rim track and at the top of foundation wall or slab at stud or joist locations.

3.3 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 and to manufacturer's written instructions unless more stringent requirements are indicated.
- C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.
 - 1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch.
- D. 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 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, and complying with requirements for spacing, edge distances, and screw penetration.
- E. Install framing members in one-piece lengths unless splice connections are indicated for track or tension members.
- F. Install temporary bracing and supports to secure framing and support loads comparable in intensity to those for which structure was designed. Maintain braces and supports in place, undisturbed, until entire integrated supporting structure has been completed and permanent connections to framing are secured.
- G. Do not bridge building expansion joints with cold-formed steel framing. Independently frame both sides of joints.
- H. Install insulation, specified in Division 07 section "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.
- I. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.
- J. Erection Tolerances: 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 +/- 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

- A. Install continuous tracks sized to match studs. Align tracks accurately and securely anchor to supporting structure as indicated.

- B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:
 - 1. Stud Spacing: 16 inches, or closer if required by design.
- C. Set studs plumb, except as needed for diagonal bracing or required for nonplumb walls or warped surfaces and similar requirements.
- D. Isolate non-load-bearing steel framing from building structure to prevent transfer of vertical loads while providing lateral support.
 - 1. Install single deep-leg deflection tracks and anchor to building structure.
 - 2. Connect vertical deflection clips to bypassing or infill studs and anchor to building structure.
- E. Install horizontal bridging in wall studs, spaced vertically in rows indicated on Shop Drawings but not more than 48 inches apart. Fasten at each stud intersection.
 - 1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.
 - a. Install solid blocking at centers indicated on Shop Drawings.
 - 2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.
 - 3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.
 - 4. Bridging: Proprietary bridging bars installed according to manufacturer's written instructions.
- F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 SOFFIT INSTALLATION

- A. Install perimeter 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.
 - 1. Install joists over supporting frame with a minimum end bearing of 1.5 inches.
 - 2. Reinforce ends and bearing points of joists with web stiffeners, end clips, joist hangers, steel clip angles, or steel-stud sections as indicated on Shop Drawings.
- C. Space joists not more than 2 inches from abutting walls, and as follows:
 - 1. Joist Spacing: As indicated.
- D. Frame openings with built-up joist headers consisting of joist and joist track, or another combination of connected joists if indicated.

- E. Install joist reinforcement at interior supports with single, short length of joist section located directly over interior support, with lapped joists of equal length to joist reinforcement, or as indicated on Shop Drawings.
 - 1. Install web stiffeners to transfer axial loads of walls above.
- F. Install bridging at intervals indicated on Shop Drawings. Fasten bridging at each joist intersection as follows:
 - 1. Bridging: Joist-track solid blocking of width and thickness indicated, secured to joist webs.
 - 2. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and joist-track solid blocking of width and thickness indicated. Fasten flat straps to bottom flange of joists and secure solid blocking to joist webs.
- G. Secure joists to load-bearing interior walls to prevent lateral movement of bottom flange.
- H. 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.

3.6 FIELD QUALITY CONTROL

- A. Testing: Contracting Authority 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 Engineer.
- D. Remove and replace work where test results indicate that it does not comply with specified requirements.
- E. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.

3.7 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 A 780 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

**SECTION 05 7000
DECORATIVE METAL**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall-mounted handrails.

1.2 RELATED REQUIREMENTS

- A. Section 09 2116 - Gypsum Board Assemblies: Placement of backing plates in stud wall construction.

1.3 REFERENCE STANDARDS

- A. ADA Standards - Americans with Disabilities Act (ADA) Standards for Accessible Design; 2010.
- B. ASTM A276 - Standard Specifications for Stainless Steel Bars and Shapes; 2016.
- C. ASTM A554 - Standard Specifications for Welded Stainless Steel Mechanical Tubing; 2015.
- D. ASTM A666 - Standard Specifications for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. AWS D1.1 – Structural Welding Code – Steel; American Welding Society; 2015.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's product data including description of materials, components, finishes, fabrication details, glass, anchors, and accessories.
- B. Shop Drawings: Indicate railing system elevations and sections, details of profile, dimensions, sizes, connection attachments, anchorage, size and type of fasteners, and accessories. Indicate anchor and joint locations, brazed connections, transitions, and terminations.
- C. Maintenance Data: Manufacturer's instructions for care and cleaning.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Contracting Authority's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing decorative railing systems and acceptable to manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in factory provided protective coverings and packaging.
- B. Protect materials against damage during transit, delivery, storage, and installation at site.
- C. Inspect materials upon delivery for damage. Repair damage to be indistinguishable from undamaged areas; if damage cannot be repaired to be indistinguishable from undamaged parts and finishes, replace damaged items.
- D. Prior to installation, store materials and components under cover, in a dry location.

1.7 FIELD CONDITIONS

- A. Do not install railings until project is enclosed and ambient temperature of space is minimum 65°F and maximum 95°F.
- B. Maintain ambient temperature of space at minimum 65°F and maximum 95°F for 24 hours before, during, and after railing installation.

1.8 WARRANTY

- A. Warranty: Manufacturer's standard 1 year warranty against defects in materials, fabrication, finishes, and installation commencing on Date of Substantial Completion.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Decorative Metal Railings:
 - 1. Architectural Railings and Grilles, Inc: www.stainless-railing.com.
 - 2. Couturier Iron Craft, Inc: www.couturierironcraft.com.
 - 3. C. R. Laurence Co., Inc: www.crl-arch.com.
 - 4. Global Glass Railings: www.architecturalglassrailings.com.
 - 5. Hollaender Manufacturing Co: www.hollaender.com.
 - 6. Morse Industries; www.morseindustries.com.
 - 7. King Architectural Materials; www.kingmetals.com.
 - 8. Or approved equal

2.2 RAILING SYSTEMS

- A. Wall-Mounted Handrail:
 - 1. 1-1/2 inch diameter stainless steel; No. 4 bright finish.
 - 2. Handrail Brackets: Manufacturer's standard stainless steel brackets.
 - a. Mounting: Wall.
 - b. Finish: No. 4 bright finish.
 - 3. Comply with ADA Standards.

2.3 MATERIALS

- A. Stainless Steel Components:
 - 1. ASTM A666, Type 304.
 - 2. Stainless Steel Tubing: ASTM A554, Type 304, 16 gage, 0.0625 inch minimum metal thickness, 1 1/2 inch diameter.
 - 3. Stainless Steel Bars, Shapes and Moldings: ASTM A276, Type 304.
 - 4. Stainless Steel Finish: No. 4 Bright Polished finish.

2.4 ACCESSORIES

- A. Anchors and Fasteners: Provide anchors and other materials 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.
 - 1. For anchorage to stud walls, provide backing plates for bolting anchors.
 - 2. Exposed Fasteners: No exposed bolts or screws.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate and site conditions are acceptable and ready to receive work.
- B. Verify field dimensions of locations and areas to receive work.
- C. Notify Engineer immediately of conditions that would prevent satisfactory installation.
- D. Do not proceed with work until detrimental conditions have been corrected.
- E. Furnish components to be installed in other work to installer of that other work, including but not limited to blocking, sleeves, inserts, anchor bolts, embedded plates and supports for attachment of anchors.

3.2 PREPARATION

- A. Review installation drawings before beginning installation. Coordinate diagrams, templates, instructions and directions for installation of anchorages and fasteners.
- B. Clean surfaces to receive units. Remove materials and substances detrimental to the installation.

3.3 INSTALLATION

- A. Comply with manufacturer's drawings and written instructions.
- B. Install components plumb and level, accurately fitted, free from distortion or defects and with tight joints, except where necessary for expansion.
- C. Anchor securely to structure.
- D. Conceal anchor bolts and screws whenever possible. Where not concealed, use flush countersunk fastenings.
- E. Weld connections that cannot be shop welded due to size limitations.
 - 1. Weld in accordance with AWS D1.1.
 - 2. Match shop welding and bolting.
 - 3. Clean welds, bolted connections and abraded areas. Grind welds smooth.

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.

3.5 CLEANING

- A. Remove protective film from exposed metal surfaces.
- B. Metal: Clean exposed metal finishes with potable water and mild detergent, in accordance with manufacturer recommendations; do not use abrasive materials or chemicals, detergents or other substances that may damage the material or finish.

3.6 PROTECTION

- A. Protect installed components and finishes from damage after installation.
- B. Repair damage to exposed finishes to be indistinguishable from undamaged areas.
 - 1. If damage to finishes and components cannot be repaired to be indistinguishable from undamaged finishes and components, replace damaged items.

END OF SECTION

**SECTION 06 1000
ROUGH CARPENTRY**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Non-structural dimension lumber framing.
- B. Sheathing.
- C. Subflooring.
- D. Underlayment.
- E. Roofing nailers.
- F. Roofing cant strips.
- G. Preservative treated wood materials.
- H. Fire retardant treated wood materials.
- I. Miscellaneous framing and sheathing.
- J. Concealed wood blocking, nailers, and supports.
- K. Miscellaneous wood nailers, furring, and grounds.

1.2 REFERENCE STANDARDS

- A. ASTM A153 – Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- C. AWPAA U1 - Use Category System: User Specification for Treated Wood; American Wood Protection Association; 2012.
- D. PS 2 - Performance Standard for Wood-Based Structural-Use Panels; National Institute of Standards and Technology, U.S. Department of Commerce; 2010.
- E. PS 20 - American Softwood Lumber Standard; National Institute of Standards and Technology, Department of Commerce; 2010.

1.3 SUBMITTALS

- A. Product Data: Provide technical data on application instructions.
- B. Manufacturer's Certificate: Certify that wood products supplied for rough carpentry meet or exceed specified requirements.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. General: Cover wood products to protect against moisture. Support stacked products to prevent deformation and to allow air circulation.
- B. Fire Retardant Treated Wood: Prevent exposure to precipitation during shipping, storage, or installation.

PART 2 PRODUCTS

2.1 GENERAL REQUIREMENTS

- A. Dimension Lumber: Comply with PS 20 and requirements of specified grading agencies.
 - 1. If no species is specified, provide any species graded by the agency specified; if no grading agency is specified, provide lumber graded by any grading agency meeting the specified requirements.
 - 2. Grading Agency: Any grading agency whose rules are approved by the Board of Review, American Lumber Standard Committee (www.alsc.org) and who provides grading service for the species and grade specified; provide lumber stamped with grade mark unless otherwise indicated.
- B. Lumber fabricated from old growth timber is not permitted.

2.2 DIMENSION LUMBER FOR CONCEALED APPLICATIONS

- A. Sizes: Nominal sizes as indicated on drawings, S4S.
- B. Moisture Content: S-dry or MC19.
- C. Miscellaneous Framing, Blocking, Nailers, Grounds, and Furring:
 - 1. Lumber: S4S, No. 2 or Standard Grade.
 - 2. Boards: Standard or No. 3.

2.3 CONSTRUCTION PANELS

- A. Subflooring: Any PS 2 type, rated Sheathing.
 - 1. Bond Classification: Exterior.
 - 2. Span Rating: 48.
 - 3. Performance Category: 3/4 PERF CAT.
- B. Underlayment: APA Underlayment; plywood, Exposure 2, 1/2 inch thick. Fully sanded faces at resilient flooring.

2.4 ACCESSORIES

- A. Fasteners and Anchors:
 - 1. Metal and Finish: Hot-dipped galvanized steel per ASTM A153 for high humidity and preservative-treated wood locations, unfinished steel elsewhere.
- B. Subfloor Glue: Waterproof, water base, air cure type, cartridge dispensed.
 - 1. Products:
 - a. Franklin International, Inc.; PROvantage Weatherproof Subfloor Adhesive: www.titebond.com.
 - b. Liquid Nails - Subfloor & Deck Construction Adhesive: www.liquidnails.com.
 - c. LOCTITE PL 400 VOC Subfloor & Deck Adhesive: www.loctiteproducts.com
 - d. Or approved equal.

2.5 FACTORY WOOD TREATMENT

- A. Treated Lumber and Plywood: Comply with requirements of AWPA U1 - Use Category System for wood treatments determined by use categories, expected service conditions, and specific applications.
 - 1. Fire-Retardant Treated Wood: Mark each piece of wood with producer's stamp indicating compliance with specified requirements.
 - 2. Preservative-Treated Wood: Provide lumber and plywood marked or stamped by an ALSC-accredited testing agency, certifying level and type of treatment in accordance with AWPA standards.
- B. Fire Retardant Treatment:
 - 1. Manufacturers:
 - a. Arch Wood Protection, Inc: www.wolmanizedwood.com.
 - b. Hoover Treated Wood Products, Inc: www.frtw.com.
 - c. Osmose, Inc: www.osmose.com.
 - d. Or approved equal
 - 2. Interior Type A: AWPA U1, Use Category UCFA, Commodity Specification H, low temperature (low hygroscopic) type, chemically treated and pressure impregnated; capable of providing a maximum flame spread rating of 25 when tested in accordance with ASTM E84, with no evidence of significant combustion when test is extended for an additional 20 minutes.
 - a. Kiln dry wood after treatment to a maximum moisture content of 19% for lumber and 15% for plywood.
 - b. Treat rough carpentry items as indicated.
 - c. Do not use treated wood in applications exposed to weather or where the wood may become wet.
- C. Preservative Treatment:
 - 1. Manufacturers:
 - a. Arch Wood Protection, Inc: www.wolmanizedwood.com.
 - b. Koppers Performance Chemicals, Inc: www.koppersperformancechemicals.com.
 - c. Viance, LLC: www.treatedwood.com.
 - d. Osmose, Inc: www.osmose.com.
 - e. Or approved equal
 - 2. Preservative Pressure Treatment of Lumber Above Grade: AWPA U1, Use Category UC3B, Commodity Specification A using waterborne preservative to 0.25 pound per cubic foot retention.
 - a. Kiln dry lumber after treatment to maximum moisture content of 19%.
 - 3. Preservative Pressure Treatment of Plywood Above Grade: AWPA U1, Use Category UC2 and UC3B, Commodity Specification F using waterborne preservative to 0.25 pound per cubic foot retention.

- a. Kiln dry plywood after treatment to maximum moisture content of 19%.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

- A. Select material sizes to minimize waste.
- B. Reuse scrap to the greatest extent possible; clearly separate scrap for use on site as accessory components, including: shims, bracing, and blocking.
- C. Where treated wood is used on interior, provide temporary ventilation during and immediately after installation sufficient to remove indoor air contaminants.

3.2 BLOCKING, NAILERS, AND SUPPORTS

- A. Provide framing and blocking members as indicated or as required to support finishes, fixtures, specialty items, and trim.
- B. In metal stud walls, provide continuous blocking around door and window openings for anchorage of frames, securely attached to stud framing.
- C. In walls, provide blocking attached to studs as backing and support for wall-mounted items, unless item can be securely fastened to 2 or more studs or other method of support is explicitly indicated.
- D. Provide the following specific non-structural framing and blocking:
 - 1. Handrails.

3.3 INSTALLATION OF CONSTRUCTION PANELS

- A. Subflooring: Glue and nail to framing; staples are not permitted.

3.4 CLEANING

- A. Waste Disposal: Comply with the requirements.
 - 1. Comply with applicable regulations.
 - 2. Do not burn scrap on project site.
 - 3. Do not burn scraps that have been pressure treated.
 - 4. Do not send materials treated with pentachlorophenol, CCA, or ACA to co-generation facilities or "waste-to-energy" facilities.
- B. Do not leave any wood, shavings, sawdust, etc. on the ground or buried in fill.
- C. Prevent sawdust and wood shavings from entering the storm drainage system.

END OF SECTION

**SECTION 06 1063
EXTERIOR ROUGH CARPENTRY**

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Plastic Decking.
- B. Related Sections:
 - 1. Section 07 6200 "Sheet Metal Flashing and Trim" for sheet metal flashing used with exterior rough carpentry.

1.2 DEFINITIONS

- A. Boards: Lumber of less than 2 inches nominal in thickness and 2 inches nominal or greater width.
- B. Dimension Lumber: Lumber of 2 inches nominal or greater but less than 5 inches nominal in least dimension.
- C. Timber: Lumber of 5 inches nominal or greater in least dimension.
- D. Lumber grading agencies, and the abbreviations used to reference them, include the following:
 - 1. NeLMA: Northeastern Lumber Manufacturers' Association.
 - 2. NLGA: National Lumber Grades Authority.
 - 3. RIS: Redwood Inspection Service.
 - 4. SPIB: The Southern Pine Inspection Bureau.
 - 5. WCLIB: West Coast Lumber Inspection Bureau.
 - 6. WWPA: Western Wood Products Association.

1.3 DELIVERY, STORAGE, AND HANDLING

- A. Store materials under cover and protected from weather and contact with damp or wet surfaces. Stack lumber flat with spacers between each bundle to provide air circulation. Provide for air circulation around stacks and under coverings.
- B. Handle and store plastic lumber to comply with manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 PLASTIC DECKING

- A. Plastic Lumber, General: Products acceptable to authorities having jurisdiction and for which current model code evaluation reports exist that show compliance with building code in effect for Project for indicated occupancy and type of construction.

1. Allowable loads and spans, as documented in evaluation reports or in information referenced in evaluation reports, shall not be less than design loads and spans indicated.
- B. All-Plastic Lumber: Solid shapes made from high-density polyethylene (HDPE) with no cellulose fiber.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Cascades Re-Plast; Division of Plastiques Cascades, Inc.
 - b. Certainteed Corporation.
 - c. CPI Plastics Group Ltd.
 - d. Genova Products, Inc.
 - e. Kroy Building Products, Inc.
 - f. L.B. Plastics, Inc.
 - g. Outdoor Technologies, Inc.
 - h. Renew Plastics; a division of N.E.W. Plastics Corp.
 - i. Royal Crown Limited.
 - j. Thermal Industries, Inc.
 - k. U.S. Plastic Lumber Ltd.
 - l. Veka Inc.
 - m. Westech Fence.
 - n. Or approved equal
 2. Decking Size: As indicated on drawings.
 3. Surface Texture: Smooth
 4. Color: As selected by Architect from manufacturer's full range.

2.2 FASTENERS

- A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1 1/2 inches into cast-in-place concrete.
 1. For plastic decking, use stainless-steel fasteners.
- B. Nails: ASTM F 1667.
- C. Power-Driven Fasteners: NES NER-272.
- D. Post installed Anchors: Stainless-steel, anchors with capability to sustain, without failure, a load equal to six times the load imposed when installed in unit masonry assemblies and equal to four times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.
 1. Stainless-steel bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

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. Clean substrates of projections and substances detrimental to application.

3.3 INSTALLATION, GENERAL

- A. Set exterior rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit exterior rough carpentry to other construction; scribe and cope as needed for accurate fit.
- B. Install plastic lumber to comply with manufacturer's written instructions.
- C. Secure decking to framing with concealed decking fasteners.
- D. Install metal framing anchors to comply with manufacturer's written instructions.
- E. 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.
- F. Securely attach exterior rough 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.
- G. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view. Make tight connections between members. Install fasteners without splitting wood; do not countersink nail heads unless otherwise indicated.
- H. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

END OF SECTION 06 1063

**SECTION 07 1800
TRAFFIC COATINGS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Coating for waterproofing and traffic surface

1.2 REFERENCE STANDARDS

- A. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers-Tension; 2006a (Reapproved 2013).
- B. ASTM D903 - Standard Test Method for Peel or Stripping Strength of Adhesive Bonds; 1998 (Reapproved 2010).
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2015a.
- D. ASTM E96 – Standard Test Methods for Water Vapor Transmission of Materials; 2014.

1.3 SUBMITTALS

- A. Product Data: Include product characteristics and limitations. Identify dissolving solvents, fuels, and potential destructive compounds.
- B. Manufacturer's Installation Instructions: Include special field conditions required to install traffic membrane and potential incompatibilities with adjacent materials.
- C. Maintenance Data: Include procedures for stain removal, repairing surface, and cleaning.
- D. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Contracting Authority's name and registered with manufacturer.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Maintain storage area at minimum ambient temperature of 55°F.
- B. Keep away from fire or open flame.

1.5 FIELD CONDITIONS

- A. Do not install materials when temperature is below 50°F or above 90°F.
- B. Maintain this temperature range, 24 hours before, during and 72 hours after application.
- C. Restrict traffic from area where materials are being installed or are curing.

PART 2 PRODUCTS

2.1 TRAFFIC COATINGS

- A. Vehicular Coating: Fluid-applied polyurethane with slip-reducing aggregate surface.
 - 1. Finished Coating Thickness: 50 mils, minimum.
 - 2. Manufacturers:
 - a. AVM Industries, Inc; System 680SF: www.avmindustries.com.

- b. Gaco Western; GacoFlex U61 : www.gaco.com.
- c. Neogard Division of Jones-Blair Company: www.neogard.com.
- d. Pacific Polymers International, Inc: www.pacpoly.com.
- e. Pecora Corporation; Pecora Deck 800 System: www.pecora.com.
- f. Tremco Global Sealants: www.tremcosealants.com.
- g. Or approved equal

2.2 MATERIALS

- A. Membrane: Fluid applied polyurethane; waterproof; color as selected; conforming to the following:
 - 1. Tensile Strength (ASTM D412): 2000 psi.
 - 2. Water Vapor Permeance (ASTM E96): <1.0 perm.
 - 3. Surface Burning Characteristics (ASTM E84): Class A Flame spread index Smoke developed index.
 - 4. Adhesive Bond Peel Strength (ASTM D903): 23 PLI maximum.
- B. Surfacing: Clean sand.
- C. Filler and Primer: As recommended by membrane manufacturer.
- D. Sealant: As recommended by membrane manufacturer, and compatible with system and adjacent materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate is ready to receive work, surface is clean, dry and free of substances that could adversely affect bond.

3.2 PREPARATION

- A. Clean substrate surface free of foreign matter.
- B. Patch concrete substrate with filler to produce surface conducive to bond.
- C. Protect adjacent surfaces.

3.3 INSTALLATION

- A. Apply system materials in accordance with manufacturer's instructions.
- B. Apply surfacing to top coat before set.

3.4 PROTECTION

- A. Do not permit traffic over unprotected surfaces.

END OF SECTION

SECTION 07 2100
THERMAL INSULATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Board insulation and integral vapor retarder where indicated on drawings.
- B. Batt insulation and vapor retarder in exterior wall, ceiling, roof, and floor construction.

1.2 RELATED REQUIREMENTS

- A. Section 05 4000 - Cold-Formed Metal Framing: Board insulation as wall sheathing.
- B. Section 07 2119 - Foamed-In-Place Insulation: Plastic foam insulation other than boards.
- C. Section 07 2500 - WEATHER BARRIERS: Separate air barrier and vapor retarder materials.
- D. Section 07 8400 - Firestopping: Insulation as part of fire-rated through-penetration assemblies.

1.3 REFERENCE STANDARDS

- A. ASTM C578 - Standard Specifications for Rigid, Cellular Polystyrene Thermal Insulation; 2014.
- B. ASTM C612 - Standard Specifications for Mineral Fiber Block and Board Thermal Insulation; 2014.
- C. ASTM C1289 - Standard Specifications for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board; 2014.
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

1.4 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance criteria, and product limitations.
- B. Manufacturer's Certificate: Certify that products meet or exceed specified requirements.
- C. Manufacturer's Installation Instructions: Include information on special environmental conditions required for installation and installation techniques.

1.5 FIELD CONDITIONS

- A. Do not install insulation adhesives when temperature or weather conditions are detrimental to successful installation.

PART 2 PRODUCTS

2.1 APPLICATIONS

- A. Insulation Over Metal Stud Framed Walls, Continuous: Extruded polystyrene board.
- B. Cover board over rigid insulation at Skywalk B floor: 1/2 inch high density Polyisocyanurate cover board to be supplied by membrane manufacturer.

2.2 FOAM BOARD INSULATION MATERIALS

- A. Extruded Polystyrene Board Insulation: Extruded polystyrene board; ASTM C578; with either natural skin or cut cell surfaces, and the following characteristics:

1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 3. R-value; 1 inch of material at 72°F: 5, minimum.
 4. Board Edges: Square.
 5. Water Absorption, Maximum: 0.3%, by volume.
 6. Manufacturers:
 - a. Dow Chemical Co: www.dow.com.
 - b. Owens Corning Corporation: www.ocbuildingspec.com.
 - c. Kingspan: www.trustgreenguard.com
 - d. Or approved equal.
- B. Composite Polyisocyanurate Board Insulation Faced with Plywood: Rigid cellular foam, complying with ASTM C1289; Type V, fire-retardant-treated plywood one face, glass fiber mat facer one face, Class 3.
1. Flame Spread Index: 25 or less, when tested in accordance with ASTM E84.
 2. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 3. Compressive Strength: 20 psi.
 4. Board Size: 48 by 96 inch.
 5. Plywood Thickness: 5/8 inch.
 6. Thermal Resistance: R-value of 14.
 7. Board Edges: Square.
 8. Manufacturers:
 - a. Atlas Roofing Corporation; ACFoam Nail Base Roof Insulation Panels: www.atlasroofing.com/sle.
 - b. Hunter Panels, LLC; Xci Ply: www.hunterxci.com.
 - c. ACFoam Nail Base: www.atlasroofing.com
 - d. Or approved equal.

2.3 FIBER BOARD INSULATION MATERIALS

- A. Mineral Fiber Board Insulation: Rigid or semi-rigid mineral fiber, ASTM C612 or C553; unfaced flame spread index of 0 when tested in accordance with ASTM E84.
1. Smoke Developed Index: 450 or less, when tested in accordance with ASTM E84.
 2. Board Size: 24 inches by 48 inches.
 3. Board Thickness: Varies - See drawings.
 4. Maximum Density: 8.0 pounds per cubic foot.
 5. Manufacturers:

- a. Johns Manville International, Inc.; MinWool Safing: www.jm.com.
- b. Thermafiber, Inc: www.thermafiber.com.
- c. GAF: www.gaf.com
- d. Or approved equal

6. Substitutions: As approved by Engineer.

2.4 ACCESSORIES

- A. Tape joints of rigid insulation in accordance with insulation manufacturers' instructions.
- B. Adhesive: Type recommended by insulation manufacturer for application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate, adjacent materials, and insulation materials are dry and that substrates are ready to receive insulation and adhesive.
- B. Verify substrate surfaces are flat, free of honeycomb, fins, irregularities, or materials or substances that may impede adhesive bond.

3.2 BOARD INSTALLATION AT EXTERIOR WALLS

- A. Adhere a 6 inches wide strip of polyethylene sheet over expansion joints with double beads of adhesive each side of joint.
 1. Tape seal joints between sheets.
 2. Extend sheet full height of joint.
- B. Install boards horizontally on walls.
 1. Place boards to maximize adhesive contact.
 2. Install in running bond pattern.
 3. Butt edges and ends tightly to adjacent boards and to protrusions.
- C. Extend boards over expansion joints, unbonded to wall on one side of joint.
- D. Cut and fit insulation tightly to protrusions or interruptions to the insulation plane.
- E. Place 6 inches wide polyethylene sheet at perimeter of wall openings, from adhesive vapor retarder bed to window and door frames. Tape seal in place to ensure continuity of vapor retarder and air seal.
- F. Tape insulation board joints.

3.3 PROTECTION

- A. Do not permit installed insulation to be damaged prior to its concealment.

END OF SECTION

**SECTION 07 2119
FOAMED-IN-PLACE INSULATION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Foamed-in-place insulation.
 - 1. In exterior wall crevices.

1.2 REFERENCE STANDARDS

- A. ASTM C518 – Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2010.
- B. ASTM D2842 - Standard Test Method for Water Absorption of Rigid Cellular Plastics; 2012.
- C. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- D. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials; 2013.
- E. ASTM E283 – Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- F. ASTM E2178 – Standard Test Method for Air Permeance of Building Materials; 2013.

1.3 SUBMITTALS

- A. Product Data: Provide product description, insulation properties, overcoat properties, and preparation requirements.
- B. Manufacturer's Installation Instructions: Indicate special procedures, and perimeter conditions requiring special attention.
- C. Certificates: Certify that products of this section meet or exceed specified requirements.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products of the type specified in this section, with not less than 3 years of documented experience.
- B. Applicator Qualifications: Company specializing in performing work of the type specified, with minimum 3 years documented experience.

1.5 FIELD CONDITIONS

- A. Do not apply foam when temperature is below that specified by the manufacturer for ambient air and substrate.
- B. Do not apply foam when temperature is within 5°F of dew point.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Foamed-In-Place Insulation: Medium-density, rigid or semi-rigid, open or closed cell polyurethane foam; foamed on-site, using blowing agent of water or non-ozone-depleting gas.

1. Aged Thermal Resistance (R-value): 5°F hour/Btu, minimum, when tested at 1 inch thickness in accordance with ASTM C518 after aging for 180 days at 41°F.
2. Water Vapor Permeance: Vapor retarder; 1 perm, maximum, when tested at intended thickness in accordance with ASTM E96, desiccant method.
3. Water Absorption: Less than 2% by volume, maximum, when tested in accordance with ASTM D2842.
4. Air Permeance: 0.004 cubic feet per meter per square foot, maximum, when tested at intended thickness in accordance with ASTM E2178 or ASTM E283 at 1.5 psf.
5. Closed Cell Content: At least 90%.
6. Surface Burning Characteristics: Flame spread/Smoke developed index of 25/450, maximum, when tested in accordance with ASTM E84.
7. Products:
 - a. BASF Corporation; WALLTITE US: www.spf.basf.com.
 - b. Demilec (USA) LLC; HEATLOK SOY 200: www.demilecusa.com.
 - c. Gaco Western; GacoOnePass F1850R: www.gaco.com.
 - d. Johns Manville; JM Corbond III Closed Cell Spray Polyurethane Foam: www.jm.com.
 - e. Or approved equal

2.2 ACCESSORIES

- A. Primer: As required by insulation manufacturer.
- B. Overcoat: Intumescent coating of type recommended by insulation manufacturer and as required to comply with applicable codes.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify work within construction spaces or crevices is complete prior to insulation application.
- B. Verify that surfaces are clean, dry, and free of matter that may inhibit insulation or overcoat adhesion.

3.2 PREPARATION

- A. Mask and protect adjacent surfaces from over spray or dusting.
- B. Apply primer in accordance with manufacturer's instructions.

3.3 APPLICATION

- A. Apply insulation in accordance with manufacturer's instructions.
- B. Apply insulation by spray method, to a uniform monolithic density without voids.
- C. Apply overcoat monolithically, without voids to fully cover foam insulation.
- D. Patch damaged areas.

- E. Where applied to voids and gaps assure space for expansion to avoid pressure on adjacent materials that may bind operable parts.
- F. Trim excess away for applied trim or remove as required for continuous sealant bead.

3.4 FIELD QUALITY CONTROL

- A. Field inspections and tests will be performed by an independent testing agency
- B. Inspection will include verification of insulation and overcoat thickness and density.

END OF SECTION

**SECTION 07 2200
ROOF AND DECK INSULATION**

GENERAL**1.1 SECTION INCLUDES**

- A. Rigid Board Insulation
- B. Low Rise Adhesive
- C. Vapor Retarder
- D. Fasteners and Plates
- E. Thermal Barrier Board

1.2 REFERENCES

- A. ASTM C165 Test Method for Measuring Compressive Properties of Thermal Insulation
- B. ASTM C272 Test Method for Water Absorption of Core Materials for Structural Sandwich Constructions
- C. ASTM C473 Test Methods for Physical Testing of Gypsum Board Products and Gypsum Lath
- D. ASTM C518 Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus
- E. ASTM C1177 Specification for Glass Matt Gypsum Substrate for use as Sheathing
- F. ASTM C1289 Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board
- G. ASTM D1621 Test Method for Compressive Properties of Rigid Cellular Plastics
- H. ASTM D1622 Test Method for Apparent Density of Rigid Cellular Plastics
- I. ASTM D2126 Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging
- J. ASTM E96 Test Methods for Water Vapor Transmission of Materials
- K. FM Factory Mutual Engineering Corporation - Data Sheet 1-28 Insulated Steel Deck

1.3 SYSTEM DESCRIPTION

- A. UL Class "a" Rating
 - 1. It is the intent of this specification to provide a roof system with a UL Class "A" Rating. The descriptions given below are general descriptions. The insulation, roof membrane, and other components shall be as required by the membrane manufacturer to obtain a UL Class "A" Rating.
- B. Roof Drains
 - 1. Provide tapered insulation sump at all drains. Insulation shall be secured as specified below.
- C. Thermal Board
 - 1. Provide mechanically fastened 5/8 inch Densdeck Prime to steel deck.
- D. Vapor Retarder
 - 1. Provide self-adhered sheet vapor retarder over factory primed gypsum board.
- E. Polyisocyanurate Insulation
 - 1. Adhesive apply a base layer of 1 inch flat stock Polyisocyanurate insulation to vapor retarder.
 - 2. Adhesive apply second layer of tapered polyisocyanurate insulation at dead level sections of deck to allow for a minimum of ¼ inch per foot slope to the drain.
 - 3. Adhesive apply second layer of flat stock polyisocyanurate insulation at sections of structurally sloped deck.

1.4 SUBMITTALS

- A. Manufacturer's Product Data:
- B. Most recent copy of manufacturer's literature applicable to products and specifications to be used, including material characteristics, test data, installation recommendations, material safety data sheets (MSDS).
- C. Manufacturer's Installation Instructions:
 - 1. Most recent copy of manufacturer's installation instructions for applications detailing products and specifications to be used.
- D. Shop Drawings
 - 1. Submit manufacturer's shop drawings for tapered insulation systems. Shop drawings shall show board by board layout pattern of the tapered system and drain sumps and shall comply with the drainage pattern as indicated on the plans.
 - a. The responsibility of providing shop drawings for the tapered insulation system lies solely with the manufacturer of the tapered insulation system. Shop drawings by others will not be accepted.
 - b. Shop drawings shall include: Outline of roof, location of drains, scuppers, or gutters, complete board layout of tapered insulation components, thicknesses, and the average "R" value for the completed insulation system.
 - c. The roofing contractor shall verify all roof dimensions and drain locations and confirm same with the manufacturer prior for fabrication of tapered insulation.
 - 1) Submit layout pattern for mechanical fasteners and low rise adhesive for all layers of thermal barrier board and insulation that are mechanically attached and adhered.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store all insulation materials in a manner to protect them from the wind, sun, and moisture damage prior to and during installation. Any insulation that has been exposed to any moisture shall be removed from the project site.
- B. Keep materials enclosed in a watertight, yet ventilated enclosure (i.e., tarpaulins).
- C. Store materials off of the ground. Any warped or broken insulation boards shall be removed from the site.
- D. Insulation packages shall be labeled to include manufacturer, material name, and production date.

PRODUCTS

2.1 APPROVED EQUIVALENT

- A. Contractor must submit any product not specified a minimum five days before the bid date to Engineer in order for product to be considered for approval. The Engineer will notify Contractor, in writing, of decision to accept or reject request.

2.2 THERMAL BARRIER BOARD

- A. Non-Structural Gypsum Roof Board
 - 1. Acceptable Manufacturers
 - a. Georgia-Pacific, Dens-Deck Prime (5/8 inch)
 - b. United States Gypsum, Securock (5/8 inch)
 - c. Firestone, ISOGARD HD Cover Board
 - c. Or approved equal
 - 1) Requirements
 - (a) UL listed under Roofing Systems
 - 2) Physical Properties
 - (a) Property Test Method Specifications
 - (b) Compression Strength ASTM D1621 600 psi
 - (c) Water Absorption (Vol.) ASTM C1177 10%

- (d) Surface Water
- (e) Resistance (grams) ASTM C473 2.5
- (f) Permeance (Perms) ASTM C355 35
- (g) R-Factor HR (square. feet. per degree Fahrenheit per BTU) per inch thickness ASTM C518 0.35

2.3 INSULATION MATERIALS

- A. Tapered and Flat Stock Polyisocyanurate
 - 1. Acceptable Manufacturers
 - a. Firestone Polyisocyanurate
 - b. Carlisle SynTec Secure Shield Polyiso
 - c. Hy-Therm AP by Celotex Corp.
 - d. AC Foam II by Atlas Energy Products
 - e. Engry-2 by Johns Manville Roofing Systems
 - f. GAFTemp Isotherm R by GAF Building Materials, Corp.
 - g. Roof Membrane Manufacturer Supplied Approved Equivalent
 - h. Or approved equal
 - 1) Insulation board shall meet the following requirements:
 - (a) UL listed under Roof Systems
 - (b) Physical Properties
 - (c) Property Test Method Specifications
 - (d) Dimensional Stability ASTM D2126 2% max.
 - (e) Compressive Strength ASTM D1621 25 psi min.
 - (f) Water Absorption ASTM C209 1% max.
 - (g) Vapor Permeability ASTM E96 1 perm max.
 - (h) Foam Core Density ASTM D1622 2.0 pcf min.
 - (i) R-Factor HR (square. feet. per Fahrenheit per BTU) degree per inch thickness ASTM C518 5.6 (Design value)

2.4 MECHANICAL FASTENERS FOR THERMAL BARRIER AND INSULATION MATERIALS.

- A. Mechanical Fasteners and Plates for Metal Deck (22-gauge)
 - 1. Acceptable Manufacturers
 - a. Construction Fasteners
 - b. ITW Buildex
 - c. The Tru-Fast Corporation
 - d. The Rawplug Company, Inc.
 - e. Olympic Fasteners
 - f. Or approved equal
 - g. Requirements
 - 1) Plates shall be 3 inches in diameter minimum and composed of galvanized steel.
 - 2) Fastener and plates shall meet requirements of FM Standard 4470, passing the SRIU Corrosion Test Procedures - Kesternich DIN-50018 with 15% red rust allowable.
 - 3) Fastener and plate shall be approved within applicable FM tested roof system.
 - 4) Mechanical fasteners for metal deck
 - (a) Acceptable Manufacturers
 - (1) Olympic Fasteners
 - (2) Polymer Gyp Tec and Galvanized 3 inches Plates
 - (3) Drill-Tec Pressure Plates & Fasteners
 - (4) Or approved equal

2.5 ADHESIVE FOR INSULATION MATERIALS

A. Insulation Adhesive

1. Acceptable Manufacturers
 - a. Olympic Fasteners- OlyBond500 Spot Shot
 - c. Carlisle SynTec, Inc. Fast 100- LV.
 - d. Dekfast Products Group, Deckbond two-part insulation adhesive.
 - e. Roof membrane Supplied Approved Equivalent.
 - f. Or approved equal
 - 1) Requirements
 - a) Adhesive shall be a two part polyurethane low-rise adhesive applied in bead application.
 - b) Adhesive shall be approved within applicable FM tested roof system.
 - c) Provide no dollar limit adhesion warranty included in the roofing fasteners for insulation materials.

2.7 VAPOR RETARDER – SELF ADHERED

A. One-Ply self-adhering Vapor Retarder

1. Acceptable Manufacturers
 - a. Carlisle Syntec, Inc. 725 TR Air and Vapor Barrier
 - b. Firestone Building Products, V-Force Vapor Barrier Membrane
 - c. Johns Manville: www.jm.com
 - d. Roof Membrane Manufacturer Supplied Approved Equivalent
 - e. Or approved equal
 - e. Requirements
 - 1) Vapor retarder shall be approved within applicable UL and FM tested roof system and meet a Class A fire rated roof system.
 - 2) Vapor retarder of with a perm rating of 0.05 as determined by ASTM C518.

2.8 VAPOR RETARDER PRIMER

A. Vapor barrier primer

1. Acceptable Manufacturers
 - a. Carlisle Cav – Grip Primer
 - b. Firestone SA-Solvent Based (SB) Primer
 - c. Johns Manville: www.jm.com
 - d. Roof Membrane Manufacturer Supplied Approved Equivalent.
 - e. Or approved equal

EXECUTION

3.1 INSPECTION OF SURFACES

- A. Examine surfaces for adequate anchorage, foreign materials, moisture and other conditions which would adversely affect the roofing application and performance.
- B. The roofing contractor shall be responsible for preparing an adequate substrate to receive insulation.

3.2 INSTALLATION

A. Roof Insulation (General Requirements)

1. Insulation shall be laid in parallel courses with all joints staggered between courses.
2. Insulation shall be neatly fitted to all roof penetrations, projections and nailers with no gaps greater than 1/4 inch.
3. Tapered insulation sump shall be installed around roof drains. Install tapered insulation sump in such a way to provide proper slope for runoff. Shape insulation with tool as required providing a smooth surface. Under no circumstances will the membrane be left unsupported in an area greater than 1/4 inch.

4. Minimum of two layers of insulation are to be installed, joints shall be staggered a minimum of 6 inches apart where possible with relation to the layer beneath, and each layer shall be fully attached to the roof deck in accordance with these specifications.
5. No more insulation shall be placed on the surface to receive roof membrane than can be covered with roofing membrane before the end of the day's work or before the onset of inclement weather.
6. Discard all damaged or broken insulation boards. Insulation shall be dry when installed and protected from weather during application. All materials which become wet or warped shall be removed from the site and replaced with new dry materials.
7. Cut tapered insulation for final adjustments where insulation is thinnest. Dress down mismatches in surface greater than 1/8 inch.
 - a. Attachment with Fasteners
 - 1) Approved insulation assembly shall be attached to the deck with an approved fastening system. At a minimum, the amount of fasteners shall be in accordance with wind design speeds.
 - 2) Filler pieces of insulation shall have a minimum of two fasteners.
 - 3) If insulation facer is damaged in application and/or under foot or cart traffic replace damaged insulation boards with new.
 - 4) Spacing pattern of fasteners shall be as per manufacturer's recommendations to meet the manufacturer requirements. Placement of any fastener from edge of insulation board shall be a minimum of 3 inches, and a maximum of 6 inches.
 - 5) Minimum penetration into deck shall be as recommended by the fastener manufacturer. There is a 1 inch minimum for metal decks where not specified by the manufacturer.
 - b. Attachment with Adhesive
 - 1) Attachment of insulation to substrate with low-rise adhesive shall be as per required by membrane manufacturer to achieve required wind speed up lift requirements. Type and quantity of adhesive as required by the membrane manufacturer and insulation manufacturer.
 - 2) Apply primer on vapor retarder surfaces in quantity recommended by manufacturer prior to installing low rise adhesive for the attachment of the roof insulation.
 - 3) Carefully walk in each piece of insulation and continue to walk in and test for adhesion until adhesive has set and provided complete securement. Boards which can be lifted up without breaking are inadequately adhered and shall be reset in fresh adhesive.
 - 4) If insulation facer is damaged in application and/or under foot or cart traffic, refer to insulation manufacturer's recommendations for patching facer, or replace damaged insulation boards with new.
 - 5) Required adhesion will not be achieved unless the insulation and contacts the adhesive while still soft. Contact is best achieved by passing the loaded insulation cart over the row of insulation as it is being laid, taking insulation from the cart. Sufficient "walking in" will also result from the installer stepping on each square foot of surface before the adhesive hardens, but the common practice of shoving each board in and kicking it in one place will not achieve acceptable adhesion. Adhesion will not occur at a later date but must be achieved as laid.
 - 6) Cutting and fitting and trying around irregularities or protrusions shall be done before mopping insulation to the substrate.
 - 7) Cut tapered insulation for final adjustments where insulation is thinnest. Dress down mismatches in surface greater than 1/8 inch.
 - 8) Depress drain areas four feet square at a minimum as shown on drawings or referred to in this specification. Ramp up to surrounding area with tapered edge strips.
 - c. Vapor Retarder

- 1) Vapor retarder shall envelope all layers of insulation above the vapor retarder at all perimeters, drains, and roof projections.
- 2) No cuts or splits in vapor retarder materials shall be allowed before installation of insulation. Patch to maintain integrity of vapor retarder.
- 3) In no case shall the vapor retarder be considered to provide a watertight temporary roof. Any leaks or damage due to the use of the vapor retarder serving as a temporary roof shall be corrected by the Contractor at no cost to the Contracting Authority.

END OF SECTION 07 2200

**SECTION 07 2500
WEATHER BARRIERS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air Barriers: Materials that form a system to stop passage of air through exterior walls, joints between exterior walls and roof, and joints around frames of openings in exterior walls.

1.2 RELATED REQUIREMENTS

- A. Section 07 2100 - Thermal Insulation: Vapor retarder installed in conjunction with insulation.
- B. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashings installed in conjunction with weather barriers.
- C. Section 07 9005 - Joint Sealers: Sealant materials and installation techniques.

1.3 DEFINITIONS

- A. Air Barrier: Air tight barrier made of material that is relatively air impermeable but water vapor permeable, both to the degree specified, with sealed seams and with sealed joints to adjacent surfaces.

1.4 REFERENCE STANDARDS

- A. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- B. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials; 2013.
- C. ASTM E2178 - Standard Test Method for Air Permeance of Building Materials; 2013.

1.5 SUBMITTALS

- A. Product Data: Provide data on material characteristics.
- B. Shop Drawings: Provide drawings of special joint conditions.

1.6 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the materials manufacturers before, during and after installation.

PART 2 PRODUCTS

2.1 WEATHER BARRIER ASSEMBLIES

- A. Air Barrier:
 - 1. On outside surface of sheathing of exterior walls use air barrier sheet, mechanically fastened type, see drawings for locations.

2.2 AIR BARRIER MATERIALS

- A. Air Barrier Sheet, Mechanically Fastened:
 - 1. Air Permeance: 0.004 cubic feet per minute per square foot, maximum, when tested in accordance with ASTM E2178.

2. Water Vapor Permeance: 5 perms, minimum, when tested in accordance with ASTM E96/E96M Procedure A (desiccant method).
3. Ultraviolet and Weathering Resistance: Approved in writing by manufacturer for minimum of 6 months weather exposure.
4. Surface Burning Characteristics: Flame spread index of 25 or less, smoke developed index of 50 or less, when tested in accordance with ASTM E84.
5. Seam and Perimeter Tape: Polyethylene self-adhering type, mesh reinforced, 2 inches wide, compatible with sheet material; unless otherwise specified.
6. Products:
 - a. DuPont Building Innovations; Tyvek Commercial Wrap with Tyvek Fluid Applied Flashing and Joint Compound and Tyvek Tape: www.dupont.com.
 - b. Fiberweb, Inc; Typar MetroWrap: www.typar.com.
 - c. Fortifiber Building Systems Group; WeatherSmart: www.fortifiber.com.
 - d. Pactiv Corporation; GreenGuard MAX Building Wrap: greenguard.pactiv.com.
 - e. VaproShield, LLC; WrapShield: www.vaproshield.com.
 - f. Or approved equal

2.3 ACCESSORIES

- A. Sealants, Tapes, Fluid Applied Flashing and Accessories for Sealing Weather Barrier and Sealing Weather Barrier to Adjacent Substrates: As specified or as recommended by weather barrier manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces and conditions are ready to accept the work of this section.

3.2 PREPARATION

- A. Remove projections, protruding fasteners, and loose or foreign matter that might interfere with proper installation.

3.3 INSTALLATION

- A. Install materials in accordance with manufacturer's instructions.
- B. Air Barriers: Install continuous air tight barrier over surfaces indicated, with sealed seams and with sealed joints to adjacent surfaces.
- C. Mechanically Fastened Sheets - On Exterior:
 1. Install sheets shingle-fashion to shed water, with seams generally horizontal.
 2. Overlap seams as recommended by manufacturer but at least 6 inches.
 3. Overlap at outside and inside corners as recommended by manufacturer but at least 12 inches.
 4. Seal seams, laps, penetrations, tears, and cuts with self-adhesive tape; use only large-headed, gasketed fasteners recommended by the manufacturer.

5. Install air barrier and vapor retarder UNDER jamb flashings.
 6. Install head flashings under weather barrier.
 7. At openings to be filled with frames having nailing flanges, wrap excess sheet into opening; at head, seal sheet over flange and flashing.
- D. Openings and Penetrations in Exterior Weather Barriers:
1. Install flashing over sills, covering entire sill frame member, extending at least 5 inches onto weather barrier and at least 6 inches up jambs; mechanically fasten stretched edges.
 2. At openings to be filled with frames having nailing flanges, seal head and jamb flanges using a continuous bead of sealant compressed by flange and cover flanges with at least 4 inches wide; do not seal sill flange.
 3. At openings to be filled with non-flanged frames, seal weather barrier to all sides of opening framing, using flashing at least 9 inches wide, covering entire depth of framing.
 4. At head of openings, install flashing under weather barrier extending at least 2 inches beyond face of jambs; seal weather barrier to flashing.
 5. At interior face of openings, seal gap between window/door frame and rough framing, using joint sealant over backer rod.
 6. Service and Other Penetrations: Form flashing around penetrating item and seal to weather barrier surface.

3.4 FIELD QUALITY CONTROL

- A. Do not cover installed weather barriers until required inspections have been completed.

3.5 PROTECTION

- A. Do not leave materials exposed to weather longer than recommended by manufacturer.

END OF SECTION

**SECTION 07 4213
METAL WALL PANELS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manufactured metal panels for soffits, with accessory components.

1.2 RELATED REQUIREMENTS

- A. Section 05 4000 - Cold-Formed Metal Framing: Wall panel substrate.
- B. Section 06 1000 - Rough Carpentry: Wall panel substrate.
- C. Section 07 2100 - Thermal Insulation.
- D. Section 07 9005 - Joint Sealers.

1.3 REFERENCE STANDARDS

- A. ASTM B209 – Standard Specifications for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate dimensions, layout, joints, construction details, methods of anchorage.
- B. Samples: Submit 2 samples of wall panel and soffit panel, 12 inch by 12 inch in size illustrating finish color, sheen, and texture.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store prefinished material off ground and protected from weather. Prevent twisting, bending, or abrasion, and provide ventilation to stored materials. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that may cause discoloration or staining of products.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Peterson Aluminum Corporation; Product Flush Vent.
- B. MBCI, www.mbc.com; Product - Artisan Series
- C. Berridge, www.berridge.com; Product – Berridge Flush Seam Panel
- D. Or approved Equal.

2.2 MANUFACTURED METAL PANELS

- A. Soffit Panels:
 - 1. Profile: Style as indicated.
 - 2. Material: Precoated steel sheet, 22 gage, 0.0299 inch minimum thickness.

- 3. Color: As selected by Engineer from manufacturer's standard line.
- B. Internal and External Corners: Same material, thickness, and finish as exterior sheets; profile to suit system; shop cut and factory mitered to required angles.
- C. Expansion Joints: Same material, thickness and finish as exterior sheets; 22 gage, .0299 inch thick; manufacturer's standard brake formed type, of profile to suit system.
- D. Trim: Same material, thickness and finish as exterior sheets; brake formed to required profiles.
- E. Anchors: Galvanized steel.

2.3 MATERIALS

- A. Precoated Aluminum Sheet: ASTM B209, 3105 alloy, O temper, and smooth surface texture; continuous-coil-coated on exposed surfaces with specified finish coating and on panel back with specified panel back coating.

2.4 ACCESSORIES

- A. Sealants: Manufacturer's standard type suitable for use with installation of system; non-staining.
 - 1. Color: To be selected by Engineer.
- B. Fasteners: Manufacturer's standard type to suit application; with soft neoprene washers, steel, hot dip galvanized. Fastener cap same color as exterior panel.
- C. Field Touch-up Paint: As recommended by panel manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that building framing members are ready to receive panels.

3.2 PREPARATION

- A. Install sub girts perpendicular to panel length, securely fastened to substrates and shimmed and leveled to uniform plane. Space at intervals indicated.

3.3 INSTALLATION

- A. Install panels on soffits in accordance with manufacturer's instructions.
- B. Protect surfaces in contact with cementitious materials and dissimilar metals with bituminous paint. Allow to dry prior to installation.
- C. Fasten panels to structural supports; aligned, level, and plumb.
- D. Locate joints over supports. Lap panel ends minimum 2 inches.
- E. Provide expansion joints where indicated.
- F. Use concealed fasteners unless otherwise approved by Engineer.
- G. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.4 TOLERANCES

- A. Maximum Offset From True Alignment Between Adjacent Members Butting or In Line: 1/16 inch.

3.5 CLEANING

- A. Remove site cuttings from finish surfaces.
- B. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

SECTION 07 4214
INSULATED METAL WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Factory-assembled metal panel system for walls and soffits, with trim, related flashings and accessory components.

1.2 RELATED REQUIREMENTS

- A. Section 05 1200 - Structural Steel Framing: Structural steel building frame.
- B. Section 07 2100 - Thermal Insulation.
- C. Section 07 6200 - Sheet Metal Flashing and Trim.
- D. Section 07 8400 - Firestopping.

1.3 REFERENCE STANDARDS

- A. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- B. FM 4880 - Class 1 Fire Rating of Insulated Wall or Wall and Roof/Ceiling Panels, Interior Finish Materials or Coatings and Exterior Wall Systems; 2010.

1.4 SUBMITTALS

- A. Product Data: Provide manufacturer documentation on tested structural, thermal, and fire resistance capabilities of assembled panel.
- B. Shop Drawings: Indicate dimensions, panel profile and layout, joints, and construction details.
- C. Samples: Submit two samples of panel, 4 inches by 4 inches in size illustrating finish color, sheen, and texture.
- D. Design and Performance Data: Indicate panel profile and dimensions.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this Section with minimum 3 years experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Protect panels from accelerated weathering by removing or venting sheet plastic shipping wrap.
- B. Store pre-finished material off ground with weather protection to prevent twisting, bending, or abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- C. Prevent contact with materials that could cause discoloration or staining.

1.7 WARRANTY

- A. Submit Manufacturer's 40 year limited warranty on the exterior paint finish for adhesion to the metal substrate and 30 year limited warranty on the exterior paint finish for chalk and fade.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers:

1. Centria: www.centria.com.
2. Kingspan: www.kingspanpanels.us
3. Metl-Span, a Division of NCI Group, Inc: www.metlspan.com.
4. Or approved equal

2.2 PANEL SYSTEM

A. Metal Panel System: Factory-assembled metal panel system, with trim, related flashings and accessory components.

1. Provide all products by same manufacturer.
2. Provide positive drainage to exterior for moisture entering or condensation occurring within panel system.
3. Accommodate tolerances of building structural framing.
4. Provide continuity of thermal barrier at building enclosure elements.
5. Provide continuity of air barrier seal at building enclosure elements.

B. Performance Requirements:

1. Thermal Performance: When tested in accordance with ASTM C518, "measurement of steady state thermal transmission", the panels shall provide a K-factor of 0.14 btu/square feet/hour/°F at a 75°F mean temperature.
2. Structural Performance: Design and size to withstand all dead loads and wind loads caused by positive and negative wind pressure acting normal to plane of panel.
 - a. Verify structural performance in accordance with ASTM E330/E330M, using test pressure 1.5 times design wind pressure, with 10 seconds duration of maximum load.
 - b. Design Wind Loads: Calculated in accordance with applicable code.
3. Movement: Accommodate the movement caused by the following without damage to system, components, or deterioration of seals:
 - a. Normal movement between system components.
 - b. Seasonal temperature cycling.
 - c. Dynamic loading and release of loads.
 - d. Deflection of structural support framing,
 - e. Shortening of building concrete structural columns.
 - f. Creep of concrete structural members.

2.3 PANELS AND TRIM

- A. Architectural Wall Panels, Type IMP-1, 2, & 3: Exterior and interior metal sheet skin, factory-assembled, with foamed in place insulation; exterior and interior sheet interlocking at edges, fitted with continuous gaskets.
1. Panel Width: 30 inch and 24 inch - see exterior elevations.
 2. Profile: Flat; vertical panels.
 3. Panel Thickness: 3 inches.
 4. Core Material: Foamed-in-place polyurethane, FM Class 1
 5. Exterior Sheet: Pre-finished galvanized steel, 22 gage, 0.0299 inch minimum base metal thickness; stucco embossed.
 6. Interior Sheet: Galvanized steel, pre-finished, 26 gage, 0.0188 inch minimum base metal thickness.
 7. Panel Edge Profile: Tongue and groove, for flush seam.
 8. Fabricate panels in longest practicable lengths.
 9. Exterior Finish: Polyvinylidene fluoride (PVDF) coating; color as selected:
 - a. IMP-1: Color as selected by Engineer from manufacturer's standard range.
 - b. IMP-2: Color as selected by Engineer from manufacturer's standard range.
 - c. IMP-3: Color as selected by Engineer from manufacturer's standard range.
 10. Interior Finish: Polyvinylidene fluoride (PVDF) coating; color as selected from manufacturer's standard range.
- B. Soffit Panels: Same as wall panels.
- C. Fire-Resistant Panels, Type IMP-4: Exterior and interior metal sheet skin, factory-assembled, with mineral wool insulation; exterior and interior sheet interlocking at edges.
1. Profile: Manufacturer's standard; vertical panels.
 2. Panel Width: 42 inch, or manufacturer's standard.
 3. Panel Thickness: As required to achieve Fire Rating.
 4. Fire Rating: 2 hour.
 5. Core Material: Mineral wool.
 6. R-Value: 3.6 per inch.
 7. Exterior Sheet: Pre-finished galvanized steel, 22 gage, 0.0299 inch minimum base metal thickness; stucco embossed.
 - a. Color: As selected by Engineer from Manufacturer's standard range.
 8. Interior Sheet: Galvanized steel, pre-finished, 26 gage, 0.0188 inch minimum base metal thickness.
 - a. Color: As selected by Engineer from Manufacturer's standard range.
 9. Products:

- a. Metl-Span, ThermalSafe
 - b. Kingspan, MF
 - c. Centria, VersaShield MW
 - d. Or approved equal
- D. Internal and External Corners: Same material, thickness, and finish as exterior sheets; factory-fabricated mitered to required angles in one continuous piece with minimum 18 inches returns.
- E. Trim, Closure Pieces, Expansion Joints, Caps, Flashings, and Infills: Same material, thickness and finish as exterior sheets; factory-fabricated to required profiles; fabricated in longest practicable lengths.
1. Exposed Fasteners: Not permitted.

2.4 PANEL MATERIALS

- A. Gaskets: Manufacturer's standard type suitable for use with panel system, permanently resilient; ultraviolet and ozone resistant; color as selected.
- B. Panel Sealants: Manufacturer's standard type suitable for use with installation of panel system; non-staining, skinning, non-shrinking, non-sagging, ultra-violet and ozone resistant; color as selected.

2.5 ACCESSORIES

- A. Subgirts: As required for system design.
- B. Anchors: Galvanized steel.
- C. Field Touch-up Paint: As recommended by panel manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that structural framing is ready to receive panel system.

3.2 INSTALLATION

- A. Install panel system on walls and soffits in accordance with manufacturer's instructions.
- B. Permanently fasten panel system to structural supports; aligned, level, and plumb, within specified tolerances.
- C. Locate panel joints over supports and where indicated.
- D. Use concealed fasteners unless otherwise approved by Engineer.
- E. Seal and place gaskets to prevent weather penetration. Maintain neat appearance.

3.3 CLEANING

- A. Remove site cuttings from finish surfaces.
- B. Clean and wash prefinished surfaces with mild soap and water; rinse with clean water.

END OF SECTION

SECTION 07 4264
METAL COMPOSITE MATERIAL WALL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Exterior cladding consisting of formed metal composite material (MCM) sheet, secondary supports, and anchors to structure, attached to solid backup.
- B. Matching flashing and trim.

1.2 RELATED REQUIREMENTS

- A. Section 05 4000 - Cold-Formed Metal Framing: Panel support framing.
- B. Section 07 6200 - Sheet Metal Flashing and Trim: Metal flashing components integrated with this wall system.
- C. Section 07 9005 - Joint Sealants: Sealing joints between siding and adjacent construction and fixtures.

1.3 REFERENCE STANDARDS

- A. ASTM A36 - Standard Specifications for Carbon Structural Steel; 2014.
- B. ASTM A153 - Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM D523 - Standard Test Method for Specular Gloss; 2014.
- D. ASTM D1781 – Standard Test Method for Climbing Drum Peel for Adhesives; 1998 (Reapproved 2012).
- E. ASTM D1929 – Standard Test Method for Determining Ignition Temperature of Plastics; 2013a.
- F. ASTM D2244 - Standard Practice for Calculation of Color Differences from Instrumentally Measured Color Coordinates; 2011.
- G. ASTM D4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films; 2007.
- H. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.

1.4 SUBMITTALS

- A. Product Data - MCM Sheets: Manufacturer's data sheets on each product to be used, including thickness, physical characteristics, and finish, and:
 - 1. Finish manufacturer's data sheet showing physical and performance characteristics.
 - 2. Storage and handling requirements and recommendations.
 - 3. Fabrication instructions and recommendations.
 - 4. Specimen warranty for finish, as specified herein.

- B. Shop Drawings: Show layout and elevations, dimensions and thickness of panels, connections, details and location of joints, sealants and gaskets, method of anchorage, number of anchors, supports, reinforcement, trim, flashings, and accessories.
 - 1. Indicate panel numbering system.
 - 2. Differentiate between shop and field fabrication.
 - 3. Indicate substrates and adjacent work with which the wall system must be coordinated.
 - 4. Include large-scale details of anchorages and connecting elements.
- C. Verification Samples: For each finish product specified, minimum size 12 inches square, representing actual product in color and texture.
- D. Manufacturer's Qualification Statement.
- E. Installer's Qualification Statement.
- F. Maintenance Data: Care of finishes and warranty requirements.
- G. Executed Warranty: Submit warranty and ensure that forms have been completed in Contracting Authority's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Field Measurements: Verify actual dimensions by field measurement before fabrication; show recorded measurements on shop drawings.
- B. Wall System Manufacturer Qualifications: Company specializing in manufacturing products specified in this section.
 - 1. Approved by MCM sheet manufacturer.
- C. Installer Qualifications: Company specializing in performing work of the type specified in this section.
 - 1. Approved by wall system manufacturer.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products in manufacturer's original, unopened, undamaged containers with identification labels intact.
 - 1. Protect finishes by applying heavy duty removable plastic film during production.
 - 2. Package for protection against transportation damage.
 - 3. Provide markings to identify components consistently with drawings.
 - 4. Exercise care in unloading, storing and installing panels to prevent bending, warping, twisting and surface damage.
- B. Store products protected from exposure to harmful weather conditions and at temperature conditions recommended by manufacturer.
 - 1. Store in well ventilated space out of direct sunlight.
 - 2. Protect from moisture and condensation with tarpaulins or other suitable weather tight covering installed to provide ventilation.
 - 3. Store at a slope to ensure positive drainage of any accumulated water.

4. Do not store in any enclosed space where ambient temperature can exceed 120°F.
5. Avoid contact with any other materials that might cause staining, denting, or other surface damage.

1.7 WARRANTY

- A. MCM Sheet Manufacturer's Finish Warranty: Provide manufacturer's written warranty stating that the finish will perform as follows for minimum of 5 years:
 1. Chalking: No more than that represented by a No.8 rating based on ASTM D4214.
 2. Color Retention: No fading or color change in excess of 5 Hunter color difference units, calculated in accordance with ASTM D2244.
 3. Gloss Retention: Minimum of 30% gloss retention, when tested in accordance with ASTM D523.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Metal Composite Material Sheet Manufacturers:
 1. 3A Composites USA; Alucobond: www.alucobondusa.com.
 2. Alcoa, Inc; Reynobond: www.alcoa.com.
 3. Centria: www.centria.com.
 4. Or approved equal

2.2 MATERIALS

- A. Metal Composite Material (MCM) Sheet: 2 sheets of aluminum sandwiching a solid core of extruded thermoplastic material formed in a continuous process with no glues or adhesives between dissimilar materials; core material free of voids and spaces; no foamed insulation material content.
 1. Overall Sheet Thickness: 4 mm, minimum.
 2. Face Sheet Thickness: 0.019 inch, minimum.
 3. Alloy: Manufacturer's standard, selected for best appearance and finish durability.
 4. Bond and Peel Strength: No adhesive failure of the bond between the core and the skin nor cohesive failure of the core itself below 22.4 inch-pound per inch with no degradation in bond performance, when tested in accordance with ASTM D1781, simulating resistance to panel delamination, after 8 hours of submersion in boiling water and after 21 days of immersion in water at 70°F.
 5. Surface Burning Characteristics: Flame spread index of 25, maximum; smoke developed index of 450, maximum; when tested in accordance with ASTM E84.
 6. Flammability: Self-ignition temperature of 650°F or greater, when tested in accordance with ASTM D1929.
 7. Factory Finish: One coat fluoropolymer resin coating, approved by the coating manufacturer for the length of warranty specified for the project, and applied by coil manufacturing facility that specializes in coil applied finishes.
 8. Color/Texture: As selected by Engineer from manufacturer's full range.

- B. Flashing: Sheet aluminum; 0.040 inch thick, minimum; finish and color to match MCM sheet.
- C. Anchors, Clips and Accessories: Use one of the following:
 - 1. Steel complying with ASTM A36/A36M and hot-dipped galvanized to ASTM A153/A153M.
- D. Joint Sealer: Clear silicone sealant approved by MCM sheet manufacturer.
- E. Provide panel system manufacturer's and installer's standard corrosion resistant accessories, including fasteners, clips, anchorage devices and attachments.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify dimensions, tolerances, and interfaces with other work.
- B. Verify substrate on-site to determine that conditions are acceptable for product installation in accordance with manufacturers written instructions.
- C. If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

3.2 PREPARATION

- A. Protect adjacent work areas and finish surfaces from damage during installation.

3.3 INSTALLATION

- A. Do not install products that are defective, including warped, bowed, dented, and broken members, and members with damaged finishes.
- B. Comply with instructions and recommendations of MCM sheet manufacturer and wall system manufacturer, as well as with approved shop drawings.
- C. Install wall system securely allowing for necessary thermal and structural movement; comply with wall system manufacturer's instructions for installation of concealed fasteners.
- D. Do not handle or tool products during erection in manner that damages finish, decreases strength, or results in visual imperfection or failure in performance. Return component parts that require alteration to shop for refabrication, if possible, or for replacement with new parts.
- E. Do not form panels in field unless required by wall system manufacturer and approved by the Engineer; comply with MCM sheet manufacturer's instructions and recommendations for field forming.
- F. Separate dissimilar metals; use gasket fasteners, isolation shims, or isolation tape where needed to eliminate possibility of electrolytic action between metals.
- G. Install flashings as indicated on shop drawings At flashing butt joints, provide a lap strap under flashing and seal lapped surfaces with a full bed of non-hardening sealant.
- H. Install square, plumb, straight, and true, accurately fitted, with tight joints and intersections maintaining the following installation tolerances:
 - 1. Variation From Plane or Location: 1/2 inch in 30 feet of length and up to 3/4 inch in 300 feet, maximum.
 - 2. Deviation of Vertical Member From True Line: 0.1 inch in 25 feet run, maximum.
 - 3. Deviation of Horizontal Member From True Line: 0.1 inch in 25 feet run, maximum.

4. Offset From True Alignment Between 2 Adjacent Members Abutting End To End, In Line:
0.03 inch, maximum.

- I. Replace damaged products.

3.4 CLEANING

- A. Ensure weep holes and drainage channels are unobstructed and free of dirt and sealants.
- B. Remove protective film after installation of joint sealers, after cleaning of adjacent materials, and immediately prior to completion of work.
- C. Remove temporary coverings and protection of adjacent work areas.
- D. Clean installed products in accordance with manufacturer's instructions.

3.5 PROTECTION

- A. Protect installed panel system from damage during construction.

END OF SECTION

**SECTION 07 5323
ETHYLENE-PROPYLENE-DIENE-MONOMER
ROOFING - FULLY ADHERED**

PART 1 GENERAL

1.1 WORK INCLUDES

- A. Thermal Board
- B. Rigid Insulation
- C. Elastomeric sheet roofing attached with adhesive.
- B. Membrane Flashings.
- C. Other accessories as required.
- D. Membrane Manufacturer's Warranty.

1.2 REFERENCES

- A. ASTM D412 - Test Methods for Rubber Properties in Tension.
- B. ASTM D471 - Test Method for Rubber Property - Effect of Liquids.
- C. ASTM D573 - Test Method for Rubber - Deterioration in an Air Oven.
- D. ASTM D624 - Test Method for Rubber Property - Tear Resistance.
- E. ASTM D746 - Test Method for Brittleness Temperature of Plastics and Elastomers by Impact.
- F. ASTM D816 - Methods of Testing Rubber Cements.
- G. ASTM D1149 - Test Method for Rubber Deterioration - Surface Ozone Cracking in a Chamber (Flat Specimens).
- H. ASTM D1204 - Test Method for Linear Dimensional Changes of Nonrigid Thermoplastic Sheet or Film at Elevated Temperature.
- I. ANSI/UL 790 - Tests for Fire Resistance of Roof Covering Materials.
- J. FM 1-49 - Factory Mutual Loss Prevention Data-Perimeter Flashing.
- K. NRCA - NRCA Roofing and Waterproofing Manual.

1.3 SYSTEM DESCRIPTION

- A. Fully-adhered 60-mil thick EPDM (ethylene propylene diene monomer) membrane meeting the requirements of Underwriters Laboratories Class A Fire Resistance Rating for the installed slope.
- B. Roofing System Design: Provide a membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE / SE/7.
 - 1. Field-of-Roof Uplift Pressure: 31.1 pounds per square feet.
 - 2. Perimeter Uplift Pressure: 52.2 pounds per square feet.
 - 3. Corner Uplift Pressure: 78.5 pounds per square feet.

1.4 SUBMITTALS

- A. All submittals shall be subject to the Engineer's review and approval.
- B. Manufacturer's Product Data
 - 1. Most recent copy of manufacturer's literature applicable to products and specifications to be used, including material characteristics, test data, installation recommendations, material safety data sheet (MSDS), and complete flashing details of system. MSDS sheets shall be submitted directly to the Engineer.
 - 2. Specimen copy of manufacturer's warranty.
- C. Manufacturer's Installation Instructions

1. Most recent copy of manufacturer's installation instructions for applicators detailing products and specifications to be used, including procedures for installation of membrane and flashing.
- D. Manufacturer's Certificates
1. Copy of completed contractor's application form for manufacturer's warranty to be submitted to the Engineer at the same time as original is submitted to the membrane manufacturer.
 2. Copy of the contractor-submitted manufacturer's warranty form approved by the manufacturer. Note: The Contractor will not be permitted to start work until the approved warranty form is submitted to the Engineer.
- E. Shop Drawings
1. Roof Plan and Details: By submittal of a bid for this project, the contractor certifies that the project plans and specifications have been reviewed, and that the proposed roof system will be installed in accordance with these plans and specifications. If, after award of contract and upon review of existing field conditions, the contractor wishes to modify the roof plans and/or details, the proposed change shall be submitted as a shop drawing for review by the Engineer.
 2. Roof Insulation: Reference Section 07 2200 - Roof and Deck Insulation for requirements.
 3. Sheet Metal Fabrication: Reference Section 07 6200 – Sheet Metal Flashing and Trim for requirements.
- F. Samples
- G. Manufacturer's Field Services and Reports

1.5 QUALITY ASSURANCE

- A. Applicator shall be certified by manufacturer to install specified products.
- B. The entire installation of roofing, insulation, flashing and sheet metal work shall be of the quality required for acceptance by the membrane manufacturer to obtain the warranty specified in this section.
- C. Comply with the requirements of the regulatory agencies as specified herein.
- D. As an approved applicator, all items required by the membrane manufacturer in the installation of the manufacturer's system will be included in the work.
- E. The roofing contractor shall assure that all roofing materials (i.e., membrane, insulation, fasteners, asphalt, adhesives, sealants, etc.) are compatible with each other and the substrates which they will be in contact with.

1.6 QUALIFICATIONS

- A. Applicator/Installer shall have the following qualifications:
 1. Company specializing in performing the work of this section with a minimum of 5 years documented experience.
 2. Company certified by the membrane manufacturer for a minimum of 3 years as an approved applicator of the products specified in this section.
 3. Company having workers trained by the membrane manufacturer. These trained workers shall perform the work.
 4. Company eligible to receive a manufacturer's warranty.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store materials according to manufacturer's recommended procedures.
- B. Deliver materials in sufficient quantity to allow continuity of work.

- C. Coordinate delivery of materials with Contracting Authority so that minimal interruption of Contracting Authority's operations occurs.
- D. Materials shall be stored in their original, tightly sealed containers or unopened packages, and shall be clearly labeled with the manufacturer's brand name and such identifying reference numbers as are appropriate. Deliver materials to job site on pallets. Do not stack pallets.
- E. Materials shall be stored in a neat, safe manner, so as not to exceed allowable live load of the storage area. Contractor shall not load pallets of material onto the roof deck without approval from the Engineer prior to loading. Disperse materials on roof deck to avoid concentrated loading.
- F. Store materials in dry, protected areas in an upright position. Control temperature of storage areas in accordance with manufacturer's instructions. Protect materials from freezing.
- G. Follow manufacturer's guidelines for required temperatures of material prior to application.
- H. Any materials damaged in handling or storage are not to be used.
- I. The Contractor shall assume full responsibility for the protection and safekeeping of materials stored on Contracting Authority's premises.
- J. Store roll goods on ends only. Discard rolls which have been flattened, creased, or otherwise damaged.
- K. Remove wet material from project site.
- L. Comply with fire and safety regulations.
- M. Splice cleaner and bonding adhesives are extremely flammable. Do not use near fire or flame or in unventilated areas. Dispense from UL approved containers and consult material safety data sheets for specific information.
- N. Do not allow EPDM membrane to come into direct contact with steam or steam source.
- O. Installation may continue in cold weather provided adhesives and sealants are stored at room temperature prior to application and used within a 4-hour period after being brought to the roof if approved by the manufacturer.

1.8 JOB CONDITIONS

- A. Apply roofing in dry weather.
- B. If the newly constructed roof or existing insulation becomes wet due to rainstorms, faulty water cutoffs, or other reasons, the Contractor shall remove and dispose of all wet materials, dry the affected roof area, and reconstruct the roof in accordance with these specifications at no cost to the Contracting Authority.
- C. All bonding, splicing and sealing surfaces must be free of dirt, moisture and any other contaminants.
- D. The roof surface shall be free of ponded water, ice, snow, or algae prior to installing the new roof system.
- E. Ensure roof deck is structurally sound to support construction traffic. Notify Engineer immediately of any conditions that are not structurally sound.

1.9 WARRANTY

- A. Provide to the Contracting Authority the membrane manufacturer's 25 Year No-Dollar Limit Total Roof System Material and Workmanship Warranty effective from the date of final acceptance by the Contracting Authority.

PART 2 PRODUCTS

2.1 APPROVED EQUIVALENT

- A. Contractor shall submit to the Engineer a minimum of 5 days prior to the bid date any product not specified in order for product to be considered for approval. The Engineer will notify Contractor, in writing, of decision to accept or reject request.

2.2 ELASTOMERIC SHEET ROOFING

- A. EPDM Roofing Membrane 0.060 inch, Black, Non-Reinforced.
1. Membrane shall be installed with 6 inches seams.
 2. Membrane shall have 6 inches factory applied seam tape.
 3. Twenty foot wide rolls of EPDM membrane shall be used where ever possible to minimize seams. Provide membrane sheet layout submittal.
 4. Acceptable Manufacturers
 - a. Carlisle SynTec Systems
 - b. Versico Roofing Systems
 - c. Firestone Building Products
 - d. Or approved equal
- B. Requirements
1. Roofing system is classified by Underwriters Laboratories to meet the requirements of Class "A" Fire Resistance.
 2. Roofing system is classified by Factory Mutual to meet the requirements of FRMRC Windstorm Resistance Classifications listed in Section 1.03.B.
 3. Physical Properties
 - a. Thickness, Min., 0.060 inches $\pm 10\%$, ASTM D412
 - b. Tensile Strength, Min., 1305 psi ASTM D412 Die C
 - c. Elongation, Ultimate, Min., 300% ASTM D412
 - d. Tensile Set, Max. 50% Elongation ASTM D412 10
 - e. Tear Resistance, Min., 150 pounds per inch ASTM D624 Die C
 - f. Brittleness Point, Max. -49°F ASTM D746
 - g. Linear Dimensional Change, Max. $\pm 2\%$ ASTM D1204
 - h. Ozone Resistance ASTM D1149 No Cracks
 - i. Heat Aging, Min., 1205psi ASTM D573
 - j. Water Absorption, Max. Mass. +8 to -2% ASTM D471
 - k. Factory Seam Strength ASTM D816 Sheet Failure or 50 pounds per inch min.
- C. Related Materials
1. Uncured EPDM Flashing: As recommended and furnished by the manufacturer.
 2. Cured Flashing Membrane: As recommended and furnished by the manufacturer.
 3. Bonding Adhesive: Compatible with materials as recommended by the manufacturer.
 4. Splicing Material: Liquid type cement or rubber-to-rubber tape self-vulcanizing, metal-to-rubber tape non-vulcanizing.
 5. Splice Cleaner: Furnished by the membrane manufacturer.
 6. Seam Tape: Furnished by the membrane manufacturer.
 7. Lap Sealant: Compatible with materials as recommended by the manufacturer. Trowel as required by the manufacturer.
 8. In-seam Sealant: Compatible with materials as recommended by the manufacturer. Install according to manufacturer's instructions.
 9. Water Cutoff Mastic: Compatible with materials as recommended by the manufacturer.
 10. Factory Molded Pipe Flashing: Configuration as required and compatible with materials as recommended by the manufacturer.
 11. Night Seal: Compatible with materials as recommended by the manufacturer.
 12. Lap Primer: Compatible with materials as recommended by the manufacturer.

13. Securement Strips: Type and configuration as recommended by the manufacturer.
14. Nailing strips: Use extruded nailing strips and fasteners as recommended by the manufacturer.
15. Mechanical Fasteners and Plates: As recommended by the membrane manufacturer.
16. Walkway Pads: As recommended and furnished by the membrane manufacturer.

PART 3 EXECUTION

3.1 PRE-INSTALLATION CONFERENCE

- A. Prior to the start of roofing work, a meeting will be held at the job site for the purpose of reviewing materials, methods and procedures to facilitate proper and timely construction of the roofing system.

3.2 REFERENCE

- A. The current product specification guide published by the membrane manufacturer shall be considered part of this specification and shall be referred to for more specific application procedures regarding roofing insulation, membrane and base flashing. When a difference between this specification and the manufacturer's product specification guide is encountered, the provision which is most stringent shall govern.

3.3 INSPECTION OF SURFACES

- A. Examine surfaces for adequate anchorage, foreign materials, moisture, and other conditions which would adversely affect the roofing application and performance.
- B. The roofing contractor shall be responsible for preparing adequate surfaces to receive insulation, roofing, and flashing.

3.4 APPLICATION - GENERAL

- A. Install in accordance with the accepted roofing manufacturer's written specifications and recommended details now on file in the Engineer's office.
- B. Protect building wall area with tarpaulins or other durable materials at staging and kettle areas.
- C. Roof surfaces shall be thoroughly dry before application of roofing.
- D. Inspection of the roofing shall be made by a responsible representative of the roofing manufacturer during application and after completion.
- E. Roofing insulation shall be dry when installed and shall be protected from the weather during installation. All materials which become wet shall be removed and replaced with new dry materials.
- F. Membrane shall be installed over membrane manufacturer approved insulation. Install recovery board as required by the membrane manufacturer although details on the plans may not show it.
- G. When application of roofing is begun, the total roofing system in that area shall be completed before the end of the day and before being wet by the elements.
- H. Install temporary water cutoffs at the completion of each day's work and remove upon resumption of the work. Any leaks and damage due to insufficient water cutoffs shall be repaired by the Contractor at no cost to the Contracting Authority.
- I. Precautions shall be taken to protect the membrane from puncture.
- J. If materials are stored on the roof, the materials will be protected from the existing roof.
- K. Special care will be taken to prevent distress on the building structure when handling materials for the project.

3.5 SEQUENCING/SCHEDULING

- A. Notify the Engineer 24 hours before the first day of construction.
- B. Install all base flashing and/or fascia system fasteners and metal work, at least throughout the anticipated working area, as soon as possible after roofing application.
- C. Complete all specified carpentry and wood component installations, at least throughout the anticipated working area, as soon as possible after any roofing application.

3.6 MEMBRANE INSTALLATION

- A. Fully adhere the EPDM membrane to the acceptable substrate with bonding adhesive at the rate specified by the manufacturer.
- B. Option 1 - Overlap adjacent EPDM membrane sheets a minimum of 6 inches and clean the splice area with Splice Cleaner. Apply splicing cement at the rate specified by the manufacturer. If required by the manufacturer, prior to closing the splice, apply a bead of In-Seam Sealant no less than 1/8 inch and no more than 1/4 inch in diameter a minimum of 1/2 inch from the inside edge of the bottom membrane sheet and a minimum of 2 inches from the lead edge. After adjoining membrane sheets have been spliced together, wait a minimum of 2 hours and clean the exposed edge of the splice with Splice Cleaner and apply a 5/16-inch diameter bead of Lap Sealant. Feather the Lap Sealant to completely cover the splice edge.
- C. Option 2 - The membrane manufacturer's seam tape may be used to splice adjacent membrane sheets. Overlap adjacent EPDM membrane sheets a minimum of 6 inches and fold back top membrane as required to receive the seam tape. Clean the splice area with splice cleaner. Apply primer at the rate specified by the manufacturer. Apply seam tape so that a minimum of 1/8 inch, but no more than 1/2 inch of tape, is protruding from the finished seam. Install cover pieces as required at all T-joints and overlaps.

3.7 ADDITIONAL MEMBRANE SECUREMENT

- A. The EPDM membrane must be secured at the perimeter of each roof level, roof section, expansion joint, curb, skylight, interior wall, penthouse, etc., at any angle change which exceeds 2 inches in one horizontal foot, and at other penetrations in accordance with details published with manufacturer's specifications. The additional membrane securement may be provided by reinforced securement strip, seam fastening plates, or batten strip.

3.8 MEMBRANE FLASHING

- A. When feasible, flash all penetrations and walls with cured EPDM membrane. Uncured EPDM flashing shall be limited to overlay vertical seams (as required on angle changes) or flash inside and outside corners, scuppers, pourable sealer pockets and other penetrations or unusually shaped walls where the use of cured membrane flashing is not practical. Manufacturer's prefabricated accessories (Premolded Pipe Boots and Pressure-Sensitive Products such as Pourable Sealer Pockets, Pipe Boots, flashing and Inside-Outside Corners) should be used, when feasible, in lieu of uncured EPDM Flashing. Terminate the flashing in accordance with an appropriate manufacturer's Termination Detail.
- B. Install flashing in accordance with the details shown on the plans or with the manufacturers published standards whichever is more stringent.
- C. All perimeter flashings shall conform to Factory Mutual (FM) Loss Prevention Data Sheet 1-49.
- D. Curb and parapet flashings shall be fastened at top at 6 inches o.c. with 1 inch diameter cap nails.
- E. All flashing materials shall be 100% bonded to walls, curbs, edges, and other surfaces being flashed.

- F. All raised flashings shall be a minimum of 8 inches above the surface of the finished roof surface.
- G. All raised flashings shall have a counterflashing.

3.9 ROOF DRAINS

- A. These specifications apply for installation of cast iron drains only. For all other drain types follow membrane manufacturer's recommendations.
 - 1. Roofing contractor shall be responsible for modifying existing drain assemblies for new roof installation, including, but not limited to, lowering drain assembly, modifying leaders, etc. so that there is positive drainage of water around drain.
 - 2. Remove all existing flashing (including lead flashings), roofing materials and cement from the existing drain in preparation for membrane and water cut-off mastic.
 - 3. Provide a clean even finish on the mating surfaces between the clamping ring and the drain bowl.
 - 4. Provide tapered insulation sump at all drains (reference Section 07 2200). Taper insulation around the drain to provide a smooth transition from the roof surface to the drain. Slope shall not exceed 4 inches per foot. Drain sump shall be lower than adjoining area.
 - 5. Position the membrane, then cut a hole for the roof drain. Allow a 1 inch minimum inside the clamping ring.
 - 6. Make round holes in the EPDM membrane to align with clamping bolts. Do not cut the membrane back to the bolt holes.
 - 7. Place water cut-off mastic on the clamping ring seat flange below the membrane.
 - 8. Install the roof drain clamping ring and clamping bolts. Tighten the clamping bolts to achieve constant and uniform compression. Replace any damaged, broken, or missing clamping rings or bolts with new to match existing drain design. New bolts shall be brass or stainless steel. Drill and tap broken drain bolts as required for installation of replacement bolts.
 - 9. Replace any damaged, broken, or missing drain grates with new. New grates shall be metal.
 - 10. Seams in membranes shall be kept 18 inches away from drains.
 - 11. Seal between the membrane and the drain base shall be watertight.
 - 12. Roof drains are to be checked and made operational at the conclusion of the roof construction activities.

3.10 OTHER RELATED WORK

- A. Walkways are required at all traffic concentration points (i.e., roof hatches, access doors, rooftop ladders, etc.), regardless of traffic frequency. Walkways are also required if regular maintenance (once a month or more) is necessary to service rooftop equipment.
- B. Walkway Pads/Rolls must be adhered to the EPDM membrane with splicing cement. When concrete pavers are used, they shall be loose laid and installed in conjunction with a slip sheet of cured EPDM membrane.
- C. Copings, counterflashings and other metal work shall be fastened to prevent the metal from pulling free of buckling and sealed to prevent moisture from entering the roofing system or building.

3.11 PROTECTION OF APPLIED ROOFING

- A. Protection Against Moisture Absorption: When precipitation is imminent and at the end of each day's work, provide protection as follows:
 - 1. Water cut-offs

- a. Water cutoffs shall be installed to prevent water from flowing beneath the roof system during inclement weather.
 - b. The roof membrane shall be extended at least 2 feet over the last row of insulation (where applicable) and a continuous layer of sealant applied onto the substrate a minimum of 10 inches from the membrane edge. Mating surfaces must be smooth, clean and free of any loose foreign material.
 - c. Firmly embed roof membrane into sealant and provide continuous pressure over the length of the cutoff by using sufficient ballast.
 - d. Where applicable, use asphaltic bitumen and strip off roof membrane for tie off. When the existing roof is not being removed, gravel surfacing shall be spudded completely off the felts a minimum of 6 feet for the cutoff seal.
- B. Temporary Walkways, Runways and Platforms
- 1. Do not permit storing, walking, wheeling, or trucking directly on applied materials.
 - 2. Provide temporary walkways, runways, and platforms of smooth clean board or planks as necessary to avoid damage to applied roofing materials, and to distribute weight to conform to indicated live load limits of roof construction.
 - 3. Use rubber-tired equipment for roofing work.
- C. Damaged Work
- 1. Restore work damaged during construction to original condition or replace with new materials.

3.12 SHEET METAL WORK (REFERENCE SECTION 07 6200)

- A. Counterflashings, copings and other perimeter or penetration metal work shall be properly fastened and sealed by the roofing contractor or others, and it shall be their responsibility to maintain this work in a watertight condition. Care should be taken to assure the membrane is not in contact with sharp edges and is not unsupported in an area greater than 1/4 inch.

3.13 TEST CUTS

- A. Provide test cuts when requested by Engineer of completed roof system. Test cuts shall be provided to Engineer.

3.14 MANUFACTURER'S WARRANTY INSPECTIONS

- A. After the work has started, an inspection shall be made by a field technical representative of the membrane manufacturer. The representative shall review materials, methods, and procedure to facilitate proper and timely construction of the roofing system. Upon completion of the inspection the Contractor shall submit the Engineer a written report of the field technical representative's findings.
- B. Upon completion of the installation, an inspection shall be made by a field technical representative of the membrane manufacturer to ascertain that the roofing system has been installed according to the manufacturer's current published specifications. Upon completion of the inspection, the Contractor shall submit to the Engineer a written report of the field technical representative's findings.

END OF SECTION

SECTION 07 6200
SHEET METAL FLASHING AND TRIM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fabricated sheet metal items, including flashings and counterflashings.

1.2 RELATED REQUIREMENTS

- A. Section 04 2000 - Unit Masonry: Metal flashings embedded in masonry.
- B. Section 06 1000 - Rough Carpentry: Wood nailers.
- C. Section 07 9005 - Joint Sealers.

1.3 REFERENCE STANDARDS

- A. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels; 2013.
- B. ASTM A666 – Standard Specifications for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2010.
- C. ASTM B32 - Standard Specifications for Solder Metal; 2008.
- D. ASTM B209 – Standard Specifications for Aluminum and Aluminum –Alloy Sheet and Plate; 2014.
- E. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2012.

1.4 SUBMITTALS

- A. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.
 - 1. Identification of material, thickness, weight, and finish for each item and location in Project.
 - 2. Details for forming sheet metal flashing and trim, including profiles, shapes, seams, and dimensions.
 - 3. Details for joining, supporting, and securing sheet metal flashing and trim, including layout of fasteners, cleats, clips, and other attachments. Include pattern of seams.
 - 4. Details of termination points and assemblies, including fixed points.
 - 5. Details of expansion joints and expansion-joint covers, including showing direction of expansion and contraction.
 - 6. Details of edge conditions and counterflashings as applicable.
 - 7. Details of special conditions.
 - 8. Details of connections to adjoining work.
 - 9. Detail formed flashing and trim at a scale of not less than 3 inches per 12 inches (1:4).
- B. Samples: Submit 2 samples 3 inches by 3 inches in size illustrating metal finish color.

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

1.5 QUALITY ASSURANCE

- A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.
- B. Permanent Installation Tests for Water Infiltration: Test installations for water infiltration using AAMA 502 and ASTM E 1105 (water penetration) as guidelines. Water tests will be performed using a Monarch B-25 Nozzle. Deficiencies include uncontrolled water leakage, unsatisfactory workmanship. If deficiencies are found, repair or modify and retest until satisfactory results are obtained.
 - 1. Water penetration testing of completed roof and wall flashing, and penetrations including; through-wall flashing, expansion joints, roof-edge flashing, coping cap, joint-style lap joint, sealant joints, soldered joints, pipe/post counter-flashing, roof penetration flashing, and others joints or seams not identified. Intent is to perform in place testing of various types of penetrations.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Stack material to prevent twisting, bending, and abrasion, and to provide ventilation. Slope metal sheets to ensure drainage.
- B. Prevent contact with materials that could cause discoloration or staining.

PART 2 PRODUCTS

2.1 SHEET MATERIALS

- A. Pre-Finished Aluminum: ASTM B209; 0.032 inch thick; plain finish shop pre-coated with modified silicone coating.
 - 1. Modified Silicone Polyester Coating: Pigmented Organic Coating System, AAMA 2603; baked enamel finish system.
 - 2. Color: As selected by Engineer from manufacturer's full colors.
- B. Stainless Steel: At thru wall flashing ASTM A666 Type 304, soft temper, 0.015 inch thick; smooth No. 4 finish.

2.2 ACCESSORIES

- A. Fasteners: Stainless steel, with soft neoprene washers.
- B. Underlayment: Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.
 - 1. Thermal Stability: ASTM D 1970; stable after testing at 240°F.
 - 2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20°F.
 - 3. Products: Subject to compliance with requirements, provide one of the following:
 - a. Carlisle Coatings & Waterproofing Inc.; CCW WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.; Ultra.

- c. Henry Company; Blueskin PE200 HT.
 - d. Metal-Fab Manufacturing, LLC; MetShield.
 - e. Owens Corning; WeatherLock Metal High Temperature Underlayment.
 - f. Or approved equal
- C. Slip Sheet: Rosin sized building paper.
- D. Primer: Zinc chromate type.
- E. Sealant Tape: Pressure-sensitive, 100% solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch wide and 1/8 inch thick.
- F. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; low modulus; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.
- G. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type expansion joints with limited movement.
- H. Epoxy Seam Sealer: 2 part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.
- I. Through-Wall Sheet Metal Flashing: Manufacture through-wall flashing with snaplock receiver on exterior face to receive counterflashing.
- 1. Stainless Steel: 0.016 inch thick.
 - 2. Accessories:
 - a. Counterflashing Wind-Restraint Clips: Provide clips to be installed before counterflashing to prevent wind uplift of counterflashing lower edge.
 - 3. Finish: Mill.
- J. Plastic Cement: ASTM D4586, Type I.

2.3 FABRICATION

- A. Form sections true to shape, accurate in size, square, and free from distortion or defects.
- B. Form pieces in longest possible lengths.
- C. Hem exposed edges on underside 1/2 inch; miter and seam corners.
- D. Form material with flat lock seams, except where otherwise indicated. At moving joints, use sealed lapped, bayonet-type or interlocking hooked seams.
- E. Tin edges to be soldered. Solder shop formed metal joints. After soldering, remove flux. Wipe and wash solder joints clean. Weather seal joints.
- F. Fabricate corners from 1 piece with minimum 18 inches long legs; seam for rigidity, seal with sealant.
- G. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify roof openings, curbs, pipes, sleeves, ducts, and vents through roof are solidly set, reglets in place, and nailing strips located.
- B. Verify roofing termination and base flashings are in place, sealed, and secure.

3.2 PREPARATION

- A. Install starter and edge strips, and cleats before starting installation.
- B. Back paint concealed metal surfaces with protective backing paint to a minimum dry film thickness of 15 mil.

3.3 INSTALLATION

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

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40°F and 70°F, set joint members for 50% movement each way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40°F.
 2. Prepare joints and apply sealants to comply with requirements of manufacture guidelines.
- F. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1 1/2 inches, except reduce pre-tinning where pre-tinned surface would show in completed Work.
1. Do not solder metallic-coated steel sheet.
 2. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.
 3. Stainless-Steel Soldering: Tin edges of uncoated sheets using solder recommended for stainless steel and acid flux. Promptly remove acid flux residue from metal after tinning and soldering. Comply with solder manufacturer's recommended methods for cleaning and neutralization.
- G. Secure flashings in place using concealed fasteners.
- H. Apply plastic cement compound between metal flashings and felt flashings.
- I. Fit flashings tight in place. Make corners square, surfaces true and straight in planes, and lines accurate to profiles.
- J. Seal metal joints watertight.
- 3.4 FIELD QUALITY CONTROL
- A. Inspection will involve surveillance of work during installation to ascertain compliance with specified requirements.

END OF SECTION

**SECTION 07 8205
BOARD AND BLANKET FIREPROOFING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Board fireproofing for structural members.

1.2 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping: Except firestopping installed in conjunction with duct fireproofing.

1.3 REFERENCE STANDARDS

- A. ASTM C612 - Standard Specifications for Mineral Fiber Block and Board Thermal Insulation; 2014.
- B. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2014.
- C. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials; 2014.
- D. UL (DIR) - Online Certifications Directory; current listings at database.ul.com.

1.4 SUBMITTALS

- A. Test Reports: Show compliance with specified test requirements; listing cards or sheets provided by UL will be considered sufficient substantiation; provide full reports from other agencies.
- 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.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store products under cover and elevated above grade.
- C. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.6 FIELD CONDITIONS

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

PART 2 PRODUCTS

2.1 FIREPROOFING APPLICATIONS

- A. Provide completed fire resistance rated assemblies identical in materials and construction to those tested for fire resistance.

- B. Columns: Use mineral fiber board fireproofing.
 - 1. Hourly Rating: 1 hour and 2 hour, see drawings for locations.
 - 2. Conform to UL Assembly Design No. X309.
- C. Beams: Use mineral fiber board fireproofing.
 - 1. Hourly Rating: 1 hour and 2 hour, see drawings for locations.
 - 2. Conform to UL Assembly Design No. S301.

2.2 BOARD FIREPROOFING

- A. Mineral Fiber Board Fireproofing: Light weight, semi-rigid, asbestos-free, non-cementitious, completely inorganic boards complying with ASTM C612 with thermal resistivity sufficient to perform acceptably in specified applications; capable of being field-installed using ordinary tools and screws or pins.
 - 1. Fire Resistance at Rated Assemblies: Tested by independent testing agency in accordance with ASTM E119 for specific hourly-rated assembly indicated.
 - 2. Thickness: As shown on drawings, and as required to achieve fire ratings indicated.
 - 3. Surface Burning Characteristics: Flame spread index of 0 when tested in accordance with ASTM E84.
 - 4. Combustibility: Noncombustible, when tested in accordance with ASTM E136.
 - 5. Surface Finish: None.
 - 6. Manufacturers:
 - a. Johns Manville: www.jm.com.
 - b. Roxul, Inc: www.roxul.com
 - c. Albi Manufacturing, Division of StanChem, Inc.; www.albi.com
 - d. Isolatek International: www.cafco.com
 - e. Or approved equal
- B. Fasteners: As required by applicable fire rated design.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Do not begin installation until substrates have been properly prepared.
- B. Do not install until members and construction to be protected have been completed, ancillary work that needs to be covered by fireproofing has been completed, and the need for subsequent cutting and patching of fireproofing has been eliminated.

3.2 PREPARATION

- A. Clean surfaces thoroughly prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.

3.3 BOARD FIREPROOFING INSTALLATION

- A. Minimize the amount of time that structural members are exposed without fireproofing.
- B. Install in strict accordance with manufacturer's instructions, conditions of testing, and as indicated on the drawings.
- C. Fasten fireproofing using insulation pins welded directly to surface of substrate or manufacturer's proprietary fasteners; do not use adhesives.
- D. Ensure that no gaps or cracks in fireproofing exist that would impair fire resistance of separation.
- E. Coordinate with related fireproofing work.
- F. Finish exposed board with joint tape and joint compound covering fastener heads and accessories; apply thin skim coat of joint compound over entire surface; touch-up and sand to produce a smooth surface ready for decoration.

3.4 INSPECTION AND LABELING

- A. Do not enclose or cover fireproofing work until it has been inspected by authorities having jurisdiction.
- B. After completion of installation label major fireproofing surfaces with permanent, red marking in the words "Fire Resistant Barrier - Do Not Remove" or equivalent as approved by authorities having jurisdiction.

3.5 PROTECTION

- A. Avoid unnecessary exposure of fireproofing to abrasion and other damage likely to occur during subsequent construction operations.
- B. Minimize cutting and patching of fireproofing; repair or replace fireproofing removed to accomplish other work; maintain required full thickness of fireproofing on all members and substrates.
- C. Protect installed products until completion of project.
- D. Touch-up, repair or replace damaged products before Date of Substantial Completion.

END OF SECTION

**SECTION 07 8400
FIRESTOPPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Firestopping systems.
- B. Firestopping of all joints and penetrations in fire resistance rated and smoke resistant assemblies, and other openings indicated.

1.2 RELATED REQUIREMENTS

- A. Section 09 2116 - Gypsum Board Assemblies: Gypsum wallboard fireproofing.

1.3 REFERENCE STANDARDS

- A. ASTM E814 - Standard Test Method for Fire Tests of Penetration Firestop Systems; 2013a.
- B. ASTM E1966 - Standard Test Method for Fire Resistive Joint Systems; 2007 (Reapproved 2011).
- C. ASTM E2307 - Standard Test Method for Determining Fire Resistance of Perimeter Fire Barriers Using Intermediate-Scale, Multi-story Test Apparatus; 2015a.
- D. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; 2013.
- E. UL 2079 - Standard for Tests for Fire Resistance of Building Joint Systems; Underwriters Laboratories Inc.; 2004.
- F. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.4 SUBMITTALS

- A. Product Data: Provide data on product characteristics, performance ratings, and limitations.

1.5 QUALITY ASSURANCE

- A. Fire Testing: Provide firestopping assemblies of designs that provide the scheduled fire ratings when tested in accordance with methods indicated.

1.6 FIELD CONDITIONS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for 3 days after installation of materials.

PART 2 PRODUCTS

2.1 FIRESTOPPING - GENERAL REQUIREMENTS

- A. Manufacturers:
 - 1. A/D Fire Protection Systems Inc: www.adfire.com.
 - 2. 3M Fire Protection Products: www.3m.com/firestop.
 - 3. Hilti, Inc: www.us.hilti.com.
 - 4. Nelson FireStop Products: www.nelsonfirestop.com.

5. Specified Technologies, Inc: www.stifirestop.com.
 6. Or approved equal
- B. Firestopping: Any material meeting requirements.
- C. Materials: Use any material meeting requirements.
- D. Mold Resistance: Provide firestopping materials with mold and mildew resistance rating of 0 as determined by ASTM G21.
- E. Primers, Sleeves, Forms, Insulation, Packing, Stuffing, and Accessories: Type required for tested assembly design.
- F. Fire Ratings: See Drawings for required systems and ratings.

2.2 FIRESTOPPING ASSEMBLY REQUIREMENTS

- A. Perimeter Fire Containment Firestopping: Use any system that has been tested according to ASTM E2307 to have fire resistance F Rating equal to required fire rating of the floor assembly.
1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
 2. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated.
 3. Where floor assembly is not required to have a fire rating, provide systems that have been tested to show L Rating as indicated.
- B. Floor-to-Floor, Wall-to-Wall, and Wall-to-Floor Joints, Where Both Are Fire-Rated: Use any system that has been tested according to ASTM E1966 or UL 2079 to have fire resistance F Rating equal to required fire rating of the assembly in which the joint occurs.
1. Movement: In addition, provide systems that have been tested to show movement capability as indicated.
 2. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated.
 3. Water tightness: In addition, provide systems that have been tested to show W Rating as indicated.
 4. Listing by UL, FM, or Intertek in their certification directory will be considered evidence of successful testing.
- C. Through Penetration Firestopping: Use any system that has been tested according to ASTM E814 to have fire resistance F Rating equal to required fire rating of penetrated assembly.
1. Air Leakage: In addition, provide systems that have been tested to show L Rating as indicated.
 2. Water tightness: In addition, provide systems that have been tested to show W Rating as indicated.
 3. Listing by UL, FM, or Intertek in their certification directory will be considered evidence of successful testing.

2.3 FIRESTOPPING FOR FLOOR-TO-FLOOR, WALL-TO-FLOOR, AND WALL-TO-WALL JOINTS

A. Concrete and Concrete Masonry Walls and Floors:

1. Floor to Floor Joints:
 - a. 2 Hour Construction: UL System FF-D-1013; Basis of design: Hilti CFS-SP WB Firestop Joint Spray and CP 672.
2. Top of Wall Joints at Concrete/Concrete Masonry Wall to Concrete Floor:
 - a. 2 Hour Construction: UL System HW-D-0268; Basis of design: Hilti CP 606 Flexible Firestop Sealant.

B. Gypsum Board Walls:

1. Wall to Wall Joints:
 - a. 2 Hour Construction: UL System WW-D-0067; Basis of design: Hilti CP 606 Flexible Firestop Sealant.
 - b. 1 Hour Construction: UL System WW-D-0067; Basis of design: Hilti CP 606 Flexible Firestop Sealant.
2. Top of Wall Joints at Metal Deck, Wall Perpendicular to Ribs, Cut to Fit Ribs:
 - a. 2 Hour Construction: UL System HW-D-0045; Basis of design: Hilti CP 606 Flexible Firestop Sealant.
 - b. 1 Hour Construction: UL System HW-D-0045; Basis of design: Hilti CP 606 Flexible Firestop Sealant.

2.4 FIRESTOPPING PENETRATIONS THROUGH CONCRETE AND CONCRETE MASONRY CONSTRUCTION

A. Penetrations Through Floors or Walls By:

1. Multiple Penetrations in Large Openings:
 - a. 2 Hour Construction: UL System C-AJ-8143; Basis of design: Hilti FS-ONE MAX Intumescent Firestop Sealant.
2. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System C-AJ-1425; Basis of design: Hilti CFS-S SIL GG Firestop Silicone Sealant Gun-Grade.
3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System C-AJ-2109; Basis of design: Hilti CP 643N/644 Firestop Collar.
4. Electrical Cables Not In Conduit:
 - a. 2 Hour Construction: UL System C-AJ-3283; Basis of design: Hilti CP653 Speed Sleeve.
5. Cable Trays with Electrical Cables:
 - a. 2 Hour Construction: UL System C-AJ-4094; Basis of design: Hilti CFS-BL Firestop Block.

6. Insulated Pipes:
 - a. 2 Hour Construction: UL System C-AJ-5048; Hilti FS-ONE MAX Intumescent Firestop Sealant, CP 606 Flexible Firestop Sealant, CP 601S Elastomeric Firestop Sealant, CP 604 Self-Leveling Firestop Sealant or CFS-S SIL GG Firestop Silicone Sealant Gun-Grade or approved equal
7. HVAC Ducts, Uninsulated:
 - a. 2 Hour Construction: UL System C-AJ-7111; Basis of design: Hilti FS-ONE MAX Intumescent Firestop Sealant.

2.5 FIRESTOPPING PENETRATIONS THROUGH GYPSUM BOARD WALLS

A. Penetrations By:

1. Multiple Penetrations in Large Openings:
 - a. 2 Hour Construction: UL System W-L-8013; Basis of design: Hilti CFS-BL Firestop Block.
 - b. 1 Hour Construction: UL System W-L-8013; Basis of design: Hilti CFS-BL Firestop Block.
2. Uninsulated Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System W-L-1506; Basis of design: Hilti CFS-D Firestop Cable Disc.
3. Uninsulated Non-Metallic Pipe, Conduit, and Tubing:
 - a. 2 Hour Construction: UL System W-L-2128; Basis of design: Hilti FS-ONE MAX Intumescent Firestop Sealant.
4. Electrical Cables Not In Conduit:
 - a. 2 Hour Construction: UL System W-L-3395; Basis of design: Hilti CP653 Speed Sleeve.
5. Cable Trays with Electrical Cables:
 - a. 2 Hour Construction: UL System W-L-4060; Basis of design: Hilti FS-ONE MAX Intumescent Firestop Sealant.
6. Insulated Pipes:
 - a. 2 Hour Construction: UL System W-L-5029; Basis of design: Hilti FS-ONE Intumescent Firestop Sealant.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.2 PREPARATION

- A. Clean substrate surfaces of dirt, dust, grease, oil, loose material, or other matter that could adversely affect bond of firestopping material.
- B. Remove incompatible materials that could adversely affect bond.

- C. Install backing materials to arrest liquid material leakage.

3.3 INSTALLATION

- A. Install materials in manner described in fire test report and in accordance with manufacturer's instructions, completely closing openings.
- B. Do not cover installed firestopping until inspected by authority having jurisdiction.
- C. Install labeling required by code.

3.4 FIELD QUALITY CONTROL

- A. Repair or replace penetration firestopping and joints at locations where inspection results indicate firestopping or joints do not meet specified requirements.

3.5 CLEANING

- A. Clean adjacent surfaces of firestopping materials.

3.6 PROTECTION

- A. Protect adjacent surfaces from damage by material installation.

END OF SECTION

**SECTION 07 9005
JOINT SEALERS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sealants and joint backing.

1.2 RELATED REQUIREMENTS

- A. Section 07 2500 - WEATHER BARRIERS: Sealants required in conjunction with air barriers and vapor retarders:
- B. Section 07 8400 - Firestopping: Firestopping sealants.
- C. Section 07 9513 - Expansion Joint Covers.
- D. Section 08 8000 - Glazing: Glazing sealants and accessories.

1.3 REFERENCE STANDARDS

- A. ASTM C920 - Standard Specifications for Elastomeric Joint Sealants; 2014.
- B. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- C. ASTM D1056 - Standard Specifications for Flexible Cellular Materials--Sponge or Expanded Rubber; 2007.
- D. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness; 2005 (Reapproved 2010).

1.4 SUBMITTALS

- A. Product Data: Provide data indicating sealant chemical characteristics.

1.5 FIELD CONDITIONS

- A. Maintain temperature and humidity recommended by the sealant manufacturer during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Gunnable and Pourable Sealants:
 - 1. BASF Construction Chemicals-Building Systems: www.buildingsystems.basf.com.
 - 2. Dow Corning Corporation: www.dowcorning.com.
 - 3. Pecora Corporation: www.pecora.com.
 - 4. Tremco Global Sealants: www.tremcosealants.com.
 - 5. W.R. Meadows, Inc: www.wrmeadows.com.
 - 6. Polymeric Systems, Inc: www.polymericsystems.com
 - 7. Or approved equal

2.2 SEALANTS

- A. General Purpose Exterior Sealant: Polyurethane; ASTM C920, Grade NS, Class 25, Uses M, G, and A; single component.
 - 1. Color: Match adjacent finished surfaces.
 - 2. Applications: Use for:
 - a. Control, expansion, and soft joints in masonry.
 - b. Joints between concrete and other materials.
 - c. Joints between metal frames and other materials.
 - d. Other exterior joints for which no other sealant is indicated.
 - 3. Product: "NP 1" by Sonneborn; "Vulkem 116" by Tremco; "Dynatrol 1" by Pecora; "PSI 901/RC1" by Polymeric Systems, Inc; Sika Corporation - Sikaflex - 1a; Tremco; DyMonic or approved equal.
- B. Exterior Metal Joint Sealant: Butyl or polyisobutylene, nondrying, nonskinning, noncuring.
 - 1. Applications:
 - a. Concealed sealant bead in sheet metal work.
 - 2. Product: "Multi-Purpose Sealant" by Sonneborn; "BC-158" by Pecora; "PSI 301" by Polymeric Systems, Inc; Tremco - Tremco Butyl Sealant or approved equal.
- C. General Purpose Interior Sealant: Acrylic emulsion latex; ASTM C 834, single component, paintable.
 - 1. Color: Standard colors matching finished surfaces, or paintable.
 - 2. Applications:
 - a. Interior wall and ceiling control joints.
 - b. Joints between door and window frames and wall surfaces.
 - c. Other interior joints for which no other type of sealant is indicated.
 - 3. Product: Basis of design: "Sonolac" manufactured by Sonneborn; "AC-20 + Silicone" manufactured by Pecora.
- D. Epoxy Concrete Floor Joint Filler: Self-leveling, pourable, semi-rigid sealant intended for filling cracks and control joints not subject to significant movement; rigid enough to support concrete edges under traffic.
 - 1. Composition: Single or multi-part, 100% solids by weight.
 - 2. Hardness: 85, minimum, after 7 days, when tested in accordance with ASTM D2240, Shore A.
 - 3. Color: Match adjacent finished surfaces.
 - 4. Joint Width, Minimum: 1/8 inch.
 - 5. Joint Depth: Provide product suitable for joints from 1/8 inch to 2 inches in depth including space for backer rod.

6. Applications: Use for:
 - a. Control joints in concrete slabs and floors not filled with filler placed in form.
 - b. Construction joints in concrete slabs and floors.
 7. Products:
 - a. Nox-Crete; DynaFlex 502: www.nox-crete.com
 - b. W.R. Meadows, Inc; Rezi-Weld Flex: www.wrmeadows.com
 - c. Sika; Sikadur 51 NS: usa.sika.com
 - c. Or approved equal.
- E. Type S and O - Silicone Sealant: ASTM C920, Class 25-50; single component, neutral curing, non-sagging, non-staining, fungus resistant, non-bleeding.
1. Color: Match adjacent finished surfaces.
 2. Applications: Use for:
 - a. Aluminum Framing.
 3. Products:
 - a. Dow Corning – 795
 - b. GE Silicones - UltraPruf II SCS2900
 - c. Sonneborn – Omniseal Polymeric Systems - PSI-631
 - d. Tremco - Spectrem 2
 - e. Or approved equal

2.3 ACCESSORIES

- A. Primer: Non-staining type, recommended by sealant manufacturer to suit application.
- B. Joint Cleaner: Non-corrosive and non-staining type, recommended by sealant manufacturer; compatible with joint forming materials.
- C. Joint Backing: Round foam rod compatible with sealant; ASTM D1667, closed cell PVC; oversized 30% to 50% larger than joint width.
- D. Bond Breaker: Pressure sensitive tape recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that substrate surfaces are ready to receive work.
- B. Verify that joint backing and release tapes are compatible with sealant.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean and prime joints in accordance with manufacturer's instructions.

- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Protect elements surrounding the work of this section from damage or disfigurement.

3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Measure joint dimensions and size joint backers to achieve width-to-depth ratio, neck dimension, and surface bond area as recommended by manufacturer, except where specific dimensions are indicated.
- D. Install bond breaker where joint backing is not used.
- E. Install sealant free of air pockets, foreign embedded matter, ridges, and sags.
- F. Apply sealant within recommended application temperature ranges. Consult manufacturer when sealant cannot be applied within these temperature ranges.
- G. Tool joints concave.
- H. Concrete Floor Joint Filler: Install concrete floor joint filler per manufacturer's written instructions. After floor joint filler is fully cured, shave joint filler flush with top of concrete slab.

3.4 CLEANING

- A. Clean adjacent soiled surfaces.

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 and remove damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from the original work

END OF SECTION

**SECTION 07 9513
EXPANSION JOINT COVER ASSEMBLIES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Expansion joint cover assemblies for floor, wall, and ceiling surfaces.

1.2 RELATED REQUIREMENTS

- A. Section 09 2116 - Gypsum Board Assemblies: Placement of expansion joint assemblies in gypsum board walls and ceilings.
- B. Section 09 5100 - Acoustical Ceilings: Expansion joint assemblies in suspended ceiling grids.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Installation Templates: For frames and anchors to be embedded in concrete or masonry, furnish templates to relevant installers; include installation instructions and tolerances.

1.4 SUBMITTALS

- A. Product Data: Provide joint assembly profiles, profile dimensions, anchorage devices and available colors and finish.
- B. Shop Drawings: Indicate joint and splice locations, miters, layout of the work, effected adjacent construction and anchorage locations.
- C. Samples: Submit two samples 4 inches long, illustrating profile, dimension, color, and finish selected.
- D. Manufacturer's Installation Instructions: Indicate rough-in sizes and required tolerances for item placement.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Resilient Joint Filler: 15 feet length and any special tools required for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Expansion Joint Cover Assemblies:
 - 1. Architectural Art Mfg., Inc: www.archart.com.
 - 2. Construction Specialties, Inc: www.c-sgroup.com.
 - 3. Inpro: www.inprocorp.com - Basis of Design.
 - 4. MM Systems Corp: www.mmsystemscorp.com.
 - 5. Nystrom, Inc: www.nystrom.com.
 - 6. Or approved equal.

2.2 EXPANSION JOINT COVER ASSEMBLY APPLICATIONS

- A. Interior/Exterior Floor Joints Subject to Thermal Movement:
 - 1. Products:

- a. Inpro; 1100 Series Seal (precompressed foam): www.inprocorp.com.
 - b. Architectural Arts; "P Series" Fire Barrier System.
 - c. Construction Specialties, Inc: www.c-sgroup.com
 - d. Or approved equal.
- B. Interior Wall/Ceiling Joints Subject to Thermal Movement:
1. Products:
 - a. Inpro; 1100 Series Seal (precompressed foam) and Santoprene seal: www.inprocorp.com. See contract documents.
 - b. Architectural Arts; "P Series" Fire Barrier System.
 - c. Construction Specialties, Inc: www.c-sgroup.com
 - d. Or approved equal.
- C. Interior/Exterior Wall Joints Subject to Thermal Movement:
1. Products:
 - a. Inpro; 1100 Series Seal (precompressed foam): www.inprocorp.com.
 - b. Architectural Arts; "P Series" Fire Barrier System.
 - c. Construction Specialties, Inc: www.c-sgroup.com
 - d. Or approved equal.

2.3 EXPANSION JOINT COVER ASSEMBLIES

- A. Expansion Joint Cover Assemblies - General: Factory-fabricated and assembled; designed to completely fill joint openings, sealed to prevent passage of air, dust, water, smoke; suitable for traffic expected.
1. Joint Dimensions and Configurations: As indicated on drawings.
 2. Joint Cover Sizes: Selected to suit joint width and configuration, based on manufacturer's published recommendations and limitations.
 3. Joint Cover Styles: As indicated on drawings.
 4. Joint Movement Capability: If not indicated, provide minimum +/- 25% joint movement capability.
 5. Lengths: Provide covers in full lengths required; avoid splicing wherever possible.
 6. Anchors, Fasteners, and Fittings: Provided by cover manufacturer.
- B. Floor Joint Covers: Coordinate with indicated floor coverings.
- C. Sliding Cover Plate Type Covers: Provide plate with beveled edges and neat fit that does not collect dirt.
- D. Covers In Gypsum Board Assemblies: Provide style with anchoring wings that can be completely covered by joint compound.

2.4 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper; or ASTM B308/B308M, 6061 alloy, T6 temper.
 - 1. Exposed Finish at Floors: Natural anodized.
 - 2. Exposed Finish at Walls and Ceilings: Natural anodized.
- B. Anchors and Fasteners: As recommended by cover manufacturer.
- C. Backing Paint for Aluminum Components in Contact with Cementitious Materials: Asphaltic type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joint preparation and dimensions are acceptable and in accordance with manufacturer's requirements.

3.2 INSTALLATION

- A. Install components and accessories in accordance with manufacturer's instructions.
- B. Align work plumb and level, flush with adjacent surfaces.
- C. Rigidly anchor to substrate to prevent misalignment.

END OF SECTION

**SECTION 08 1113
HOLLOW METAL DOORS AND FRAMES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Non-fire-rated steel doors and frames.

1.2 RELATED REQUIREMENTS

- A. Section 08 7100 - Door Hardware.
- B. Section 08 8000 - Glazing: Glass for doors and borrowed lites.
- C. Section 09 9113 EXTERIOR PAINTING: Field painting
- D. Section 09 9123 - INTERIOR PAINTING: Field painting.

1.3 REFERENCE STANDARDS

- A. ANSI/ICC A117.1 - American National Standard for Accessible and Usable Buildings and Facilities; International Code Council; 2009.
- B. ANSI A250.8 - SDI-100 Recommended Specifications for Standard Steel Doors and Frames; 2003.
- C. ANSI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames; 1998 (R2011).
- D. ASTM A653 - Standard Specifications for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- E. BHMA A156.115 - Hardware Preparation in Steel Doors and Steel Frames; 2006.
- F. NAAMM HMMA 840 - Guide Specifications for Installation and Storage of Hollow Metal Doors and Frames; The National Association of Architectural Metal Manufacturers; 2007.

1.4 SUBMITTALS

- A. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.
- B. Door and Frame Schedule: Indicate door numbers, sizes, handing, etc. for approval.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 3 years documented experience.
- B. Maintain at the project site a copy of all reference standards dealing with installation.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with NAAMM HMMA 840.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

1.7 PROJECT CONDITIONS

- A. Coordinate the work with door opening construction, door frame and door hardware installation.

- B. Doors and/or frames which are not manufactured to specified size and planar tolerances shall be removed from the site and replaced without charge to the Contracting Authority.
- C. Electrical Hardware Preparation: When there are electrical hardware items being installed in hollow metal frames the supplier shall weld in masonry mud boxes of the appropriate size to protect the hardware devices from damage and also allow room for installation of the electrified hardware items and wiring as specified in Section 08 71 00 - Door Hardware. The boxes will be configured to allow for conduit knockouts that will not interfere with the hardware mounting. When there are two electrical items to be installed in the same frame provide 1/2 inch conduit between the two components to allow one 3/4 inch pipe to be field installed by the electrician out of the frame.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Steel Doors and Frames:

1. Assa Abloy Ceco, Curries, or Fleming: www.assaabloydss.com.
2. Mesker Door, Inc: www.meskerdoor.com
3. West Central Manufacturing: www.westcentralmfg.com
4. Windsor Republic Doors: www.republicdoor.com
5. Steelcraft, an Allegion brand: www.allegion.com/us.
6. Or approved equal.

2.2 DOORS AND FRAMES

A. Requirements for All Doors and Frames:

1. Accessibility: Comply with ANSI/ICC A117.1.
2. Door Top Closures: Flush with top of faces and edges.
3. Door Edge Profile: Beveled on both edges.
4. Door Texture: Smooth faces. Joints welded and ground smooth
5. Hardware Preparation: In accordance with BHMA A156.115, with reinforcement welded in place, in addition to other requirements specified in door grade standard, and the following:
 - a. Steel Door Reinforcing:
 - 1) Minimum 10 gauge steel of equivalent thread depth for hinges.
 - 2) Minimum 12 gauge steel for lock front, closers, and overhead hold open/stop arms.
 - 3) Minimum 14 gauge steel for other hardware.
 - b. Steel Frame Reinforcing:
 - 1) Minimum 7 gauge steel of equivalent thread depth for hinges.
 - 2) Minimum 12 gauge steel for closers and overhead hold open/stop arms.
 - 3) Minimum 14 gauge steel for strikes and other hardware.

- c. Factory installed reinforcing and preparation for mortised hardware.
 - d. Galvanizing for Units in Exterior Walls and Wet Areas: All components hot-dipped zinc-iron alloy-coated (galvannealed), manufacturer's standard coating thickness.
 - e. Finish: Factory primed, for field finishing.
 - f. Hollow metal door frames at gypsum wall board assemblies shall not be grouted
- B. Combined Requirements: If a particular door and frame unit is indicated to comply with more than one type of requirement, comply with all the specified requirements for each type; for instance, an exterior door that is also indicated as being sound-rated must comply with the requirements specified for exterior doors and for sound-rated doors; where two requirements conflict, comply with the most stringent.

2.3 STEEL DOORS

A. Exterior Doors:

- 1. Grade: ANSI A250.8 Level 3, physical performance Level A, Model 2, seamless.
- 2. Core: Cardboard honeycomb.
- 3. Edge Construction: Welded
- 4. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653/A653M, with A60/ZF180 coating.
- 5. Gauge: 16
- 6. Finish: Factory primed, for field finishing.

2.4 STEEL FRAMES

A. General:

- 1. Comply with the requirements of grade specified for corresponding door.
 - a. ANSI A250.8 Level 2 and 3 Doors: 14 gage frames.
- 2. Finish: Same as for door.
- 3. Face Width: 2 inches, unless otherwise indicated
- 4. Provide mortar guard boxes for hardware cut-outs in frames to be installed in masonry or to be grouted.
 - a. Coordinate with electric lock hardware.

B. Exterior Door Frames: Fully welded.

- 1. Galvanizing: All components hot-dipped zinc-iron alloy-coated (galvannealed) in accordance with ASTM A653, with A60 coating.
- 2. Weatherstripping: Separate, see Section 08 7100.

2.5 FINISH MATERIALS

- A. Primer: Rust-inhibiting, complying with ANSI A250.10, door manufacturer's standard.
- B. Bituminous Coating: Asphalt emulsion or other high-build, water-resistant, resilient coating.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 PREPARATION

- A. Coat inside of frames to be installed in masonry or to be grouted, with bituminous coating, prior to installation.

3.3 INSTALLATION

- A. Install in accordance with the requirements of the specified door grade standard and NAAMM HMMA 840.
- B. Coordinate frame anchor placement with wall construction.
- C. Coordinate installation of hardware.
- D. Coordinate installation of electrical connections to electrical hardware items.
- E. Touch up damaged factory finishes.

3.4 TOLERANCES

- A. Maximum Diagonal Distortion: 1/16 inch measured with straight edge, corner to corner.

3.5 ADJUSTING

- A. Adjust for smooth and balanced door movement.

3.6 SCHEDULE

- A. Refer to Door and Frame Schedule on the drawings.

END OF SECTION

SECTION 08 1116
ALUMINUM DOORS AND FRAMES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flush aluminum doors with aluminum faces.
- B. Fire rated aluminum doors and frames.
- C. Aluminum door frames for doors specified in this section.
- D. Glazing.

1.2 RELATED REQUIREMENTS

- A. Section 07 9005 - Joint Sealers.
- B. Section 08 7100 - Door Hardware: Hardware for aluminum doors.
- C. Section 08 8000 - Glazing: Glazing materials for aluminum doors and frames.

1.3 REFERENCE STANDARDS

- A. AAMA 609 - Voluntary Guide Specification for Cleaning and Maintenance of Architectural Anodized Aluminum; American Architectural Manufacturers Association; 2009.
- B. AAMA 701/702 - Voluntary Specifications for Pile Weatherstripping and Replaceable Fenestration Weatherseals; American Architectural Manufacturers Association; 2011.
- C. ASTM A123 - Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.
- D. ASTM E2112 - Standard Practice for Installation of Exterior Windows, Doors and Skylights; 2007.
- E. NFPA 252 - Standard Methods of Fire Tests of Door Assemblies; National Fire Protection Association; 2012.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's descriptive literature for each type of door; include information on fabrication methods.
- B. Shop Drawings: Include elevations of each opening type.
 - 1. Verify dimensions by field measurements before fabrication and indicate on shop drawings.
- C. Verification Samples: Actual pieces of products in each finish specified, not less than 6 inches square or 6 inches long for linear components.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Not less than 5 years of experience in manufacturing components of the types specified.
- B. Installer Qualifications: Firm with documented experience in installing components of the types specified.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver aluminum components in manufacturer's standard protective packaging, palletted, crated, or banded together.
- B. Inspect delivered components for damage and replace. Repaired components will not be accepted.
- C. Store components under cover in manufacturer's packaging until installation.

1.7 FIELD CONDITIONS

- A. Do not begin installation of interior aluminum components until space has been enclosed and ambient thermal conditions are being maintained at levels consistent with final project requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Flush Aluminum Doors with Aluminum Faces and Related Frames and Accessories:
 1. Kawneer North America: Heavy Wall 350 - Basis of design to be heavy.
www.kawneer.com <http://www.kawneer.com>.
 2. Manko.
 3. Pittco Architectural Metals, Inc.
 4. Tubelite Inc.; www.tubeliteinc.com <http://www.tubeliteinc.com>
 5. United States Aluminum Corp: www.usalum.com <http://www.usalum.com>.
 6. Vistawall Architectural Products: www.vistawall.com <http://www.vistawall.com>.
 7. Wausau Window and Wall Systems; Product System: www.wausauwindow.com
<http://www.wausauwindow.com>
 8. YKK AP America Inc: www.ykkap.com.
 9. Or approved equal.

2.2 DOORS AND FRAMES

- A. Flush Doors with Aluminum Faces: Aluminum internal framing and faces; no steel components.
 1. Thickness: 2 inches, nominal.
 2. Facing: Seamless aluminum sheet, 0.090 inch, smooth texture.
 3. Finish: Natural anodized.
 4. Weatherstripping: Replaceable pile type; at jambs and head of exterior doors.
- B. Fire Rated Aluminum Doors and Frames: Aluminum internal framing and faces; no steel components, filled with insulating compound.
 1. Fire Rating for Assembly: 90 minutes.
 2. Thickness: Manufacturer's standard to achieve required fire rating.
 3. Facing: Seamless aluminum sheet, 0.090 inch, smooth texture.

4. Finish: Natural anodized.
 5. Weatherstripping: Replaceable pile type; at jambs and head of exterior doors.
 6. Details: Head, jamb and sill details per Manufacturer's standard details to achieve associated fire rating.
 7. Products:
 - a. TGP Architectural.
 - b. AluFlam.
 - c. GPX Architectural.
 - d. Or approved equal.
 8. Clear Fire Rated Glazing:
 - a. Vetrotech Saint Gobain.
 - b. SaffiFirst.
 - c. Technical Glass Products (TGP).
 - d. Or approved equal.
- C. Door, Sidelight, and Transom Frames: Extruded aluminum hollow or C-shaped sections; no steel components.
1. Finish: Same as doors.
 2. Weatherstripping: Replaceable pile type; at jambs and head.
- D. Dimensions and Shapes: As indicated on drawings; dimensions shown are nominal.
1. Provide vision lites where indicated.
 2. Provide clearances as follows:
 - a. Hinge and Lock Stiles: 0.125 inch.
 - b. Between Meeting Stiles: 0.25 inch.
 - c. At Top Rail and Bottom Rail: 0.125 inch.

2.3 COMPONENTS

- A. Flush Door Panels: Without visible seams on face.
1. Framing and Hardware Backup: Extruded aluminum tubing, 0.125 inch minimum thickness.
 2. Top, Side, and Bottom Edges: Extruded aluminum cap.
 3. Laminating Adhesive: Manufacturer's standard low-VOC materials.
- B. Frames: Extruded aluminum shapes, not less than 0.062 inch thick, reinforced at hinge and strike locations.
1. Corner Brackets: Extruded aluminum, fastened with stainless steel screws.

- 2. Trim: Extruded aluminum, not less than 0.062 inch thick, removable snap-in type without exposed fasteners.
- C. Vision Lites: Extruded aluminum framed, gasket glazed.
 - 1. Glazing: As specified in Section 08 8000 - Glazing.

2.4 ACCESSORIES

- A. Replaceable Weatherstripping: AAMA 701/702 wool pile.
- B. Fasteners: Aluminum, non-magnetic stainless steel, or other material warranted by manufacturer as non-corrosive and compatible with aluminum components.
- C. Brackets and Reinforcements: Manufacturer's high-strength aluminum units where feasible, otherwise, non-magnetic stainless steel or steel hot-dip galvanized in compliance with ASTM A123/A123M.
- D. Bituminous Coating: Cold-applied asphaltic mastic, compounded for 30-mil thickness per coat.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that wall surfaces and openings are ready to receive frames and are within tolerances specified in manufacturer's instructions.
- B. Verify that frames installed by other trades for installation of doors of this section are in strict accordance with recommendations and approved shop drawings and within tolerances specified in manufacturer's instructions.

3.2 PREPARATION

- A. Perform cutting, fitting, forming, drilling, and grinding of frames as required for project conditions.
- B. Replace components with damage to exposed finishes.
- C. Separate dissimilar metals to prevent electrolytic action between metals.

3.3 INSTALLATION

- A. Install doors and frames in accordance with manufacturer's instructions and approved shop drawings.
- B. Set frames plumb, square, level, and aligned to receive doors. Anchor frames to adjacent construction in strict accordance with manufacturer's recommendations and within specified tolerances.
- C. Where aluminum surfaces contact metals other than stainless steel, zinc, or small areas of white bronze, protect from direct contact by painting dissimilar metal with heavy coating of bituminous paint.
- D. Hang doors and adjust hardware to achieve specified clearances and proper door operation.
- E. Install door hardware as specified in Section 08 7100.
- F. Comply with glazing installation requirements of Section 08 8000.

3.4 CLEANING

- A. Upon completion of installation, thoroughly clean door and frame surfaces in accordance with AAMA 609.
- B. Do not use abrasive, caustic, or acid cleaning agents.

3.5 PROTECTION

- A. Protect products of this section from damage caused by subsequent construction until substantial completion.
- B. Replace damaged or defective components that cannot be repaired to a condition indistinguishable from undamaged components.

END OF SECTION

**SECTION 08 4313
ALUMINUM-FRAMED STOREFRONTS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum-framed storefront, with vision glass and spandrel glass.

1.2 RELATED REQUIREMENTS

- A. Section 07 9005 - Joint Sealers: Perimeter sealant and back-up materials.
- B. Section 08 4413 - Glazed Aluminum Curtain Walls.
- C. Section 08 7100 - Door Hardware: Hardware items other than specified in this section.
- D. Section 08 8000 - Glazing: Glass and glazing accessories.

1.3 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2012.
- B. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document); American Architectural Manufacturers Association; 2015.
- C. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 2012.
- D. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; American Architectural Manufacturers Association; 2009.
- E. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; 2011.
- F. ASTM A36 – Standard Specifications for Carbon Structural Steel; 2012.
- G. ASTM A123 – Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.
- H. ASTM B209 - Standard Specifications for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- I. ASTM B221 - Standard Specifications for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2013.
- J. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- K. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- L. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.

- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

- A. Product Data: For each type of product: 1. Provide component dimensions, describe components within assembly, anchorage and fasteners, glass and infill, internal drainage details ; 2. Include job specific interface construction details, label what is included and what is not included in this section, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, and finishes for all products: 3. For windows and storefront, submit surface temperature and dew point analysis showing compliance with the specified thermal performance.
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- C. Samples: Submit two samples roughly 1 inch by 3 inches in size illustrating finished aluminum surface, glass, glazing materials.
- D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- E. Warranty: Submit manufacturer warranty and ensure forms have been completed in Contracting Authority's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in Iowa.
- B. Manufacturer and Installer Qualifications: Company specializing in manufacturing aluminum glazing systems with minimum 10 years of documented experience utilizing manufacture certified installer.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.8 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40°F. Maintain this minimum temperature during and 48 hours after installation.

1.9 WARRANTY

- A. Provide 5 year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- B. Provide 10 year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Include provision for replacement of units with excessive fading, chalking, or flaking. Manufacture agrees to repair or replace aluminum windows and storefronts that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to the following: 1. Failure to meet performance requirements; 2. Structural failures including

excessive deflection, water leakage, condensation, and air infiltration. 3. Deterioration of materials and finishes beyond normal weathering. 4. Failure of insulating glass

PART 2 PRODUCTS

2.1 BASIS OF DESIGN -- FRAMING FOR INSULATING GLAZING

- A. Back-Set Style, Thermally-Broken:
 - 1. Basis of Design:
 - a. Exterior Applications: Kawneer North America; Trifab VG451 with HP
- B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
 - 1. YKK AP America Inc: www.ykkap.com.
 - 2. Manko.
 - 3. Pittco Architectural Metals, Inc.
 - 4. Tubelite Inc.; www.tubeliteinc.com <<http://www.tubeliteinc.com>>
 - 5. United States Aluminum Corp; Product System: www.usalum.com.
 - 6. Vistawall Architectural Products: www.vistawall.com <<http://www.vistawall.com>>.
 - 7. Wausau Window and Wall Systems; Product System: www.wausauwindow.com <<http://www.wausauwindow.com>>
 - 8. EFCO Corporation
 - 9. Or approved equal.

2.2 STOREFRONT

- A. Aluminum-Framed Storefront: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Glazing Rabbet: For 1 inch insulating glazing.
 - 2. Finish: Class II natural anodized.
 - a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Touch-up surfaces cut during fabrication so that no natural aluminum is visible in completed assemblies, including joint edges.
 - 3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors and hardware; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 - 4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 - 5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.

6. Expansion/Contraction: Provide for expansion and contraction within system components caused by cycling temperature range of 170°F over a 12 hour period without causing detrimental effect to system components, anchorages, and other building elements.
 7. Movement: Allow for movement between storefront and adjacent construction, without damage to components or deterioration of seals.
 8. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 9. Preparation for Window Treatments: Provide reinforced interior horizontal head rail.
- B. Performance Requirements:
1. Wind Loads: Design and size components to withstand the specified load requirements without damage or permanent set, when tested in accordance with ASTM E330/E330M, using loads 1.5 times the design wind loads and 10 second duration of maximum load.
 - a. Design Wind Loads: Comply with requirements of 2015 International Building Code. Reference Structural documents.
 - b. Member Deflection: Limit member deflection to flexure limit of glass in any direction, with full recovery of glazing materials.
 2. Water Penetration Resistance: No uncontrolled water on interior face, when tested in accordance with ASTM E331 at pressure differential of 8.00 pounds per square foot.
 3. Air Leakage: Maximum of 0.06 cubic feet per minute per square foot of wall area, when tested in accordance with ASTM E283 at 6.27 pounds per square foot pressure differential across assembly.
 4. Condensation Resistance Factor of Framing: 50, minimum, measured in accordance with AAMA 1503.
 5. Overall U-value Including Glazing: 0.38 Btu/(hour square feet °F), maximum at exterior locations.

2.3 COMPONENTS

- A. Aluminum Framing Members: Tubular aluminum sections, drainage holes and internal weep drainage system.
1. Glazing stops: Flush.
 2. Structurally Reinforced Members: Extruded aluminum with internal reinforcement of structural steel member.
- B. Glazing: As specified in Section 08 8000 - Glazing.

2.4 MATERIALS

- A. Extruded Aluminum: ASTM B221.
- B. Sheet Aluminum: ASTM B209.
- C. Structural Steel Sections: ASTM A36; galvanized in accordance with requirements of ASTM A123.
- D. Structural Supporting Anchors Attached to Structural Steel: Design for bolted attachment.

- E. Structural Supporting Anchors Attached to Reinforced Concrete Members: Design for welded attachment to weld plates embedded in concrete.
- F. Fasteners: Aluminum, Non-magnetic stainless steel or other non-corrosive material. Do not use exposed fasteners except on application of hardware.
- G. Exposed Flashings and Break Aluminum: 0.063 inch (unless otherwise noted) thick aluminum sheet; finish to match framing members. Provide custom bent profiles as shown on Drawings including fasteners and receiver clips as required for a complete assembly.
- H. Perimeter Sealant: Type Dow Chemical #795; GE SilPruf SCS 2000; Sonneborn Omniseal Polymeric Systems – PSI-631; Tremco – Spectrum 2 for interior and exterior sealant; Or approved equal.
- I. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements.
- J. Glazing Accessories: As specified in Section 08 8000.

2.5 FINISHES

- A. Class II Natural Anodized Finish: AAMA 611 AA-M12C22A31 Clear anodic coating not less than 0.4 mils thick.
- B. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.

3.2 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Where fasteners penetrate sill flashings, make watertight by seating and sealing fastener heads to sill flashing.
- H. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- I. Install glass and infill panels in accordance with Section 08 8000, using glazing method required to achieve performance criteria.
- J. Install perimeter sealant in accordance with Section 07 9005.

- K. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 feet non-cumulative or 1/16 inches per 10 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.

3.4 FIELD QUALITY CONTROL

- A. Contracting Authority will provide in separate agreement independent testing and inspection for air infiltration and water leakage.
 - 1. Contractor shall schedule and coordinate testing with Contracting Authority's consultant.
 - 2. Testing (by Contracting Authority) will include testing for air and water leakage.
 - 3. Contractor shall replace curtain wall and door components that have failed field testing.

3.5 ADJUSTING

- A. Adjust operating hardware and sash for smooth operation.

3.6 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.
- D. Remove excess sealant by method acceptable to sealant manufacturer.

3.7 PROTECTION

- A. Protect installed products from damage during subsequent construction.

END OF SECTION

SECTION 08 4413
GLAZED ALUMINUM CURTAIN WALLS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aluminum-framed curtain wall, with vision glazing.
- B. Perimeter sealant.

1.2 RELATED REQUIREMENTS

- A. Section 08 4313 - Aluminum-Framed Storefronts:
- B. Section 08 8000 - Glazing.

1.3 REFERENCE STANDARDS

- A. AAMA CW-10 - Care and Handling of Architectural Aluminum From Shop to Site; American Architectural Manufacturers Association; 2012.
- B. AAMA 501.1 - Standard Test Method for Exterior Windows, Curtain Walls and Doors for Water Penetration Using Dynamic Pressure; American Architectural Manufacturers Association; 2005.
- C. AAMA 501.4 - Recommended Static Test Method for Evaluating Curtain Wall and Storefront Systems Subjected to Seismic and Wind Induced Interstory Drifts; 2009.
- D. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 2012.
- E. AAMA 1503 - Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors and Glazed Wall Sections; American Architectural Manufacturers Association; 2009.
- F. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; American Society of Civil Engineers; 2011.
- G. ASTM B209 - Standard Specifications for Aluminum and Aluminum-Alloy Sheet and Plate; 2010.
- H. ASTM B221 - Standard Specifications for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes; 2013.
- I. ASTM C794 - Standard Test Method for Adhesion-in-Peel of Elastomeric Joint Sealants; 2010.
- J. ASTM C1184 - Standard Specifications for Structural Silicone Sealants; 2013.
- K. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements; 2009.
- L. ASTM E283 - Standard Test Method for Determining the Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen; 2004 (Reapproved 2012).
- M. ASTM E330 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylights and Curtain Walls by Uniform Static Air Pressure Difference; 2014.
- N. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference; 2000 (Reapproved 2009).

- O. ASTM E547 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Cyclic Static Air Pressure Differential; 2000 (Reapproved 2009).
- P. ASTM E1105 - Standard Test Method for Field Determination of Water Penetration of Installed Exterior Windows, Skylights, Doors, and Curtain Walls, by Uniform or Cyclic Static Air Pressure Difference; 2000 (Reapproved 2008)

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate with installation of other components that comprise the exterior enclosure.
- B. Preinstallation Meeting: Conduct a preinstallation meeting one week before starting work of this section; require attendance by all affected installers.

1.5 SUBMITTALS

- A. Product Data: Provide Product data for each type of product: 1. Provide component dimensions, describe components within assembly, anchorage and fasteners, glazing and infill, internal drainage details ; 2. Include job specific interface construction details, label what is included and what is not included in this section, material descriptions, glazing and fabrication methods, dimensions of individual components and profiles, and finishes for all projects: 3. For windows and curtain wall, submit surface temperature and dew point analysis showing compliance with the specified thermal performance.
- B. Shop Drawings: Indicate system dimensions, framed opening requirements and tolerances, affected related Work, expansion and contraction joint location and details, and field welding required.
- C. Samples: Submit two fabrication samples of horizontal to vertical intersection using min. 12 inches lengths of full size components illustrating finished aluminum surface, joinery, glazing, infill panels, glazing materials.
- D. Manufacturer's Certificate: Certify that the products supplied meet or exceed the specified requirements.
- E. Design Data: Provide framing member structural and physical characteristics and engineering calculations, and identify dimensional limitations; include load calculations at points of attachment to building structure.
- F. Warranty: Submit manufacturer warranty and ensure forms have been completed in Contracting Authority's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Designer Qualifications: Design structural support framing components under direct supervision of a Professional Structural Engineer experienced in design of this Work and licensed in Iowa.
- B. Manufacturer and Installer Qualifications: Manufacturer shall be company specializing in manufacturing aluminum glazing systems with minimum 10 years of documented experience. Installer shall be approved by window and curtain wall manufacture for installation of units required for this Project.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Handle products of this section in accordance with AAMA CW-10.
- B. Protect finished aluminum surfaces with wrapping. Do not use adhesive papers or sprayed coatings that bond to aluminum when exposed to sunlight or weather.

1.8 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40°F. Maintain this minimum temperature during and 48 hours after installation.

1.9 WARRANTY

- A. Provide 5 year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- B. Provide 10 year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking. Manufacture agrees to repair or replace aluminum windows and storefronts that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to the following: 1. Failure to meet performance requirements; 2. Structural failures including excessive deflection, water leakage, condensation, and air infiltration. 3. Deterioration of materials and finishes beyond normal weathering. 4. Failure of insulating glass.

PART 2 PRODUCTS

2.1 BASIS OF DESIGN

- A. Pressure Cap Four Sides; Not Unitized, Field Assembled.
 - 1. Basis of Design: Kawneer 1600UT.
- B. Other Manufacturers: Provide either the product identified as "Basis of Design" or an equivalent product of one of the manufacturers listed below:
 - 1. Manko.
 - 2. Pittco Architectural Metals, Inc.
 - 3. Tubelite Inc.; www.tubeliteinc.com <<http://www.tubeliteinc.com>>
 - 4. United States Aluminum Corp: www.usalum.com <<http://www.usalum.com>>.
 - 5. Vistawall Architectural Products: www.vistawall.com <<http://www.vistawall.com>>.
 - 6. Wausau Window and Wall Systems; Product System: www.wausauwindow.com <<http://www.wausauwindow.com>>
 - 7. EFCO Corporation
 - 8. YKK AP America Inc: www.ykkap.com.
 - 9. Oldcastle.
 - 10. Or approved equal.
- C. Source Limitations: factory glazed aluminum windows, storefront, and curtain wall framing, shall be from a single source from a single manufacturer.

2.2 CURTAIN WALL

- A. Aluminum-Framed Curtain Wall: Factory fabricated, factory finished aluminum framing members with infill, and related flashings, anchorage and attachment devices.
 - 1. Outside glazed, with pressure plate and mullion cover.
 - 2. Finish: Class I natural anodized.

- a. Factory finish all surfaces that will be exposed in completed assemblies.
 - b. Coat concealed metal surfaces that will be in contact with cementitious materials or dissimilar metals with bituminous paint.
 3. Fabrication: Joints and corners flush, hairline, and weatherproof, accurately fitted and secured; prepared to receive anchors; fasteners and attachments concealed from view; reinforced as required for imposed loads.
 4. Construction: Eliminate noises caused by wind and thermal movement, prevent vibration harmonics, and prevent "stack effect" in internal spaces.
 5. System Internal Drainage: Drain to the exterior by means of a weep drainage network any water entering joints, condensation occurring in glazing channel, and migrating moisture occurring within system.
 6. Air and Vapor Seal: Maintain continuous air barrier and vapor retarder throughout assembly, primarily in line with inside pane of glazing and inner sheet of infill panel and heel bead of glazing compound.
 7. Perimeter Clearance: Minimize space between framing members and adjacent construction while allowing expected movement.
 8. Preparation for Window Treatments: Provide reinforced interior horizontal head rail.
- B. Structural Performance Requirements: Design and size components to withstand the following load requirements without damage or permanent set.
1. Design Wind Loads: Comply with the requirements of ASCE 7. Refer to Structural Drawings.
 - a. Member Deflection: For spans less than 13 feet 6 inches, limit member deflection to flexure limit of glass in any direction, and maximum of 1/175 of span or 3/4 inch, whichever is less and with full recovery of glazing materials.
 - b. Member Deflection: For spans over 13 feet 6 inches and less than 40 feet, limit member deflection to flexure limit of glass in any direction, and maximum of 1/240 of span plus 1/4 inch, with full recovery of glazing materials.
 2. Movement: Accommodate the following movement without damage to components or deterioration of seals:
 - a. Expansion and contraction caused by 180°F surface temperature.
 - b. Expansion and contraction caused by cycling temperature range of 170°F over a 12 hour period.
 - c. Movement of curtain wall relative to perimeter framing.
 - d. Deflection of structural support framing, under permanent and dynamic loads.
- C. Water Penetration Resistance: No uncontrolled water on indoor face when tested as follows:
1. Test Pressure Differential: 10 pounds per square foot.
 2. Test Method: AAMA 501.1.
- D. Air Leakage: Maximum of 0.06 cubic feet/min/square feet of wall area, when tested in accordance with ASTM E283 at 6.27 pounds per square foot pressure differential across assembly.

E. Thermal Performance Requirements:

1. Overall U-value Including Glazing: 0.38 Btu/ (hour square feet °F), maximum.

2.3 COMPONENTS

A. Aluminum Framing Members: Tubular aluminum sections, thermally broken with interior section insulated from exterior, drainage holes and internal weep drainage system.

1. Cross-Section: 6 inches by 2 1/2 inches nominal dimension.

B. Glazing: As specified in Section 08 8000.

2.4 MATERIALS

A. Extruded Aluminum: ASTM B221 (ASTM B221M).

B. Sheet Aluminum: ASTM B209 (ASTM B209M).

C. Fasteners: Stainless steel; type as required or recommended by curtain wall manufacturer.

D. Exposed Flashings: 0.032 inch thick aluminum sheet; finish to match framing members.

E. Structural Glazing Adhesive: Silicone, neutral cure; formulated specifically for structural sealant glazing and complying with ASTM C1184.

1. Ultraviolet radiation resistant for 2000 to 4000 micro-watts minimum for 21 days.
2. Adhesion when subjected to ultraviolet radiation through glass in accordance with ASTM C794 without failure.
3. Minimum adhesion tensile strength of 100 psi.
4. Tested for compatibility with glazing accessories and weatherseal sealant.

F. Weatherseal Sealant: Silicone, same type as glazing adhesive.

G. Perimeter Sealant: Provide one of the following for all interior and exterior surfaces.

1. Dow Corning – 795
2. GE Silicones – UltraPruf II SCS 2900
3. Sonneborn – Omniseal Polymeric Systems – PSI-631
4. Tremco – Spectrem 2
5. Or approved equal.

H. Glazing Gaskets: Type to suit application to achieve weather, moisture, and air infiltration requirements. Type to comply with ASTM C 864 and be extruded of silicone compatible EPDM rubber that provides for silicone adhesion.

I. Glazing Accessories: As specified in Section 08 8000.

2.5 FINISHES

A. Class I Natural Anodized Finish: AAMA 611 AA-M12C22A41 Clear anodic coating not less than 0.7 mils thick.

B. Touch-Up Materials: As recommended by coating manufacturer for field application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify dimensions, tolerances, and method of attachment with other work.
- B. Verify that wall openings and adjoining air and vapor seal materials are ready to receive work of this section.
- C. Verify that anchorage devices have been properly installed and located.

3.2 INSTALLATION

- A. Install wall system in accordance with manufacturer's instructions approved shop drawings.
- B. Attach to structure to permit sufficient adjustment to accommodate construction tolerances and other irregularities.
- C. Provide alignment attachments and shims to permanently fasten system to building structure.
- D. Align assembly plumb and level, free of warp or twist. Maintain assembly dimensional tolerances, aligning with adjacent work.
- E. Provide thermal isolation where components penetrate or disrupt building insulation.
- F. Install sill flashings. Turn up ends and edges; seal to adjacent work to form water tight dam.
- G. Coordinate attachment and seal of perimeter air and vapor barrier materials.
- H. Provide perforated metal panels specified in this Section.
- I. Spray foam all shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- J. Pressure Plate Framing: Install glazing and infill panels in accordance with Section 08 8000, using exterior dry glazing method.
- K. Install perimeter sealant in accordance with Manufacturer requirements.
- L. After installation, touch-up damaged finish with paint supplied by manufacturer and matching original coating.
- M. Touch-up minor damage to factory applied finish; replace components that cannot be satisfactorily repaired.

3.3 TOLERANCES

- A. Maximum Variation from Plumb: 0.06 inches every 3 feet non-cumulative or 0.5 inches per 100 feet, whichever is less.
- B. Maximum Misalignment of Two Adjoining Members Abutting in Plane: 1/32 inch.
- C. Sealant Space between Curtain Wall Mullions and Adjacent Construction: Maximum of 3/4 inch and minimum of 1/4 inch.

3.4 FIELD QUALITY CONTROL

- A. Contracting Authority will provide in separate agreement independent testing for air infiltration and water leakage.
- B. Contractor shall schedule and coordinate testing with Contracting Authority's provided testing company.

1. Contractor shall schedule and coordinate testing with Engineer.
 2. Testing will include testing for air and water leakage.
 3. Contractor shall replace curtain wall and door components that have failed field testing.
- C. Contractor shall replace curtain wall components that have failed field testing and retest until performance is satisfactory.

3.5 CLEANING

- A. Remove protective material from pre-finished aluminum surfaces.
- B. Wash down surfaces with a solution of mild detergent in warm water, applied with soft, clean wiping cloths. Take care to remove dirt from corners. Wipe surfaces clean.
- C. Remove excess sealant by method acceptable to sealant manufacturer.

3.6 PROTECTION

- A. Protect installed products from damage during subsequent construction.

END OF SECTION

**SECTION 08 7100
DOOR HARDWARE**

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes commercial door hardware for the following:
 - 1. Swinging doors.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware.
 - 3. Automatic operators.
- C. 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. UL/ULC and CSA C22.2 – Standards for Automatic Door Operators Used on Fire and Smoke Barrier Doors and Systems of Doors.
 - 8. State Building Codes, Local Amendments.
- D. 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

1.2 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. Contracting Authority 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.

1.3 QUALITY ASSURANCE

- A. **Manufacturers Qualifications:** Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. **Installer Qualifications:** A minimum 3 years documented experience installing both standard and electrified door hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. **Door Hardware Supplier Qualifications:** Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor and Engineer 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:** 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 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.

1.4 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 Contracting Authority via registered mail or overnight package service. Instructions for delivery to the Contracting Authority shall be established at the "Keying Conference".

1.5 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.

1.6 WARRANTY

- A. 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 Contracting Authority. 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.
- B. Special Warranty Periods:
 - 1. 10 years for mortise locks and latches.
 - 2. 5 years for exit hardware.
 - 3. 25 years for manual surface door closer bodies.
 - 4. 2 years for electromechanical door hardware.

1.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Contracting Authority'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:
- C. 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.
- D. 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. 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. Acceptable Manufacturers:
 - a. McKinney Products (MK).
 - b. Pemko Manufacturing (PE).
 - c. Ives (IV).
 - d. Or approved equal.

2.3 POWER TRANSFER DEVICES

- A. Concealed Quick Connect Electric Power Transfers: Provide concealed wiring pathway housing mortised into the door and frame for low voltage electrified door hardware. Furnish with Molex™ standardized plug connectors and sufficient number of concealed wires (up to 12) to accommodate the electrified functions specified in the Door Hardware Sets. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Wire nut connections are not acceptable.

- 1. Acceptable Manufacturers:

- a. Pemko Manufacturing (PE) – EL-CEPT Series.
- b. Securitron (SU) - EL-CEPT Series.
- c. Von Duprin (VD) - EPT-10 Series.
- d. Or approved equal.

B. Electric Door Wire Harnesses: Provide electric/data transfer wiring harnesses with standardized plug connectors to accommodate up to 12 wires. Connectors plug directly to through-door wiring harnesses for connection to electric locking devices and power supplies. Provide sufficient number and type of concealed wires to accommodate electric function of specified hardware. Provide a connector for through-door electronic locking devices and from hinge to junction box above the opening. Wire nut connections are not acceptable. Determine the length required for each electrified hardware component for the door type, size and construction, minimum of two per electrified opening.

- 1. Provide one each of the following tools as part of the base bid contract:
 - a. McKinney Products (MK) - Electrical Connecting Kit: QC-R001.
 - b. VonDuprin (VD) – Connect Series.
 - c. McKinney Products (MK) - Connector Hand Tool: QC-R003.
 - d. VonDuprin (VD) – Equivalent to McKinney QC-R003.
 - e. Or approved equal.

2. Acceptable Manufacturers:

- a. McKinney Products (MK) – QC-C Series.
- b. VonDuprin (VD) – Connect Series
- c. Assa Abloy
- d. Sargent
- e. Or approved equal.

C. Provide mortar guard enclosure on steel frames installed at masonry openings for each electrical hinge specified.

2.4 CYLINDERS AND KEYING

A. General: Cylinder manufacturer to have 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.

1. Acceptable Manufacturers:

- a. Corbin Russwin Hardware (RU).
- b. Sargent Manufacturing (SA).
- c. Schlage (SC).
- d. Or approved equal.

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. 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 Engineer.
 3. Existing System: Key locks to Contracting Authority's existing system.
- E. Key Quantity: Provide the following minimum number of keys:
1. Change Keys per Cylinder: Two.
 2. Master Keys (per Master Key Level/Group): Five.
 3. Construction Keys (where required): Ten.
- F. Construction Keying: Provide construction master keyed cylinders.

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. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) – ML2000 Series.
 - b. Sargent Manufacturing (SA) – 8200 Series.
 - c. Schlage (SC) – L9000 Series.
 - d. Or approved equal.

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: BHMA A156.13.
 2. Strikes for Bored Locks and Latches: BHMA A156.2.
 3. Strikes for Auxiliary Deadlocks: BHMA A156.5.
 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. Electromechanical Options: Subject to same compliance standards and requirements as mechanical exit devices, electrified devices to be of type and design as specified in hardware sets. Include any specific controllers when conventional power supplies are not sufficient to provide the proper inrush current.
 6. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy duty escutcheon trim with threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets.
 - b. Where function of exit device requires a cylinder, provide a cylinder (Rim or Mortise) as specified in Hardware Sets.
 7. Vertical Rod Exit Devices: Where surface or concealed vertical rod exit devices are used at interior openings, provide as less bottom rod (LBR) unless otherwise indicated. Provide dust proof strikes where thermal pins are required to project into the floor.
 8. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2 inches wide stiles.
 9. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 10. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 11. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified 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. Acceptable Manufacturers:

- a. Corbin Russwin Hardware (RU) - ED4000 / ED5000 Series.
- b. Sargent Manufacturing (SA) - 80 Series.
- c. Von Duprin (VD) - 35A/98 XP Series.
- d. Or approved equal.

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, and through-bolt and security type fasteners as required for proper installation.

B. Door Closers, Surface Mounted (Large Body Cast Iron): 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 body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control.

1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) - DC8000 Series.
 - b. LCN Closers (LC) - 4040XP Series.
 - c. Norton Door Controls (NO) – 9500 Series.
 - d. Sargent Manufacturing (SA) - 281 Series.
 - e. Or approved equal.

2.9 AUTOMATIC DOOR OPERATORS

- A. General: Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for compliance with UL 325. Coordinate operator mechanisms with door operation, hinges, and activation devices.
 - 1. Fire-Rated Doors: Provide door operators for fire-rated door assemblies that comply with NFPA 80 for fire-rated door components and are listed and labeled by a qualified testing agency.
- B. Brackets and Reinforcements: Manufacturer's standard, fabricated from aluminum with nonferrous shims for aligning system components.
- C. Standard: Certified ANSI/BHMA A156.19.
 - 1. Performance Requirements:
 - a. Opening Force if Power Fails: Not more than 15 pounds required to release a latch if provided, not more than 30 pounds required to manually set door in motion, and not more than 15 pounds required to fully open door.
 - b. Entrapment Protection: Not more than 15 pounds required to prevent stopped door from closing or opening.
- D. Configuration: Surface mounted. Door operators to control single swinging and pair of swinging doors.
- E. Operation: Power opening and spring closing operation capable of meeting ANSI A117.1 accessibility guideline. Provide time delay for door to remain open before initiating closing cycle as required by ANSI/BHMA A156.19. When not in automatic mode, door operator to function as manual door closer with fully adjustable opening and closing forces, with or without electrical power.
 - 1. On-off switch to control power to be key switch operated.
- F. Features: Operator units to have full feature adjustments for door opening and closing force and speed, backcheck, motor assist acceleration from 0 to 30 seconds, time delay, vestibule interface delay, obstruction recycle, and hold open time from 0 up to 30 seconds.
- G. Provide outputs and relays on board the operator to allow for coordination of exit device latch retraction, electric strikes, magnetic locks, card readers, safety and motion sensors and specified auxiliary contacts.
- H. Activation Devices: Provide activation devices in accordance with ANSI/BHMA A156.19 standard, for condition of exposure indicated and for long term, maintenance free operation under normal traffic load operation. Coordinate activation control with electrified hardware and access control interfaces. Activation switches are standard SPST, with optional DPDT availability.
- I. Signage: As required by cited ANSI/BHMA A156.19 standard for the type of operator.
 - 1. Acceptable Manufacturers:
 - a. Horton Automatics (HO) - 4000 Series.
 - b. LCN Closers (LC) - 4640 Series.
 - c. Norton Door Controls (NO) - 6000 Series.

- d. Or approved equal.

2.10 SURFACE MOUNTED CLOSER HOLDERS

- A. Single Point Closer Holders: Single point closer holder designed to hold open fire or smoke rated doors until interruption of signal from fire alarm, smoke detector or remote release switch. Pull side, push side, or double egress mounting applications available with non-handed track and closer body and dual voltage input (24V/120V). Voltage to be 24VDC unless otherwise specified. Pull side mounted closers to have minimum adjustable hold-open range of 85 to 110 degrees. Auxiliary door stops are required at hold open point.

1. Acceptable Manufacturers:

- a. LCN Door Closers (LC) - 4040SE Series.
- b. Norton Door Controls (NO) - 7200 Series.
- c. Rixson Door Controls (RF) - Smok-Chek V Series.
- d. Sargent Manufacturing (SA) - 2408 Series.
- e. Corbin Russwin (RU) DC62900 Series.
- f. Or approved equal.

2.11 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. Acceptable Manufacturers:

- a. Ives (IV).
- b. Rockwood Manufacturing (RO).
- c. Trimco (TC).
- d. Or approved equal.

- 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. Acceptable Manufacturers:

- a. Glynn Johnson (GJ).
- b. Rixson Door Controls (RF).
- c. Rockwood Manufacturing (RO).
- d. Sargent Manufacturing (SA).
- e. Or approved equal.

2.12 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 UBC 7-2, 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. Acceptable Manufacturers:
 - 1. National Guard Products (NG).
 - 2. Pemko Manufacturing (PE).
 - 3. Reese Enterprises, Inc. (RE).
 - 4. Or approved equal.

2.13 ELECTRONIC ACCESSORIES

- A. Door Position Switches: Door position magnetic reed contact switches specifically designed for use in commercial door applications. On recessed models the contact and magnetic housing snap-lock into a 1 inch diameter hole. Surface mounted models include wide gap distance design complete with armored flex cabling. Provide SPDT, N/O switches with optional Rare Earth Magnet installation on steel doors with flush top channels.
 - 1. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) – 3280 Series.
 - b. Security Door Controls (SD) - DPS Series.
 - c. Securitron (SU) - DPS Series.
 - d. Or approved equal.
- B. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.

1. Acceptable Manufacturers:
 - a. Corbin Russwin Hardware (RU) – 782.
 - b. Sargent Manufacturing (SA) – 3500 Series.
 - c. Securitron (SU) - BPS Series.
 - d. Von Duprin (VD) - PS.
 - e. Or approved equal.

2.14 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.

2.15 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.

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 Contracting Authority'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 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 Engineer 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. Manufacturer's Abbreviations:

1. MK - McKinney
2. SA - Sargent
3. RF - Rixson
4. NO - Norton
5. RO - Rockwood
6. PE - Pemko
7. SU - Securitron

Hardware Schedule

Set: 1.0

Doors: 101a

2 Continuous Hinge	MCK-14HD EPT	CL	MK
1 Exit Device CVR-LBR	12 NB 43 53 55 56 MD8613 ETL (latch retraction)	US32D	SA
1 Exit Device CVR-LBR	12 NB 43 53 55 MD8613 ETL	US32D	SA
1 Door Closer	281 P10	EN	SA
1 Door Operator	6060	689	NO
2 Kick Plate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
2 Wall Stop	400	US26D	RO
1 Gasketing	S88D		PE
2 Door Sweep	315CN TKSP8281		PE
2 Electric Power Transfer	EL-CEPT		SU
2 ElectroLynx Harness	QC-C1500P (Frame - EPT to Power/Controller)		MK

2 ElectroLynx Harness	QC-CxxxP (Door - EPT to Exit Device)	MK
1 Wiring Diagram	WD-SYSPK	SA
2 Door Actuator Switch	505	NO
2 Door Position Switch	DPS-M-GY	SU
1 Power Supply	BPS-24-1	SU

Notes: Doors normally closed, latched and secure.
 Free egress at all times.
 Entry by ADA Operator as programmed by access control system.
 Card reader and electrical wiring by security contractor.

Set: 2.0

Doors: 101b

2 Continuous Hinge	MCK-14HD	CL	MK
2 Exit Device CVR-LBR	12 NB 43 MD8613 ETL	US32D	SA
2 Electromechanical Closer/Holder	2468	EN	SA
2 Kick Plate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1 Gasketing	S88D		PE
1 Astragal (2-piece set)	29324CNB TKSP8		PE

Set: 3.0

Doors: 102a, 102b

2 Continuous Hinge	MCK-14HD EPT	CL	MK
1 Exit Device CVR	16 43 53 55 56 MD8613 ETL (latch retraction)	US32D	SA
1 Exit Device CVR	16 43 53 55 MD8613 ETL	US32D	SA
1 Door Closer	281 P10	EN	SA
1 Door Operator	6060	689	NO
2 Kick Plate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1 Threshold	253x3AFG		PE
1 Weather Stripping	316APK TKSP8		PE
1 Rain Guard	346A TKSP8		PE
2 Door Sweep	315CN TKSP8281		PE
1 Astragal (2-piece set)	29324CNB TKSP8		PE
2 Electric Power Transfer	EL-CEPT		SU
2 ElectroLynx Harness	QC-C1500P (Frame - EPT to Power/Controller)		MK
2 ElectroLynx Harness	QC-CxxxP (Door - EPT to Exit Device)		MK
1 Wiring Diagram	WD-SYSPK		SA
2 Door Actuator Switch	505		NO
2 Door Position Switch	DPS-M-GY		SU

1 Power Supply

BPS-24-1

SU

Notes: Doors normally closed, latched and secure.

Free egress at all times.

Entry by card reader or ADA Operator as programmed by access control system.

Card reader and electrical wiring by security contractor.

Set: 4.0

Doors: 103, 104, 105

1 Continuous Hinge	MCK-14HD	CL	MK
1 Storeroom Lock	8204 LNL	US26D	SA
1 Surface Overhead Stop	9-X36	630	RF
1 Door Closer	281 PD10	EN	SA
1 Kick Plate	K1050 10" x 2" LDW 4BE CSK	US32D	RO
1 Threshold	253x3AFG		PE
1 Weather Stripping	316APK TKSP8		PE
1 Rain Guard	346A TKSP8		PE
1 Door Sweep	315CN TKSP8281		PE
1 Door Position Switch	DPS-M-GY		SU

END OF SECTION 08 7100

**SECTION 08 8000
GLAZING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Insulating glass units.
- B. Glazing compounds and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 08 4313 - Aluminum-Framed Storefronts: Glazing furnished as part of storefront assembly.
- B. Section 08 4413 - Glazed Aluminum Curtain Walls: Glazing furnished as part of wall assembly.

1.3 REFERENCE STANDARDS

- A. ASTM C1193 - Standard Guide for Use of Joint Sealants; 2013.
- B. ASTM C1376 - Standard Specifications for Pyrolytic and Vacuum Deposition Coatings on Flat Glass; 2010.
- C. ASTM E2190 - Standard Specifications for Insulating Glass Unit Performance and Evaluation; 2010.
- D. GANA (SM) - GANA Sealant Manual; Glass Association of North America; 2008.

1.4 SUBMITTALS

- A. Product Data on Insulating Glass Unit Glazing Types: Provide structural, physical and environmental characteristics, size limitations, and special handling and installation requirements.
- B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements. Identify available colors.
- C. Samples: Submit two samples 6 inches by 6 inch in size of glass units.
- D. Manufacturer's Certificate: Certify that glass and glazing products meets or exceeds specified requirements.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Contracting Authority's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing the work of this section with minimum 3 years documented experience.

1.6 MOCK-UPS

- A. Provide on-site glazing mock-up with the specified glazing components.
- B. Locate where directed.

1.7 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F (4 degrees C).
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.8 WARRANTY

- A. Insulating Glass Units: Provide a 5 year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including replacement of failed units.

PART 2 PRODUCTS

2.1 INSULATING GLASS UNITS

- A. Insulating Glass Units Manufacturers:
 - 1. Fabricator certified by glass manufacturer for type of glass, coating, and treatment involved and capable of providing specified warranty.
 - 2. Cardinal Glass Industries: www.cardinalcorp.com.
 - 3. Guardian Industries Corp: www.sunguardglass.com.
 - 4. Pilkington North America Inc: www.pilkington.com/na.
 - 5. PPG Industries, Inc: www.ppgideascales.com.
 - 6. Viracon, Apogee Enterprises, Inc: www.viracon.com.
 - 7. Or approved equal.
- B. Insulating Glass Units: Types as indicated.
 - 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 - 2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
 - 3. Metal Edge Spacers: Aluminum, bent and soldered corners.
 - 4. Spacer Color: Black.
 - 5. Edge Seal: Glass to elastomer with supplementary silicone sealant.
 - 6. Edge Seal Color: Black.
 - 7. Purge interpane space with dry air, hermetically sealed.
- C. Type IG-1 - Insulating Glass Units: Vision glass, double glazed.
 - 1. Applications: Exterior glazing unless otherwise indicated.
 - 2. Space between lites filled with air.
 - 3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.

4. Inboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 5. Total Thickness: 1 inch.
 6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.38, maximum.
 7. Solar Heat Gain Coefficient (SHGC): 0.40%, maximum.
- D. Type SP - Insulating Glass Units: Spandrel glazing.
1. Applications: Exterior spandrel glazing unless otherwise indicated.
 2. Space between lites filled with air.
 3. Outboard Lite: Annealed float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Same as on vision units, on #2 surface.
 4. Inboard Lite: Heat-strengthened float glass, 1/4 inch thick.
 - a. Tint: Clear.
 - b. Opacifier: Ceramic frit, on #4 surface.
 - c. Opacifier Color: Black.
 5. Total Thickness: 1 inch.
 6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.38, maximum.
- E. Type IG-2 - Insulating Glass Units: Safety glazing.
1. Applications:
 - a. Glazed lites in exterior doors.
 - b. Glazed sidelights and panels next to doors.
 - c. Other locations required by applicable federal, state, and local codes and regulations.
 2. Space between lites filled with air.
 3. Glass Type: Same as Type IG-1 except use fully tempered float glass for both outboard and inboard lites.
 4. Tint: Clear.
 5. Total Thickness: 1 inch.
 6. Thermal Transmittance (U-Value), Summer - Center of Glass: 0.38, maximum.
 7. Solar Heat Gain Coefficient (SHGC) 0.40%, maximum.
 8. Glazing Method: Dry glazing method, gasket glazing.

2.2 GLAZING COMPOUNDS

- A. Glazing Putty: Polymer modified latex recommended by manufacturer for outdoor use, knife grade consistency; grey color.
- B. Silicone Sealant: Single component; neutral curing; capable of water immersion without loss of properties; non-bleeding; non-staining; ASTM C 920, Type S, Grade NS, Class 25, Uses M, A, and G; cured Shore A hardness of 15 to 25; Color: As selected by Engineer from standard colors.

2.3 ACCESSORIES

- A. Setting Blocks: Silicone, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

- A. Verify that openings for glazing are correctly sized and within tolerances, including those for size, squareness, and offsets at corners.
- B. Verify that surfaces of glazing channels or recesses are clean, free of obstructions that may impede moisture movement, weeps are clear, and support framing is ready to receive glazing system.

3.2 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.3 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA Sealant Manual, and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.4 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.

- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

3.5 PROTECTION

- A. After installation, mark pane with an 'X' by using removable plastic tape or paste; do not mark heat absorbing or reflective glass units.
- B. Remove and replace glass that is damaged during construction period prior to Date of Substantial Completion.

END OF SECTION

**SECTION 09 2116
GYPSUM BOARD ASSEMBLIES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Performance criteria for gypsum board assemblies.
- B. Metal stud wall framing.
- C. Metal channel ceiling framing.
- D. Gypsum wallboard.
- E. Joint treatment and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 06 1000 - Rough Carpentry: Wood blocking product and execution requirements.
- B. Section 07 8400 - Firestopping: Top-of-wall assemblies at fire rated walls.

1.3 REFERENCE STANDARDS

- A. ASTM A653 – Standard Specifications for Steel Sheet, Zinc-coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2013.
- B. ASTM C475 - Standard Specifications for Joint Compound and Joint Tape for Finishing Gypsum Board; 2012.
- C. ASTM C645 - Standard Specifications for Nonstructural Steel Framing Members; 2014.
- D. ASTM C754 - Standard Specifications for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products; 2011.
- E. ASTM C840 - Standard Specifications for Application and Finishing of Gypsum Board; 2013.
- F. ASTM C954 – Standard Specifications for Steel Drill Screws for the Application of Gypsum Panel Products or Metal Plaster Bases to Steel Studs from 0.033 inch to 0.112 inch in Thickness; 2011.
- G. ASTM C1002 – Standard Specifications for Steel Self-Piercing Tapping Screws for Application of Gypsum Panels Products or Metal Plaster Bases to Wood Studs or Steel Studs; 2014.
- H. ASTM C1047 - Standard Specifications for Accessories for Gypsum Wallboard and Gypsum Veneer Base; 2014a.
- I. ASTM C1396 - Standard Specifications for Gypsum Board; 2014.
- J. ASTM C1658 - Standard Specifications for Glass Mat Gypsum Panels; 2013.
- K. ASTM D3273 - Standard Test Method for Resistance to Growth of Mold on the Surface of Interior Coatings in an Environmental Chamber; 2012.
- L. GA-216 - Application and Finishing of Gypsum Board; Gypsum Association; 2013.
- M. GA-600 - Fire Resistance Design Manual; Gypsum Association; 2012.
- N. UL (FRD) - Fire Resistance Directory; Underwriters Laboratories Inc.; current edition.

1.4 SUBMITTALS

- A. Product Data: Provide data on metal framing, gypsum board, accessories, and joint finishing system.
- B. Product Data: Provide manufacturer's data on partition head to structure connectors, showing compliance with requirements.

PART 2 PRODUCTS

2.1 GYPSUM BOARD ASSEMBLIES

- A. Provide completed assemblies complying with ASTM C840 and GA-216.
- B. Fire Rated Assemblies: Provide completed assemblies complying with applicable code.
 - 1. Fire Rated Shaft Walls: UL listed assembly No. U415; 1 and 2 hour rating, see drawings for locations.
 - 2. UL Assembly Numbers: Provide construction equivalent to that listed for the particular assembly in the current UL (FRD).

2.2 METAL FRAMING MATERIALS

- A. Manufacturers - Metal Framing, Connectors, and Accessories:
 - 1. Clarkwestern Dietrich Building Systems LLC: www.clarkdietrich.com.
 - 2. Marino: www.marinoware.com.
 - 3. Phillips Manufacturing Company: www.phillipsmfg.com.
 - 4. Or approved equal.
- B. Non-Loadbearing Framing System Components: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754 for the spacing indicated, with maximum deflection of wall framing of L/240 at 5 psf.
 - 1. Studs: "C" shaped with flat or formed webs with knurled faces.
 - 2. Runners: U shaped, sized to match studs.
 - 3. Ceiling Channels: C-shaped.
 - 4. Furring: Hat-shaped sections, minimum depth of 7/8 inch.
 - 5. Depths as shown on drawings.
- C. Shaft Wall Studs and Accessories: ASTM C645; galvanized sheet steel, of size and properties necessary to comply with ASTM C754.
 - 1. Studs: "C-H" shaped.
 - 2. Runners: "J" shaped for floor, sides, and ceiling.
 - 3. Manufacturers - Shaft Wall Studs and Accessories:
 - a. Same manufacturer as other framing materials.
- D. Ceiling Hangers: Type and size as specified in ASTM C754 for spacing required.

- E. Partition Head to Structure Connections: Provide mechanical anchorage devices that accommodate deflection using slotted holes, screws and anti-friction bushings, preventing rotation of studs while maintaining structural performance of partition.
 - 1. Structural Performance: Maintain lateral load resistance and vertical movement capacity required by applicable code, when evaluated in accordance with AISI SG02-1.
 - 2. Material: ASTM A653 steel sheet, SS Grade 50, with G60 hot dipped galvanized coating.

2.3 BOARD MATERIALS

A. Manufacturers - Gypsum-Based Board:

- 1. American Gypsum Company: www.americangypsum.com.
- 2. Georgia-Pacific Gypsum: www.gpgypsum.com.
- 3. National Gypsum Company: www.nationalgypsum.com.
- 4. USG Corporation: www.usg.com.
- 5. Or approved equal.

B. Gypsum Wallboard: Paper-faced gypsum panels as defined in ASTM C1396/C1396M; sizes to minimize joints in place; ends square cut.

- 1. Application: Use for ceilings and above 8 feet 0 inches AFF, unless otherwise indicated.
- 2. At Assemblies Indicated with Fire-Rating: Use type required by indicated tested assembly; if no tested assembly is indicated, use Type X board, UL or WH listed.
- 3. Thickness: As indicated on drawings, and as follows:
 - a. Vertical Surfaces: 5/8 inch unless noted otherwise.
 - b. Ceilings: 5/8 inch.
 - c. Multi-Layer Assemblies: Thicknesses as indicated on drawings.

C. Impact Resistant Wallboard:

- 1. Application: From Fin Floor to 8 feet 0 inches AFF.
- 2. Mold Resistance: Score of 10, when tested in accordance with ASTM D3273.
- 3. Type: Fire resistance rated Type X, UL or WH listed.
- 4. Thickness: 5/8 inch.
- 5. Edges: Tapered.
- 6. Products:
 - a. American Gypsum Company; M-Bloc IR Type X.
 - b. Continental Building Products; Protecta HIR 300 Type X with Mold Defense.
 - c. Georgia-Pacific Gypsum; DensArmor Plus Impact-Resistant.
 - d. National Gypsum Company; Gold Bond eXP Interior Extreme IR Gypsum Panel.
 - e. Or approved equal.

- D. Shaftwall and Coreboard: Type X; 1 inch thick by 24 inches wide, square long edges, ends square cut.
 - 1. Glass Mat Faced Type: Glass mat shaftliner gypsum panel or glass mat coreboard gypsum panel as defined in ASTM C1658/C1658M.
 - 2. Products:
 - a. American Gypsum Company; M-Glass Shaft Liner.
 - b. Continental Building Products; Weather Defense Platinum Shaftliner Type X.
 - c. Georgia-Pacific Gypsum; DensGlass Shaftliner (mold-resistant).
 - d. National Gypsum Company; Gold Bond Brand eXP Shaftliner.
 - e. Or approved equal.

2.4 ACCESSORIES

- A. Finishing Accessories: ASTM C1047, galvanized steel or rolled zinc, unless noted otherwise.
 - 1. Types: As required for finished appearance.
- B. Joint Materials: ASTM C475 and as recommended by gypsum board manufacturer for project conditions.
- C. Screws for Attachment to Steel Members Less Than 0.033 inch In Thickness, to Wood Members, and to Gypsum Board: ASTM C1002; self-piercing tapping type; cadmium plated for exterior locations.
- D. Screws for Attachment to Steel Members From 0.033 to 0.112 inch in Thickness: ASTM C954; steel drill screws for application of gypsum board to loadbearing steel studs.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that project conditions are appropriate for work of this section to commence.

3.2 SHAFT WALL INSTALLATION

- A. Shaft Wall Framing: Install in accordance with manufacturer's installation instructions.
 - 1. Install "C-H" at 24 inches on center, and per UL system.
- B. Shaft Wall Liner: Cut panels to accurate dimension and install sequentially between special friction studs.

3.3 FRAMING INSTALLATION

- A. Metal Framing: Install in accordance with ASTM C754 and manufacturer's instructions.
- B. Suspended Ceilings and Soffits: Space framing and furring members at 16 inches on center, unless noted otherwise.
 - 1. Install bracing as required at exterior locations to resist wind uplift.
- C. Studs: Space studs at 16 inches on center.
 - 1. Extend partition framing to structure where indicated and to ceiling in other locations.

2. Partitions Terminating at Ceiling: Attach ceiling runner securely to ceiling track in accordance with manufacturer's instructions.
 3. Partitions Terminating at Structure: Attach top runner to structure, maintain clearance between top of studs and structure, and connect studs to track using specified mechanical devices in accordance with manufacturer's instructions; verify free movement of top of stud connections; do not leave studs unattached to track.
- D. Openings: Reinforce openings as required for weight of doors or operable panels, using not less than double studs at jambs.

3.4 BOARD INSTALLATION

- A. Comply with ASTM C840, GA-216, and manufacturer's instructions. Install to minimize butt end joints, especially in highly visible locations.
- B. Single-Layer Non-Rated: Install gypsum board in most economical direction, with ends and edges occurring over firm bearing.
- C. Fire-Rated Construction: Install gypsum board in strict compliance with requirements of assembly listing.
- D. Installation on Metal Framing: Use screws for attachment of gypsum board.

3.5 INSTALLATION OF TRIM AND ACCESSORIES

- A. Control Joints: Place control joints where shown on drawings, but not to exceed 25 feet.
- B. Corner Beads: Install at external corners, using longest practical lengths.

3.6 JOINT TREATMENT

- A. Finish gypsum board in accordance with levels defined in ASTM C840, as follows:
 1. Level 4: All walls and ceilings to receive paint finish or wall coverings, unless otherwise indicated.
- B. Tape, fill, and sand exposed joints, edges, and corners to produce smooth surface ready to receive finishes.
 1. Feather coats of joint compound so that camber is maximum 1/32 inch.

3.7 TOLERANCES

- A. Maximum Variation of Finished Gypsum Board Surface from True Flatness: 1/8 inch in 10 feet in any direction.

END OF SECTION

**SECTION 09 2216.13
NON-STRUCTURAL PLASTIC FURRING**

PART 4 - GENERAL

4.1 SUMMARY

A. Section Includes:

1. Non-load-bearing recycled plastic furring systems for interior gypsum board assemblies.

B. Related Requirements:

4.2 ACTION SUBMITTALS

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

4.3 INFORMATIONAL SUBMITTALS

- A. Evaluation Reports: Screw pullout test from EcoStud LLC.

- B. Construction detail: Detail drawings.

PART 5 - PRODUCTS

5.1 PERFORMANCE REQUIREMENTS

- A. Physical properties of the recycled plastic resin used to produce the non-structure recycled plastic furring elements: Tensile strength greater than 6000 PSI ASTM D 638-08, Izod Impact 6 – 12 ASTM D 256, Flame Spread Log 1 ASTM E162, Limited Oxygen Index LOI 48 ASTM D2843, Maximum Smoke Density Dm 280 ASTM E662, Screw pull-out value greater than 100 pounds SPP Internal Standard, Thermal Conductivity 0.19 W/mK, Acoustical Velocity 1920 m. min, Impedance 3.27 MRayls, Attenuation 11.2 dB/cm, 5 MHz, Density 1.38 gm/cm³
- B. Bond characteristics of adhesive: Adhesive shall exhibit t-pull bond strength of greater than 50 psi. Preferred failure mode is cohesive.

5.2 FURRING SYSTEMS

- A. Recycled Content of Plastic Products: 100% post industrial recycled content with varying amounts of Post-consumer recycled content. Where needed for specific LEED accreditation 100% post consumer content may be specified, if specified it shall be called out and the contractor and manufacturer shall be made aware through signed documentation.
- B. Z-Shaped Furring: With non-slotted web, typical profile thickness of 0.090 inch, wall attachment flange of greater than 1.375 inch and depth required to fit insulation thickness indicated.

5.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Recycled Plastic Furring: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten recycled plastic members to substrates.
 - 2. Adhesives: OSI QB-300, Chemlink M-1, Chemlink Build Secure, Chemlink Wall Secure or Engineer approved equal
 - 3. Sealants: 30 year Siliconized Acrylic Sealant, Chemlink M-1, 100% pure silicone or Engineer approved equal.

PART 6 - EXECUTION

6.1 EXAMINATION

- A. Examine areas and substrates, with Installer present for compliance with requirements and other conditions affecting performance of the Work.
- B. Clean by scraping any mortar or other protrusion from the substrate. Any surface dirt, dust or effervescence shall be removed through brushing or other acceptable means.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

6.2 INSTALLATION, GENERAL

- A. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- B. Do not bridge building control and expansion joints with recycled plastic furring members. Fur both sides of joints independently.
- C. Direct Furring with Z-Furring Members:
 - 1. Erect insulation, specified in Division 07 Section "Thermal Insulation," vertically and hold in place with Z-furring members spaced 24 inches o.c. per design specification.
 - 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with a minimum of 10 square inch coverage of adhesive per 8 foot section using either a continuous bead or evenly spaced deposit technique and concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 16 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 per detail 10-3671. At interior corners, space second member no more than 12 inches from corner and cut insulation to fit.
- D. 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 09 2216.13

**SECTION 09 5100
ACOUSTICAL CEILINGS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Suspended metal grid ceiling system.
- B. Acoustical units.

1.2 RELATED REQUIREMENTS

- A. Section 05 3100 - Steel Decking: Placement of special anchors or inserts for suspension system.
- B. Section 26 5100 - Interior Lighting: Light fixtures in ceiling system.

1.3 REFERENCE STANDARDS

- A. ASTM C635 - Standard Specifications for the Manufacture, Performance, and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings; 2013a.
- B. ASTM C636 - Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels; 2013.
- C. ASTM E1264 - Standard Classification for Acoustical Ceiling Products; 2014.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Sequence work to ensure acoustical ceilings are not installed until building is enclosed, sufficient heat is provided, dust generating activities have terminated, and overhead work is completed, tested, and approved.
- B. Do not install acoustical units until after interior wet work is dry.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate grid layout and related dimensioning.
- B. Product Data: Provide data on suspension system components.
- C. Samples: Submit two samples 4 inches by 4 inches in size illustrating material and finish of acoustical units.
- D. Samples: Submit two samples each, 4 inches long, of suspension system main runner.
- E. Maintenance Materials: Furnish the following for Contracting Authority's use in maintenance of project.
 - 1. Extra Acoustical Units: Quantity equal to 5% of total installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acoustic Panels:
 - 1. Armstrong World Industries, Inc: www.armstrong.com - Basis of Design
 - 2. Hunter Douglas Contract: www.hunterdouglascontract.com.

3. USG: www.usg.com.
 4. Or approved equal.
- B. Suspension Systems:
1. Same as for acoustical units.

2.2 ACOUSTICAL UNITS

- A. Acoustical Tile Type ACT-1: Painted mineral fiber, ASTM E1264, Type IV with the following characteristics:
1. Size: 48 inches by 48 inches.
 2. Thickness: 5/8 inches.
 3. Composition: Water felted.
 4. Light Reflectance: 0.90, determined in accordance with ASTM E1264.
 5. NRC: 0.75, determined in accordance with ASTM E1264.
 6. Ceiling Attenuation Class (CAC): 35, determined in accordance with ASTM E1264.
 7. Edge: Square.
 8. Surface Color: White.
 9. Surface Finish: Fine Fissured.
 10. Suspension System: Exposed grid.
 11. Products:
 - a. Armstrong, Ultima - Basis of Design.
 - b. Hunter Douglas
 - c. USG
 - d. Or approved equal.
- B. Glass Fiber Acoustical Panels Type ACT-2: Fiberglass with acoustic transparent scrim, with the following characteristics:
1. Size: 24 inches by 72 inches.
 2. Thickness: 7/8 inch.
 3. Light Reflectance: 0.90, determined in accordance with ASTM E1264.
 4. NRC: 0.90, determined in accordance with ASTM C423.
 5. Edge: Reverse Tegular.
 6. Panel Surface Color: White.
 7. Cap Color Selection: White.
 8. Surface Texture: Fine.
 9. Suspension System: Exposed Tee grid

10. Products:
 - a. Armstrong, Capz, Ultima - Basis of Design.
 - b. Hunter Douglas
 - c. USG - DX/DXL
 - d. Or approved equal.

2.3 SUSPENSION SYSTEM(S)

- A. Suspension Systems - General: Complying with ASTM C635/C635M; die cut and interlocking components, with stabilizer bars, clips, splices, perimeter moldings, and hold down clips as required.
- B. Exposed Steel Suspension System: Formed galvanized steel, commercial quality cold rolled.
 1. Profile: Tee; 15/16 inch wide face.
 2. Construction: Double web.
 3. Finish: White, to match color of ceiling tile.
 4. Products:
 - a. For ACT-1: Armstrong, Prelude or USG DONN
 - b. For ACT-2: Armstrong, Prelude XL or USG DONN DX/DXL.
 - c. Or approved equal.

2.4 ACCESSORIES

- A. Support Channels and Hangers: Galvanized steel; size and type to suit application and ceiling system flatness requirement specified.
 1. Wire for Hangers and Ties: ASTM A 641, Class 1 zinc coating, soft annealed, with a yield stress load of at least time three design load, but not less than 12 gauge.
- B. Perimeter Moldings: Same material and finish as grid.
 1. At Exposed Grid: Provide L-shaped molding for mounting at same elevation as face of grid.
- C. Touch-up Paint: Type and color to match acoustical and grid units.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that layout of hangers will not interfere with other work.

3.2 INSTALLATION - SUSPENSION SYSTEM

- A. Install suspension system in accordance with ASTM C636, ASTM E580, and manufacturer's instructions and as supplemented in this section.
- B. Rigidly secure system, including integral mechanical and electrical components, for maximum deflection of 1:360.

- C. Locate system on room axis according to reflected plan.
- D. Install after major above-ceiling work is complete. Coordinate the location of hangers with other work.
- E. Hang suspension system independent of walls, columns, ducts, pipes and conduit. Where carrying members are spliced, avoid visible displacement of face plane of adjacent members.
- F. Where ducts or other equipment prevent the regular spacing of hangers, reinforce the nearest affected hangers and related carrying channels to span the extra distance.
- G. Do not support components on main runners or cross runners if weight causes total dead load to exceed deflection capability.
- H. Support fixture loads using supplementary hangers located within 6 inches of each corner, or support components independently.
- I. Do not eccentrically load system or induce rotation of runners.
- J. Perimeter Molding: Install at intersection of ceiling and vertical surfaces and at junctions with other interruptions.
 - 1. Use longest practical lengths.
 - 2. Overlap and rivet corners.

3.3 INSTALLATION - ACOUSTICAL UNITS

- A. Install acoustical units in accordance with manufacturer's instructions.
- B. Fit acoustical units in place, free from damaged edges or other defects detrimental to appearance and function.
- C. Fit border trim neatly against abutting surfaces.
- D. Install units after above-ceiling work is complete.
- E. Install acoustical units level, in uniform plane, and free from twist, warp, and dents.
- F. Cutting Acoustical Units:
 - 1. Make field cut edges of same profile as factory edges.
- G. Install hold-down clips on each panel to retain panels tight to grid system; comply with fire rating requirements.
- H. Install hold-down clips on panels within 20 feet of an exterior door.

END OF SECTION

**SECTION 09 6500
RESILIENT FLOORING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Resilient base.
- B. Installation accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

1.3 REFERENCE STANDARDS

- A. ASTM F1861 - Standard Specifications for Resilient Wall Base; 2008 (Reapproved 2012)e1.

1.4 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; including sizes, patterns and colors available; and installation instructions.
- B. Selection Samples: Submit manufacturers complete set of color samples for Engineer's initial selection.
- C. Maintenance Materials: Furnish the following for Contracting Authority's use in maintenance of project.
 - 1. Extra Wall Base: Quantity equivalent to 5% of each type and color.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store all materials off of the floor in an acclimatized, weather-tight space.
- B. Protect roll materials from damage by storing on end.

1.6 FIELD CONDITIONS

- A. Store materials for not less than 48 hours prior to installation in area of installation at a temperature of 70°F to achieve temperature stability. Thereafter, maintain conditions above 55°F.

PART 2 PRODUCTS

2.1 RESILIENT BASE

- A. Resilient Base: ASTM F1861, Type TS rubber, vulcanized thermoset; top set Style A, Straight (Toeless).
 - 1. Manufacturers:
 - a. Burke Flooring: www.burkemercer.com.
 - b. Johnsonite, a Tarkett Company: www.johnsonite.com.
 - c. Roppe Corp: www.roppe.com.
 - d. Or approved equal.

2. Height: 4 inches.
3. Thickness: 0.125 inch thick.
4. Finish: Satin.
5. Length: Roll.
6. Color: Color as selected from manufacturer's standards.
7. Accessories: Premolded external corners and end stops.

2.2 ACCESSORIES

- A. Primers and Adhesives: Waterproof; types recommended by base manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are flat to tolerances acceptable to flooring manufacturer, free of cracks that might telegraph through flooring, clean, dry, and free of curing compounds, surface hardeners, and other chemicals that might interfere with bonding of flooring to substrate.
- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive resilient base.

3.2 PREPARATION

- A. Clean substrate.
- B. Apply primer as required to prevent "bleed-through" or interference with adhesion by substances that cannot be removed.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's written instructions.
- B. Spread only enough adhesive to permit installation of materials before initial set.
- C. Fit joints and butt seams tightly.

3.4 RESILIENT BASE

- A. Fit joints tightly and make vertical. Maintain minimum dimension of 18 inches between joints.
- B. Install base on solid backing. Bond tightly to wall and floor surfaces.
- C. Scribe and fit to door frames and other interruptions.

3.5 CLEANING

- A. Remove excess adhesive from floor, base, and wall surfaces without damage.
- B. Clean in accordance with manufacturer's written instructions.

END OF SECTION

**SECTION 09 6813
TILE CARPETING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Carpet tile, fully adhered.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Restrictions on curing compounds for concrete slabs and floors.

1.3 REFERENCE STANDARDS

- A. CRI 104 - Standard for Installation of Commercial Carpet; Carpet and Rug Institute; 2015.
- B. CRI (CIS) - Carpet Installation Standard; Carpet and Rug Institute; 2011.

1.4 SUBMITTALS

- A. Product Data: Provide data on specified products, describing physical and performance characteristics; sizes, patterns, colors available, and method of installation.
- B. Shop Drawings: Indicate layout of joints.
- C. Samples: Submit one full-size carpet tile illustrating color and pattern design for each carpet color selected.
- D. Maintenance Materials: Furnish the following for Contracting Authority's use in maintenance of project.
 - 1. Extra Carpet Tiles: Quantity equal to 5% of total installed of each color and pattern installed.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in installing carpet tile with minimum three years documented experience.

1.6 FIELD CONDITIONS

- A. Store materials in area of installation for minimum period of 24 hours prior to installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Mohawk Group; Lees, Denim Collection - Basis of design.
- B. Interface, Inc; www.interfaceinc.com
- C. Shaw Contract; www.shawcontract.com
- D. Or approved equal
- E. Suppliers:
 - 1. Appleby & Horn.
 - 2. Randy's Carpets & Interiors.

3. Carpet King.
4. Phelan's Interiors.
5. Or approved equal.

2.2 MATERIALS

- A. Tile Carpeting, Type CPT-1: Tufted, manufactured in one color dye lot.
 1. Product: Hem GT295 manufactured by Mohawk Group - Basis of design. See 2.1 Manufacturers for other acceptable manufacturers.
 2. Tile Size: 12 inches by 36 inches, nominal.
 3. Color: Skinny 955.
 4. Face Weight: 17.0 ounce per square yard.
 5. Max. Electrostatic Charge: 3.5 Kilovolts. per AATCC-134
 6. Gage: 1/12 inch.
 7. Stitches: 11.0 per inch.
 8. Density: 7043.
 9. Primary Backing Material: EcoFlex ICT.
- B. Tile Carpeting, Type CPT-2: Tufted, manufactured in one color dye lot.
 1. Product: Zip It GT296 manufactured by Mohawk Group - Basis of design. See 2.1 - Manufacturers for other acceptable manufacturers.
 2. Tile Size: 12 inches x 36 inches, nominal.
 3. Color: Skinny 955.
 4. Face Weight: 17.0 ounce per square yard.
 5. Max. Electrostatic Charge: 3.5 Kilovolts. per AATCC-134
 6. Gage: 1/12 inch.
 7. Stitches: 11.0 per inch.
 8. Density: 7043.
 9. Primary Backing Material: EcoFlex ICT.

2.3 ACCESSORIES

- A. Sub-Floor Filler: White premix latex; type recommended by flooring material manufacturer.
- B. Carpet Tile Adhesive: Recommended by carpet tile manufacturer.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that sub-floor surfaces are smooth and flat within tolerances specified for that type of work and are ready to receive carpet tile.

- B. Verify that wall surfaces are smooth and flat within the tolerances specified for that type of work, are dust-free, and are ready to receive carpet tile.
- C. Verify that sub-floor surfaces are dust-free and free of substances that could impair bonding of adhesive materials to sub-floor surfaces.
- D. Cementitious Sub-floor Surfaces: Verify that substrates are dry enough and ready for flooring installation by testing for moisture and pH.
 - 1. Obtain instructions if test results are not within limits recommended by flooring material manufacturer and adhesive materials manufacturer.

3.2 PREPARATION

- A. Prepare floor substrates as recommended by flooring and adhesive manufacturers.
- B. Vacuum clean substrate.

3.3 INSTALLATION

- A. Starting installation constitutes acceptance of sub-floor conditions.
- B. Install carpet tile in accordance with manufacturer's instructions and CRI (CIS).
- C. Blend carpet from different cartons to ensure minimal variation in color match.
- D. Cut carpet tile clean. Fit carpet tight to intersection with vertical surfaces without gaps.
- E. Installation Method:
 - 1. Lay carpet tile in brick ashlar pattern, with pile direction parallel to next unit, set parallel to building lines. See floor finish plan.
 - 2. Mix: 50% CPT-1 and 50% CPT-2, randomly mix equal amounts of each carpet type.
- F. Fully adhere carpet tile to substrate.
- G. Trim carpet tile neatly at walls and around interruptions.
- H. Complete installation of edge strips, concealing exposed edges.

3.4 CLEANING

- A. Remove excess adhesive without damage, from floor, base, and wall surfaces.
- B. Clean and vacuum carpet surfaces.

END OF SECTION

**SECTION 09 9113
EXTERIOR PAINTING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish exterior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.

1.2 RELATED REQUIREMENTS

- A. Section 09 9123 - INTERIOR PAINTING.

1.3 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, www.paintinfo.com.
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; current edition, www.paintinfo.com.
- D. SSPC-SP 1 - Solvent Cleaning; 2015.
- E. SSPC-SP 2 - Hand Tool Cleaning; 1982 (Ed. 2004).
- F. SSPC-SP 6 - Commercial Blast Cleaning; Society for Protective Coatings; 2007.

1.4 SUBMITTALS

- A. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).
 - 3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
 - 4. Manufacturer's installation instructions.
- B. Samples: Submit three paper "draw down" samples, 8 1/2 inches by 11 inches in size, illustrating range of colors available for each finishing product specified.
 - 1. Where sheen is specified, submit samples in only that sheen.
- C. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- D. Maintenance Materials: Furnish the following for Contracting Authority's use in maintenance of project.
 - 1. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.

2. Label each container with color in addition to the manufacturer's label.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45°F and a maximum of 90°F, in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Provide lighting level of 80 foot candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
 1. Behr Process Corporation: www.behr.com.
 2. Benjamin Moore & Co: www.benjaminmoore.com.
 3. Cloverdale Paint, Brand Products of Rodda Paint Company: www.cloverdalepaint.com.
 4. Diamond Vogel Paints: www.diamondvogel.com.
 5. Duron, Inc: www.duron.com.
 6. Glidden Professional, a product of PPG Architectural Coatings: www.gliddenprofessional.com.
 7. PPG Paints: www.ppgpaints.com.
 8. Pratt & Lambert Paints: www.prattandlambert.com.
 9. Rodda Paint Company: www.roddapaint.com.
 10. Sherwin-Williams Company: www.sherwin-williams.com.
 11. Valspar Corporation: www.valsparpaint.com.
 12. Or approved equal.
- C. Primer Sealers: Same manufacturer as top coats.

2.2 PAINTS AND FINISHES - GENERAL

- A. Paints and Finishes: Ready mixed, unless required to be a field-catalyzed paint.

1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
 2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
 3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
 4. Supply each paint material in quantity required to complete entire project's work from a single production run.
 5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.
- B. Volatile Organic Compound (VOC) Content:
1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Architectural coatings VOC limits of State in which the project is located.
 2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.
- C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Engineer from the manufacturer's full line.
- D. Colors: As indicated in Color Schedule.

2.3 PAINT SYSTEMS - EXTERIOR

- A. Exterior Surfaces to be Painted, Unless Otherwise Indicated: Including concrete masonry units and primed metal.
1. Two top coats and one coat primer.
 2. Top Coat(s): Exterior Latex; MPI 77.
 - a. Products:
 - 1) Sherwin-Williams Protective & Marine, Tile-Clad HS Epoxy.
 - 2) PPG Architectural - High Performance Coatings
 - 3) Cloverdale Paint – Hi Performance
 - 4) Or approved equal
 3. Top Coat(s): Exterior Alkyd Enamel; MPI #94.
 - a. Products:
 - 1) Rodda Porsalite, Semi-Gloss, 745001. (MPI #94)

- 2) Sherwin-Williams DTM Alkyd Semi-Gloss.
 - 3) Kelly-Moore – Ext-Int Alkyd Semi-Gloss Enamel
 - 4) Or approved equal
4. Primer: As recommended by top coat manufacturer for specific substrate.

2.4 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
- 1. Interior/Exterior Latex Block Filler; MPI #116.
 - a. Products:
 - 1) Sherwin-Williams Industrial & Marine, Kem Cati-Coat HS Epoxy Filler/Sealer.
 - 2) PPG Architectural - Amercoat, Amerlock 400 BF
 - 3) Cloverdale Paint High Performance – Epoxy Block Filler
 - 4) Or approved equal

2.5 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.
- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.

3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces for finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Masonry:

1. Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions. Allow to dry.
 2. Prepare surface as recommended by top coat manufacturer.
- G. Galvanized Surfaces:
1. Prepare surface according to SSPC-SP 2.
- H. Ferrous Metal:
1. Solvent clean according to SSPC-SP1.
 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces.
 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- I. Metal Doors to be painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.
- D. Apply each coat to uniform appearance.
- E. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- F. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

END OF SECTION

SECTION 09 9123
INTERIOR PAINTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surface preparation.
- B. Field application of paints.
- C. Scope: Finish interior surfaces exposed to view, unless fully factory-finished and unless otherwise indicated.
- D. Do Not Paint or Finish the Following Items:
 - 1. Items factory-finished unless otherwise indicated; materials and products having factory-applied primers are not considered factory finished.
 - 2. Items indicated to receive other finishes.
 - 3. Items indicated to remain unfinished.
 - 4. Fire rating labels, equipment serial number and capacity labels, bar code labels, and operating parts of equipment.
 - 5. Floors, unless specifically indicated.
 - 6. Glass.
 - 7. Concrete masonry units in utility, mechanical, and electrical spaces.
 - 8. Concealed pipes, ducts, and conduits.

1.2 RELATED REQUIREMENTS

- A. Section 09 9113 - EXTERIOR PAINTING.

1.3 REFERENCE STANDARDS

- A. 40 CFR 59, Subpart D - National Volatile Organic Compound Emission Standards for Architectural Coatings; U.S. Environmental Protection Agency; current edition.
- B. MPI (APL) - Master Painters Institute Approved Products List; Master Painters and Decorators Association; current edition, www.paintinfo.com.
- C. MPI (APSM) - Master Painters Institute Architectural Painting Specification Manual; current edition, www.paintinfo.com.
- D. SSPC-SP 1 - Solvent Cleaning; 2015.
- E. SSPC-SP 6 - Commercial Blast Cleaning; Society for Protective Coatings; 2007.

1.4 SUBMITTALS

- A. Product Data: Provide complete list of products to be used, with the following information for each:
 - 1. Manufacturer's name, product name and/or catalog number, and general product category (e.g. "alkyd enamel").
 - 2. MPI product number (e.g. MPI #47).

3. Cross-reference to specified paint system(s) product is to be used in; include description of each system.
- B. Samples: Submit three paper "draw down" samples, 8 1/2 inches by 11 inches in size, illustrating range of colors available for each finishing product specified.
 1. Where sheen is specified, submit samples in only that sheen.
- C. Certification: By manufacturer that paints and finishes comply with VOC limits specified.
- D. Maintenance Materials: Furnish the following for Contracting Authority's use in maintenance of project.
 1. Extra Paint and Finish Materials: 1 gallon of each color; from the same product run, store where directed.
 2. Label each container with color in addition to the manufacturer's label.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to site in sealed and labeled containers; inspect to verify acceptability.
- B. Container Label: Include manufacturer's name, type of paint, brand name, lot number, brand code, coverage, surface preparation, drying time, cleanup requirements, color designation, and instructions for mixing and reducing.
- C. Paint Materials: Store at minimum ambient temperature of 45°F and a maximum of 90°F, in ventilated area, and as required by manufacturer's instructions.

1.6 FIELD CONDITIONS

- A. Do not apply materials when surface and ambient temperatures are outside the temperature ranges required by the paint product manufacturer.
- B. Follow manufacturer's recommended procedures for producing best results, including testing of substrates, moisture in substrates, and humidity and temperature limitations.
- C. Provide lighting level of 80 foot candles measured mid-height at substrate surface.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Provide paints and finishes used in any individual system from the same manufacturer; no exceptions.
- B. Paints:
 1. Behr Process Corporation: www.behr.com.
 2. Benjamin Moore & Co: www.benjaminmoore.com.
 3. Cloverdale Paint, Brand Products of Rodda Paint Company: www.cloverdalepaint.com.
 4. Diamond Vogel Paints: www.diamondvogel.com.
 5. Duron, Inc: www.duron.com.
 6. Glidden Professional, a product of PPG Architectural Coatings: www.gliddenprofessional.com.
 7. PPG Paints: www.ppgpaints.com.

8. Pratt & Lambert Paints: www.prattandlambert.com.
9. Rodda Paint Co: www.roddapaint.com.
10. Sherwin-Williams Company: www.sherwin-williams.com.
11. Valspar Corporation: www.valsparpaint.com.
12. Or approved equal.

C. Primer Sealers: Same manufacturer as top coats.

2.2 PAINTS AND FINISHES - GENERAL

A. Paints and Finishes: Ready mixed, unless intended to be a field-catalyzed paint.

1. Where MPI paint numbers are specified, provide products listed in Master Painters Institute Approved Product List, current edition available at www.paintinfo.com, for specified MPI categories, except as otherwise indicated.
2. Provide paints and finishes of a soft paste consistency, capable of being readily and uniformly dispersed to a homogeneous coating, with good flow and brushing properties, and capable of drying or curing free of streaks or sags.
3. Provide materials that are compatible with one another and the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
4. Supply each paint material in quantity required to complete entire project's work from a single production run.
5. Do not reduce, thin, or dilute paint or finishes or add materials unless such procedure is specifically described in manufacturer's product instructions.

B. Volatile Organic Compound (VOC) Content:

1. Provide paints and finishes that comply with the most stringent requirements specified in the following:
 - a. 40 CFR 59, Subpart D--National Volatile Organic Compound Emission Standards for Architectural Coatings.
 - b. Architectural coatings VOC limits of State in which the project is located.
2. Determination of VOC Content: Testing and calculation in accordance with 40 CFR 59, Subpart D (EPA Method 24), exclusive of colorants added to a tint base and water added at project site; or other method acceptable to authorities having jurisdiction.

C. Sheens: Provide the sheens specified; where sheen is not specified, sheen will be selected later by Architect/Engineer from the manufacturer's full line.

D. Colors: As indicated on drawings.

2.3 PAINT SYSTEMS - INTERIOR

A. Interior Surfaces to be Painted, Unless Otherwise Indicated: Including gypsum board.

1. Two top coats and one coat primer.
2. Top Coat(s): Institutional Low Odor/VOC Interior Latex; MPI #143, 144, 145, 146, 147, or 148.

- a. Products:
 - 1) PPG Paints Speedhide zero Latex, 6-4410XI Series, Satin. (MPI #145)
 - 2) Rodda Master Painter Ultra Low VOC Satin, 523601. (MPI #144)
 - 3) Valspar Professional Zero VOC Interior Latex, No. 11700 Series, Satin.
 - 4) Valspar Ultra 2000 Interior Latex, No. 670350, Satin.
 - 5) Or approved equal.
 3. Primer: As recommended by top coat manufacturer for specific substrate.
- B. Dry Fall: Metals; exposed structure and overhead-mounted services in utilitarian spaces, including shop primed steel deck, structural steel, metal fabrications, galvanized ducts, galvanized conduit, and galvanized piping.
1. Shop primer by others.
 2. One top coat.
 3. Top Coat: Latex Dry Fall; MPI #118.
 - a. Products:
 - 1) Pratt & Lambert Waterborne Dry Fall, Flat. (MPI #118)
 - 2) Rodda Latex Dryfall Flat, 05138. (MPI #118)
 - 3) Sherwin-Williams Waterborne Acrylic Dryfall, Flat. (MPI #118)
 - 4) Valspar Professional Interior Latex Dry Fall, No.275 Series, Flat. (MPI# 118)
 - 5) Or approved equal.
 4. Primer: As recommended by top coat manufacturer for specific substrate.

2.4 PRIMERS

- A. Primers: Provide the following unless other primer is required or recommended by manufacturer of top coats.
1. Interior Institutional Low Odor/VOC Primer Sealer; MPI #149.
 - a. Products:
 - 1) PPG Paints Speedhide zero Interior Latex Sealer, 6-4900XI. (MPI #149)
 - 2) Pratt & Lambert Pro-Hide Gold Interior Latex Zero VOC Primer. (MPI #149)
 - 3) Rodda Roseal II, 502701. (MPI #149)
 - 4) Valspar Professional Interior Latex Zero VOC Primer, No. 11286. (MPI #149)
 - 5) Or approved equal.

2.5 ACCESSORY MATERIALS

- A. Accessory Materials: Provide primers, sealers, cleaning agents, cleaning cloths, sanding materials, and clean-up materials as required for final completion of painted surfaces.
- B. Patching Material: Latex filler.

- C. Fastener Head Cover Material: Latex filler.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surfaces are ready to receive work as instructed by the product manufacturer.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Report any condition that may potentially effect proper application.
- C. Test shop-applied primer for compatibility with subsequent cover materials.
- D. Measure moisture content of surfaces using an electronic moisture meter. Do not apply finishes unless moisture content of surfaces are below the following maximums:
 - 1. Gypsum Wallboard: 12%.

3.2 PREPARATION

- A. Clean surfaces thoroughly and correct defects prior to application.
- B. Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
- C. Remove or mask surface appurtenances, including electrical plates, hardware, light fixture trim, escutcheons, and fittings, prior to preparing surfaces or finishing.
- D. Seal surfaces that might cause bleed through or staining of topcoat.
- E. Remove mildew from impervious surfaces by scrubbing with solution of tetra-sodium phosphate and bleach. Rinse with clean water and allow surface to dry.
- F. Gypsum Board: Fill minor defects with filler compound. Spot prime defects after repair.
- G. Galvanized Surfaces:
 - 1. Remove surface contamination and oils and wash with solvent according to SSPC-SP 1.
- H. Ferrous Metal:
 - 1. Solvent clean according to SSPC-SP1.
 - 2. Shop-Primed Surfaces: Sand and scrape to remove loose primer and rust. Feather edges to make touch-up patches inconspicuous. Clean surfaces with solvent. Prime bare steel surfaces. Re-prime entire shop-primed item.
 - 3. Remove rust, loose mill scale, and other foreign substances using methods recommended in writing by paint manufacturer and blast cleaning according to SSPC-SP 6 "Commercial Blast Cleaning". Protect from corrosion until coated.
- I. Metal Doors to be painted: Prime metal door top and bottom edge surfaces.

3.3 APPLICATION

- A. Apply products in accordance with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual".
- B. Where adjacent sealant is to be painted, do not apply finish coats until sealant is applied.
- C. Do not apply finishes to surfaces that are not dry. Allow applied coats to dry before next coat is applied.

- D. Apply each coat to uniform appearance in thicknesses specified by manufacturer.
- E. Sand wood and metal surfaces lightly between coats to achieve required finish.
- F. Vacuum clean surfaces of loose particles. Use tack cloth to remove dust and particles just prior to applying next coat.
- G. Reinstall electrical cover plates, hardware, light fixture trim, escutcheons, and fittings removed prior to finishing.

3.4 CLEANING

- A. Collect waste material that could constitute a fire hazard, place in closed metal containers, and remove daily from site.

3.5 PROTECTION

- A. Protect finishes until completion of project.
- B. Touch-up damaged finishes after Substantial Completion.

3.6 SCHEDULE - PAINT SYSTEMS

- A. Gypsum Board: Finish surfaces exposed to view.

END OF SECTION

**SECTION 10 2601
WALL AND CORNER GUARDS**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Corner guards.

1.2 SUBMITTALS

- A. Product Data: Indicate physical dimensions, features, anchorage details, and rough-in measurements.
- B. Samples: Submit two sections of corner guard, 24 inches long, illustrating component design, configuration, color and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Corner Guards:
 - 1. Inpro: www.inprocorp.com.
 - 2. Nystrom, Inc: www.nystrom.com.
 - 3. Koroseal: www.koroseal.com
 - 4. Or approved equal.

2.2 COMPONENTS

- A. Corner Guards - Surface Mounted: Stainless steel, one-piece unit without splices, installed with screws.
 - 1. Material: Stainless Steel, 16 gauge.
 - 2. Width of Wings: 2 inches.
 - 3. Height: From top of base to bottom of ceiling or opening.
 - 4. Styles: Provide 90 degree corners.
 - 5. Finish: #4 Satin.
 - 6. Locations: Provide corner guards at all outside corners of gypsum board walls.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings, concealed blocking, and anchors are correctly sized and located.

3.2 INSTALLATION

- A. Install components in accordance with manufacturer's instructions, level and plumb, secured rigidly in position to wall framing members only.

3.3 TOLERANCES

- A. Maximum Variation From Required Height: 1/4 inch.

B. Maximum Variation From Level or Plane For Visible Length: 1/4 inch.

END OF SECTION

**SECTION 10 4400
FIRE PROTECTION SPECIALTIES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fire extinguishers.
- B. Fire extinguisher cabinets.
- C. Accessories.

1.2 REFERENCE STANDARDS

- A. NFPA 10 - Standard for Portable Fire Extinguishers; 2013.
- B. UL (FPED) - Fire Protection Equipment Directory; Underwriters Laboratories Inc.; current edition.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate cabinet physical dimensions.
- B. Product Data: Provide extinguisher operational features.
- C. Maintenance Data: Include test, refill or recharge schedules and re-certification requirements.

1.4 FIELD CONDITIONS

- A. Do not install extinguishers when ambient temperature may cause freezing of extinguisher ingredients.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Fire Extinguishers:
 - 1. Ansul, a Tyco Business: www.ansul.com.
 - 2. Nystrom, Inc: www.nystrom.com.
 - 3. Pyro-Chem, a Tyco Business: www.pyrochem.com.
 - 4. Or approved equal.
- B. Fire Extinguisher Cabinets:
 - 1. Ansul, a Tyco Business: www.ansul.com.
 - 2. JL Industries, Inc: www.jlindustries.com.
 - 3. Larsen's Manufacturing Co: www.larsensmfg.com.
 - 4. Nystrom, Inc; Alpine Architectural Series FC-7041 Fire Extinguisher Cabiner, Fire Rated: www.nystrom.com - Basis of Design.
 - 5. Or approved equal.

2.2 FIRE EXTINGUISHERS

- A. Fire Extinguishers - General: Comply with product requirements of NFPA 10 and applicable codes, whichever is more stringent.
 - 1. Provide extinguishers labeled by UL for the purpose specified and indicated.
- B. Dry Chemical Type Fire Extinguishers: Carbon steel tank, with pressure gage.
 - 1. Class: A:B:C.
 - 2. Size: 10 pounds.
 - 3. Finish: Baked polyester powder coat, red color.

2.3 FIRE EXTINGUISHER CABINETS

- A. Metal: Formed aluminum.
- B. Cabinet Configuration: Recessed type.
 - 1. Inside box dimensions of 9 inches wide by 24 inches high by 6 1/4 inches deep.
 - 2. Trimless type.
 - 3. Fire Rating: 2 hour
- C. Door: 0.036 inch thick, reinforced for flatness and rigidity; lock with full glass access. Hinge doors for 180 degree opening with continuous piano hinge. Provide nylon catch.
- D. Door Glazing: Glass, clear, 1/8 inch thick tempered. Set in resilient channel gasket glazing.
- E. Cabinet Mounting Hardware: Appropriate to cabinet. Pre-drill for anchors.
- F. Finish of Cabinet Exterior Door: Satin finish, clear polyester coated.

2.4 ACCESSORIES

- A. Extinguisher Brackets: Formed steel, chrome-plated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify rough openings for cabinet are correctly sized and located.

3.2 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Secure rigidly in place.
- C. Place extinguishers in cabinets.

END OF SECTION

SECTION 22 0500
COMMON WORK RESULTS FOR PLUMBING

GENERAL**1.1 SECTION INCLUDES**

- A. The work shall include the furnishings of systems, equipment and materials specified in this Division and as called for on the Plumbing Drawings to include supervision, quality control, operation, methods and labor for the fabrication, installation, start-up and tests for the complete plumbing installation. The work shall also include the furnishing of necessary hoisting facilities to set materials and equipment in place and the furnishing of any scaffolding and transportation associated with this work.
- B. Examine the project site and become familiar with existing conditions which will affect the work. Review the drawings and specifications of other trades and take note of conditions to be created which will affect the work. All conditions shall be considered in the preparation of bids; no additional compensation will be made on the behalf of this Contractor.
 - 1. Provide labor necessary to demolish the existing plumbing systems as shown on the drawings, as described in Part 3, Existing Conditions, or as required.
 - 2. Where noted on the drawings or where called for in other sections of the specification, the Contractor for this division shall install equipment furnished by others, and shall make required service connections. Verify with the supplier of the equipment the requirements for the installation. This contractor shall be responsible for the removal and installation of railings, piping, ductwork, louvers, etc. as required to install new equipment.

1.2 DAMAGE

- A. The Contractor shall be responsible for damage to the work of other trades, or to the building and its contents, caused by equipment installation.

1.3 PERMITS AND INSPECTIONS

- A. Obtain and furnish necessary permits and inspection certificates for material and labor furnished. Permits and certificates shall be obtained from the proper inspection authorities. The cost of permits, certificates and fees required in connection with the installation shall be borne by the Contractor, unless otherwise noted in the detailed contractual description preceding these specifications. Where applications are required for the procuring of utility services to the building, see that such application is properly filed with the utility, and that information required for such an application is presented to the extent and in the form required by the utility company.

1.4 CODES AND STANDARDS

- A. Applicable provisions of the following codes and standards are hereby imposed on a general basis for the mechanical work in addition to specific applications specified by individual work sections of these specifications
 - 1. ASHRAE/IES 90.1 - Code for Energy Efficiency
 - 2. ANSI Pressure Piping Standards (B31)
 - 3. ASHRAE Safety Code for Mechanical Refrigeration (ANSI B9.1)
 - 4. AWWA Standards
 - 5. American Gas Association

6. AWS Standards for Welding
7. National Electrical Code
8. Local and/or State Plumbing, Mechanical and Building Codes
9. Occupational Safety and Health Act (OSHA)
10. Uniform Plumbing Code
11. NFPA Standards and Pamphlets
12. If any work indicated on the drawings or specified herein conflicts in any way with any of the rules and regulations of the above authorities, the Contractor shall notify the Engineer in writing 72 hours before bids are opened. In the event the Contractor fails to notify the Engineer and changes are required by said conflicts, the Contractor shall make such changes as are required without additional cost to this Contracting Authority.
13. Installations must be safe in every respect, and must not create a condition which will be harmful to building occupants; to operating, installing or testing personnel; to workmen; or to the public. The contractor for each installation shall be solely responsible for providing installations which will meet these conditions. If the Contractor believes that the installation will not be safe for all parties, report these beliefs in writing to the Engineer before any equipment is purchased or work is installed, giving recommendations. The Engineer will work out required changes and adjustments in contract price where adjustments are warranted.

1.5 DRAWINGS

- A. A complete set of drawings including civil, architectural, structural, mechanical, and electrical drawings shall be on the site at all times. Prior to installing any of the work, check the drawings for dimensions and see that the work does not interfere with clearance required for ceilings, beams, foundations, finished columns, pilasters, partitions and electrical equipment as shown on the drawings and details. After work is installed and it develops that interferences occur which have not been called to the Engineer's attention before the installation, the Contractor shall, at his own expense, make such changes in his work as directed by the Engineer.
- B. The contract drawings for plumbing work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate sizes and locations of equipment and materials. Where job conditions require reasonable changes in indicated locations and arrangement, the Contractor shall make such changes as directed by the Engineer, without additional cost to the Contracting Authority.
- C. Because of the scale of the drawings, certain basic items such as pipe fittings, access panels, and sleeves may not be shown; but where such items are required by other sections of these specifications or where they are required by the nature of the work, they shall be furnished and installed. Rough-in dimensions and locations shall be verified with the supplier of equipment furnished by other trades, or by the Engineer, prior to the time of roughing-in.
- D. Equipment specification may not deal individually with minute items required such as components, parts, controls and devices which may be required to produce the equipment performance specified, or as required to meet the equipment warranties. Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for.
- E. The drawings and the specifications are cooperative and supplementary. It is the intent of both said drawings and specifications to cover all mechanical requirements in their entirety as nearly as possible. The Contractor shall closely check the drawings and specifications for any

obvious errors or omissions and bring any such condition to the attention of the Engineer prior to the receipt of bids, in order to permit clarification by means of a mailed Addendum. If there is no question prior to the bid proposal date, the Engineer shall assume that the drawings and specifications are complete and correct and will expect the intent of said documents to be complied with, and the installation to be complete in all respects, according to said intent.

- F. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Minor deviations from the contract drawings may be made to allow for better accessibility, but changes of magnitude, or which involve extra cost, shall not be made without prior approval. Ample space shall be allowed for removal of parts that may require replacement or service in the future.
- G. All valves, pumps, etc. shall be accessible for maintenance purposes. Locate items carefully and coordinate with other trades so that each valve and piece of equipment is accessible and functional. Items located above a non-accessible ceiling, chase, or soffit shall be accessible through an access door. Coordinate location of access doors with the general contractor.

1.6 RESPONSIBILITY

- A. The Contractor's responsibility shall not end with the installation and connecting of the various apparatus. It shall include the services of an experienced superintendent, who shall be constantly in charge of the work, together with the qualified journeymen, helpers and laborers required to properly unload, install, connect, adjust, start, operate and test the work involved, including equipment and materials furnished by other trades or by the Contracting Authority, until such time as the entire plumbing installation functions properly in every detail.

1.7 COORDINATION

- A. Coordinate the work with other trades prior to installation.
- B. No piping or equipment foreign to the electrical equipment or architectural appurtenances shall be run over the top of any electrical panels or electrical equipment, in accordance with NEC 110-16 and 384-4. This does not prohibit sprinkler protection for the installation.
- C. The determination of quantities of material and equipment required shall be made from the drawings. Schedules on the drawings and in the specifications are completed as an aid, but where discrepancies arise, it shall be the Contractor's responsibility to provide the required quantity.
- D. Where the specifications state that equipment shall be furnished, installed or provided, it shall be understood to mean this Contractor shall furnish and install completely, unless it is specifically stated that the equipment is to be furnished and installed by others.
- E. The Engineer reserves the right to determine space priority of the contractors in the event of interference between the piping and equipment of the various contractors. Conflicts between the drawings and specifications, or between requirements set forth for the various trades, shall be called to the attention of the Engineer. If clarification is not asked for prior to the taking of bids, it will be assumed that none is required, and that the Contractor has submitted his bid in conformance with plans and specifications as issued and that no interference exists.
- F. No piping or equipment foreign to an elevator hoistway and machine room shall be run inside the hoistway and machine room in accordance with NEC 620-37 and ASME A17.1, 102.2.

1.8 GUARANTEE AND MAINTENANCE

- A. Materials and equipment shall be guaranteed to be free from defects and to be new equipment; no secondhand, used or salvaged equipment will be allowed. The Contracting Authority's existing equipment which is to be relocated or reinstalled under this contract shall

- be refurbished, cleaned, and repaired, and made subject to the guarantee and maintenance as herein specified, unless specifically noted otherwise.
- B. Keep the entire portion of the work in repair, without additional cost to the Contracting Authority, so far as defects in workmanship, apparatus, material or construction are concerned for 1 year from the date of final acceptance, except as otherwise specified herein.
 - C. Equipment which fails to meet performance ratings as specified and shown on the drawings shall be removed and replaced by new equipment that meets the specified requirements, without additional cost to the Contracting Authority.
 - D. Materials and workmanship shall be subject to the review of the Engineer, in whose presence various tests shall be made as required by these specifications.

PRODUCTS

2.1 SUBMITTALS

- A. Submit shop drawings and catalog data for plumbing equipment as called for in individual specification sections.
- B. Submittal data for plumbing equipment shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment to include dimensions, wiring diagrams, performance curves, rating, and other descriptive data necessary to describe fully the item proposed and its operating characteristics. Shop drawings shall be submitted on equipment and materials as required by the specifications.
- C. Approval of materials, including alternate or substitute items, shall be obtained in writing from the Engineer, verbal approval will not be considered binding.
- D. Shop drawings shall be submitted and shall have been signed, checked, approved, and initialed by the Contractor prior to submittal to the Engineer. The Engineer will review shop drawings to aid in interpreting the plans and specifications, and will in so doing assume that the shop drawings conform to specified requirements set forth in this specification. The approval of the shop drawing by the Engineer does not relieve the Contractor of the responsibility of complying with elements of the specification. The name of the job, Engineer, location, and specification section shall appear on all pages of shop drawings. Equipment marks (such as S-1, WH-1) shall be indicated for each item.
- E. At the completion of the job, furnish three copies of parts lists, operating and maintenance instructions, and manuals organized and bound, in three books.
- F. At the completion of the project, prepare and submit to the Contracting Authority record drawings showing the location of piping and valves. Drawing shall give accurate dimensions of such equipment for future use by the Contracting Authority. This drawing shall be submitted as soon as work is completed and before authorization of final payment.

2.2 SUBCONTRACTORS AND MATERIALS

- A. Submit to the Engineer for review, when requested, a list of subcontractors, materials and equipment proposed to be used. The list must be reviewed by the Engineer before this Contractor may enter into any subcontractual agreement. Equipment, materials, and devices, etc. shall be subject to the review of the Engineer, whether or not said items are herein specified.

2.3 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Materials shall be new, complete with manufacturer's guarantee or warranty, and shall be as listed by Underwriters Laboratories (UL), Inc., American Water Works Association (AWWA),

American Gas Association (AGA), etc., if a standard has been established by that agency for the type of material.

- B. Materials shall also comply with applicable standards of the National Electrical Manufacturer's Association, National Board of Fire Underwriters, National Fire Protection Association, National Safety Council, National Bureau of Standards, the National Electrical Code and the Williams-Steiger Occupational Safety and Health Act of 1970. Such standards are hereby made a part of these specifications.
- C. Work shall be performed by workmen skilled in the particular craft, shall be executed in a workmanlike manner, and shall present a neat mechanical appearance when completed. Align, level and adjust equipment for satisfactory operation, and install so that connecting and disconnecting of piping and accessories can be made readily and so that parts are easily accessible for inspection, operation and maintenance. Methods and techniques of installation shall be subject to the review of the Engineer.
- D. Materials shall be the standard product of a reputable manufacturer regularly engaged in the manufacture of the specific product. Materials of the same type of class shall be the products of one manufacturer. For example, faucets shall be from the same manufacturer.
- E. Materials shall be protected from damage, and stored indoors or protected from the weather at all times, unless other storage arrangements are approved by the Engineer.
- F. Bearing lubrication fittings shall be as recommended by the manufacturer and shall be extended, where necessary, to an accessible location.
- G. Material and equipment shall be installed in strict accordance with the manufacturer's recommendations.

2.4 MATERIAL SUBSTITUTIONS

- A. Proposals as submitted shall be based on the products specifically named in the specification or on the drawings. Material or equipment by manufacturers other than those specified may be used only by permission of the Engineer. Such permission for substitution must be requested, in writing.
- B. The Engineer reserves the sole right for the approval of proposed material or equipment, and the phrase, "or approved equivalent", used in these specifications, or on the drawings, shall be interpreted to mean an equivalent approved by the Engineer.
- C. Changes required by alternate equipment shall be made at no additional cost to the Contracting Authority; and costs incurred by other trades, public utilities or the Contracting Authority, as a result of the use of such equipment, shall be the responsibility of the Contractor.
- D. Furnish to the Engineer, when requested, samples of proposed material or equipment substitutions. These samples shall remain with the Engineer as long as needed.
- E. Identify the differences in alternate material or equipment as compared to that specified, and indicate the benefits to the project as a result of selecting the alternative.
- F. The Engineer reserves the right to refuse approval of equipment which does not meet the specification, in their opinion, or of equipment for which no local experience of satisfactory service is available. The Engineer further reserves the right to reject equipment for which maintenance service and the availability of replacement parts is questionable.

2.5 JOINING MATERIALS

- A. Refer to individual Division 22 piping sections for special joining materials not listed below.

- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8 inch maximum thickness unless 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.
 - 1) AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
 - 2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
 - 3. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
 - 4. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
 - 5. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
 - 6. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.
 - 7. Solvent Cements for Joining Plastic Piping:
 - a. ABS Piping: ASTM D 2235.
 - b. CPVC Piping: ASTM F 493.
 - c. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.
 - d. PVC to ABS Piping Transition: ASTM D 3138.
 - 8. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.6 DIELECTRIC FITTINGS

- A. Description: Combination fitting of copper alloy and ferrous materials with threaded, solder-joint, plain, or weld-neck end connections that match piping system materials.
- B. Insulating Material: Suitable for system fluid, pressure, and temperature.
- C. Dielectric Unions: Factory-fabricated, union assembly, for 250 pounds per square inch, gage minimum working pressure at 180°F.
 - 1. Available Manufacturers:
 - a. Capitol Manufacturing Co.
 - b. Central Plastics Company.
 - c. Eclipse, Inc.
 - d. Epco Sales, Inc.
 - e. Hart Industries, International, Inc.

- f. Watts Industries, Inc.; Water Products Div.
- g. Zurn Industries, Inc.; Wilkins Div.
- h. Or approved equal.

2.7 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, 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.

EXECUTION

3.1 EXISTING CONDITIONS

- A. Examine the existing buildings and grounds or site and become familiar with the conditions as they exist, or that will in any manner affect the work under this contract. No allowance will be made subsequently, in this connection, on behalf of the Contractor for any error or negligence by the Contractor.
- B. Existing equipment, such as duct or pipe, in or on the existing building and grounds which is to be replaced, or which interferes in any way with the remodeling of the existing facilities and/or installation of new equipment, shall be removed from the premises or relocated by this Contractor, as directed by the Engineer. Do not remove from the premises any equipment that may have maintenance value to the Contracting Authority without permission of the Contracting Authority. Equipment, duct or pipe not to be reused shall be removed from the premises, unless otherwise noted herein or shown on the drawings.
- C. Where existing equipment is removed or changed, all pipe no longer in service shall be removed and stubs plugged as directed by the Engineer. Building surfaces damaged and openings left by removal of equipment shall be repaired by the proper trades and paid for by this Contractor, unless otherwise noted on the drawings. The cutting and fitting shall be done by this Contractor. The cutting of floor, ceiling or wall surfaces shall be done by this Contractor with extreme care, in order to avoid any disrupting or damage of existing utility services which may be encountered. Coordinate with other trades and with the General Contractor or Construction Manager to minimize the damage to the building in order to reduce the amount of patching required.
- D. Where new openings are cut and concealed piping is encountered, such items shall be removed or relocated as required. Where systems to be removed stub through floors, walls or ceilings, openings shall be patched so that no evidence of the former installation remains.
- E. Existing active services (water, gas, sewer, electric), when encountered, shall be protected against damage. Do not prevent or disturb operation of active services that are to remain. If active services are encountered which require relocation, make request to authorities with jurisdiction for determination of procedures. Where existing services are to be abandoned, they shall be terminated in conformance with requirements of the utility or municipality having jurisdiction.
- F. The location, size and elevation of underground utilities shown on the drawings are in accordance with data supplied by the Contracting Authority and/or the various utility companies. The Contractor shall verify this data and shall report any discrepancies to the Engineer before submitting his bid.

3.2 INTERRUPTION OF SERVICE

- A. Changes in service shall be made so as to provide a minimum of interference with the operation of services in the building. When changes require shutdown of building services, notify the proper building authorities no less than 24 hours in advance and obtain approval from these authorities before making changes. Such notices shall give duration and nature of shutdown. Temporary arrangements shall be approved by the Engineer and Contracting Authority.
- B. Any and all interruptions to building services shall be coordinated with Contracting Authority.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping at indicated slopes.
- F. Install fittings for changes in direction and branch connections.
- G. Install piping to allow application of insulation.
- H. Select system components with pressure rating equal to or greater than system operating pressure.

3.4 OPENINGS, CUTTING, AND PATCHING

- A. The General Contractor shall coordinate the placing of openings in the new structure, as required for the installation of the plumbing work.
- B. Furnish to the General Contractor the accurate locations and sizes for required openings. This shall not relieve this Contractor of the responsibility of checking to assure that proper size openings are provided. When additional patching is required due to this Contractor's failure to inspect this work, this Contractor shall make arrangements for the patching required to properly close the opening, to include patch painting. This Contractor shall pay any additional cost incurred in this respect.
- C. When cutting and patching of the structure is made necessary due to this Contractor's failure to install piping, sleeves or equipment on schedule, or due to this Contractor's failure to furnish, on schedule, the information required for the leaving of openings, it shall be this Contractor's responsibility to make arrangements for this cutting and patching. This Contractor shall pay any additional cost incurred in this respect.
- D. Provide cutting and patching and patch painting in the existing structure, as required for the installation of the work. Furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Engineer. Extent of cutting shall be minimized. Use core drills, power saws or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and textures and shall be performed by craftsmen skilled in the respective craft required.

3.5 CONCRETE AND MASONRY WORK

- A. Concrete work included herein or shown on the drawings shall be done only by experienced cement finishers. Brickwork, where included, shall be laid only by experienced brick masons. Brick shall be of uniform size, hard burned, and shall be laid in cement mortar, except for patch work at a location where cement and lime mortar has previously been used. Exposed, finish brickwork shall match existing brickwork as closely as practical and shall be to the satisfaction of the Engineer and Contracting Authority.
- B. Concrete work included herein or shown on the drawings shall be in conformance with DIVISION 3.
- C. Concrete bases and pads for mechanical equipment will be furnished by General Contractor. This Contractor shall coordinate size and location.

3.6 ROOF OPENINGS

- A. Roof openings required by this Contractor that are not shown on the Structural or Architectural Drawings shall be cut and if necessary reinforced by an experienced roofing contractor.
- B. Roof penetrations for piping shall be through curbed roof openings. Equipment supports shall be by curbed and flashed runners meeting current National Roofing Contractor Association (NRCA) standards and details. Pitch pockets, pitch pans, and wood blocking are not acceptable.
- C. All roof work shall be completed such that it does not void any existing roof warranty.

3.7 PAINTING

- A. The finish of any item that has been marred, scratched or damaged in any way by this Contractor shall be repainted at the expense of this Contractor, and to the satisfaction of the Engineer.
- B. Painting and finishing of exposed mechanical systems including piping and duct shall be as shown on the drawings and in DIVISION 9 - FINISHES.

3.8 CLEANING

- A. Keep the premises clean of all debris caused by the work at all times, and keep materials stored, in areas designated by the Engineer, in such a manner as not to interfere with the progress of the work of other Contractors or with the operation of existing facilities.
- B. At the conclusion of the construction, the site shall be thoroughly cleaned of all rubble, debris and unused material and shall be left in good order. Closed off spaces shall be cleaned of waste such as material, cartons, and wood frame members used in the construction.

3.9 WIRING FOR PLUMBING EQUIPMENT

- A. The electrical contractor will provide power to and connection of motors and equipment furnished by this Contractor. Where disconnect switches are not specified to be furnished with the equipment, the Electrical Contractor will furnish disconnect switches for equipment furnished by this Contractor.
- B. Provide integral wiring, alarm wiring, control wiring, temperature control wiring and interlock wiring for equipment furnished, whether or not such wiring is furnished by the equipment vendor.
- C. Except where other sections call for starters to be furnished by manufacturers as part of their equipment, the electrical contractor will furnish motor starters for motors furnished by this Contractor.

- D. Furnish to the electrical contractor, shop drawings and a schedule for motors and other mechanical equipment furnished, which require electrical services. The schedule shall include the locations for rough-ins, electrical loads, size, and electrical characteristics for services required.
- E. Additional costs incurred, where motors or equipment furnished by this Contractor require larger services or services of different electrical characteristics than those called for on the Electrical Drawings, due to the Contractor furnishing substitute equipment, shall be paid for by this Contractor.
- F. Review the Electrical Drawings and call to the attention of the Engineer, prior to bidding, omissions of electrical services required for equipment.
- G. Plumbing equipment which requires fuse protection, to maintain UL listing, shall be coordinated with the electrical contractor to provide such protection.

3.10 MOTORS

- A. TEFC and ODP motors for equipment supplied by this contractor shall meet or exceed the Energy Policy Act of 1992 (EPACT-92).
- B. All motors that are indicated to be used with Variable Frequency Drives (VFD's) shall be inverter duty rated. Coordinate all motor requirements with the electrical contractor.
- C. All motors controlled by VFD's shall be equipped with a shaft grounding kit to divert adverse shaft currents away from the motor bearings. This contractor shall ensure (via field observation and measurement) that the shaft is effectively grounded upon startup.

3.11 PROTECTION

- A. Special care shall be taken for the protection of equipment furnished by this Contractor. Equipment and material shall be protected from elements such as weather, painting, and plastering until the project is completed. Damage from rust, paint, or scratches shall be repaired as required to restore equipment to original condition.
- B. Protection of equipment during the plastering and painting of the building shall be the responsibility of the contractor performing that work, but this shall not relieve this Contractor of the responsibility of checking to assure that adequate protection is being provided.
- C. Where the installation or connection of equipment requires this Contractor to work in areas previously finished by other contractors, this Contractor shall be responsible that such areas are protected and are not marred, soiled or otherwise damaged during the course of such work. This Contractor shall arrange with the other contractors for repairing and refinishing of such areas which may be damaged.
- D. When heavy materials must be placed upon or transported over the roof deck, sheeting shall be placed to distribute the weight and support such materials. Any damage shall be immediately corrected at no cost to the Contracting Authority.

3.12 ASBESTOS IDENTIFICATION AND CONTROL

- A. In the event that suspected asbestos containing material (ACM) is encountered during the course of the work, cease operations in the immediate area and promptly notify the Engineer. Suspected materials will then be sampled and analyzed by the Engineer. Should ACM be identified, the Contracting Authority's Representative will direct the procedures for abatement, either by subcontract to the Contractor or separate contractor. During abatement operations, cease operations in the immediate area of the abatement. Operations in other areas of the project may be performed, but care must be taken to control dust to avoid contamination of the

abatement containment or air monitoring samples. The Contractor shall coordinate activities with the asbestos abatement contractor.

- B. Should no ACM be identified, operations may be resumed. Delays caused by identification, analysis or abatement may be added to the time of the contract, at the discretion of the Engineer by Change Order.

3.13 NOISE AND VIBRATION

- A. Be responsible for the installation of all equipment in such a manner as to control the transmission of noise and vibration from any installed equipment or system, so that the sound level does not exceed NC35 in any occupied space. Be responsible for the correction of any objectionable noise in any occupied area due to improperly installed equipment.

3.14 TESTS AND DEMONSTRATIONS

- A. Systems shall be tested and placed in proper working order prior to demonstrating systems to the Contracting Authority.
- B. Prior to acceptance of the plumbing installation, demonstrate to the Engineer essential features and functions of all systems installed, and instruct the Contracting Authority in the proper operation and maintenance of such systems.
- C. Furnish the necessary trained personnel to perform the demonstrations and instructions, and arrange to have the manufacturer's representatives for the system present to assist with the demonstrations. The Contracting Authority and Contractor shall each sign a certification stating that the training has been performed and the Contracting Authority accepts same.

3.15 UTILITY REBATE APPLICATIONS

- A. This contractor shall be responsible for gathering information necessary for completing local utility rebate applications, and submitting to the proper utility companies for gas and electric rebates. Potential rebates include high efficiency gas boilers, thermostats, timeclocks, motors, and other items furnished by this plumbing contractor.

END OF SECTION

**SECTION 22 0529
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT**

GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install pipe hangers and supports.
- B. Pipe support systems shall secure pipes in place, prevent pipe vibration, provide vertical adjustment for maintaining required grades, and provide for expansion and contraction.
- C. Where supports are attached to concrete or other structural members, care shall be taken to prevent damage or weakening of the structural members.
- D. Where concrete inserts are to be used, it shall be this Contractor's responsibility to accurately locate and attach inserts to concrete forms.

1.2 REFERENCES

- A. American National Standards Institute, ANSI:
 - 1. ANSI B31.9: Building Services Piping
- B. Manufacturers Standardization Society of the Valve and Fittings Industry, MSS, 1815 North Fort Myer Drive, Arlington, VA 22209.
 - 1. MSS SP-58: Pipe Hangers and Supports - Materials, Design and Manufacturer.
 - 2. MSS SP-69: Pipe Hangers and Supports - Selection and Application.

1.3 SUBMITTALS

- A. Submit manufacturer's product data.

PRODUCTS

2.1 HANGERS AND SUPPORTS

- A. Hangers and support devices shall be Anvil International Inc., Tolco, Fee and Mason, Michigan, B-Line or approved equal. Figure numbers based on Anvil.
- B. All hangers and support devices shall be of stainless steel construction. This note shall supersede any other hanging material specified below.

EXECUTION

3.1 INSTALLATION - HORIZONTAL PIPE SUPPORTS

- A. Hanger rods for steel, wrought iron and brass pipe shall be installed in accordance with MSS SP-69 Tables 3 and 4 and the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1 1/4"	3/8"	7'-0"
1 1/2" and 2"	3/8"	9'-0"
2"	3/8"	10'-0"
2 1/2", 3", and 3 1/2"	1/2"	10'-0"
4" and 5"	5/8"	12'-0"
6"	3/4"	12'-0"

8"	7/8"	14'-0"
10" and 12"	7/8"	16'-0"
14" and 16"	1"	16'-0"
18"	1 1/8"	18'-0"
20" and 24"	1 1/4"	20'-0"

- B. Hanger rods for copper pipe and tube shall be installed in accordance with MSS-SP-69 Tables 3 and 4 and the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
1/2" and 3/4"	3/8"	5'-0"
1"	3/8"	6'-0"
1 1/4"	3/8"	7'-0"
1 1/2"	3/8"	8'-0"
2"	3/8"	8'-0"
2 1/2"	1/2"	9'-0"
3", 3 1/2", and 4"	1/2"	10'-0"
5"	1/2"	13'-0"
6"	5/8"	14'-0"
8"	3/4"	16'-0"

- C. Support horizontal cast iron soil pipe with two hangers for each pipe length. Locate hangers close to couplings.
- D. In addition to the above specified spacings, install additional hangers at change in pipe direction and at concentrated loads, large valves and strainers.
- E. Where more than one pipe is to be run parallel together, they may be supported on trapeze type hangers. Trapeze bar angles and hanger rods shall be of sufficient size to support the particular group of pipes. Trapeze hanger spacing shall be based on the smallest pipe on the rack. When hanging from light gauge metal trusses, coordinate pipe hanger spacing and hanger rod connection points with the truss manufacturer.
- F. For suspending hanger rods from brackets attached to walls, use welded steel brackets; Fig. 194 for loads up to 750 pounds; Fig. 195 for loads up to 1500 pounds; Fig 199 for loads up to 3000 pounds.
- G. Where pipes are to be racked along walls, use "Unistrut" pipe racks or 12 gauge steel strut channel, 1 5/8 inches by 1 5/8 inches minimum.
- H. Attach all pipe hangers from support rods using double locknuts tightened to prevent loosening.

3.2 INSTALLATION - VERTICAL PIPE SUPPORTS

- A. Support vertical steel, wrought iron, copper and brass pipe at every other floor line.
- B. Support vertical cast iron soil pipe at every floor line.
- C. In addition to the above, support vertical pipes at base of riser with base fitting set on concrete or brick pier, or by hanger located on horizontal connection close to riser.
- D. Where pipe sleeves extend above floor, place pipe clamps at ceiling below and support clamp extensions from inserts or other approved attachment.

3.3 PIPE ATTACHMENTS

- A. For horizontal steel and wrought iron pipe, use carbon steel adjustable clevis hanger, Fig. 260. For floor support or support directly above steel beams, use pipe roll stand, Fig. 177.
- B. For horizontal copper pipe and tube, use copper-plated malleable iron split pipe ring with turn buckle adjuster, Figs. CT-109 and 114 combined.
- C. When thermal expansion for horizontal pipe is in excess of 1/2 inch axially, use adjustable swivel pipe roll, Fig. 174, or pipe roll stand, Fig. 177.
- D. For horizontal cast iron soil pipe, use clevis hanger, Fig. 260.
- E. For vertical steel, wrought iron and cast iron pipe, use extension pipe clamps, Fig. 261.
- F. For vertical copper pipe and tube, use copper-plated extension pipe clamp, Fig. CT-121 or Fig. CT-121C.

3.4 INTERMEDIATE ATTACHMENTS

- A. Hanger rods: use carbon steel single or double end threaded, Figs. 140, 141, 253, 254 as required. Continuous threaded rod: Fig. 146 may be used wherever possible.
- B. Chain wire or perforated strap hangers will not be permitted. One pipe shall not be suspended from another pipe.

3.5 STRUCTURAL ATTACHMENTS

- A. For attaching steel or copper plated hanger rods to reinforced concrete, use galvanized malleable iron concrete inserts; Fig. 282 for loads up to 1140 pounds.
- B. For attaching steel hanger rods to structural steel beams, use malleable iron C-clamps; Fig. 92, Fig. 93 or Fig. 94 with retaining clip Fig. 89 or Fig. 89X for loads up to 500 pounds; Fig. 218 with extension piece for loads up to 1365 pounds. For copper plated hanger rods, use copper plated malleable iron C-clamps; Fig. CT-138R for loads up to 180 pounds.
- C. For attaching steel hanger rods to wood structural members, use malleable iron ceiling flange; Fig. 153 for loads up to 1270 pounds. For copper plated hanger rods, use copper plated malleable iron ceiling flange: Fig. CT-128R for loads up to 180 pounds.
- D. Vertical expansion shields or toggles shall not be used for suspending hanger rods, except with permission in cases where inserts have been omitted or cannot be used. If permitted, use expansion shields; for rod sizes up to 1/2 inch, 320 pounds maximum load. For hanger rods larger than 1/2 inch use attachment plate, Fig. 52, with wedge anchors.
- E. Powder actuated anchoring methods shall not be used.

3.6 PIPE COVERING PROTECTION

- A. Hangers and supports for insulated piping shall not injure or pierce insulation. Provide insulation protection shields in conjunction with hanger or roll device. Use Fig. 160 and 165, Protection Saddles.

3.7 SUPPLEMENTAL STEEL

- A. Provide supplemental steel required to hang or support plumbing equipment or piping.

END OF SECTION

SECTION 22 0533
HEAT TRACING FOR PLUMBING PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Self-regulating parallel resistance electric heating cable.
- B. Constant wattage resistance electric heating cable.
- C. Cable outer jacket markings.
- D. Connection kits.
- E. Accessories.
- F. Controls.

1.2 RELATED REQUIREMENTS

- A. Section 22 0553 - Identification for Plumbing Piping and Equipment
- B. Section 22 0700 - Plumbing Piping Insulation
- C. Section 22 1316 - Sanitary Waste and Vent Piping
- D. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- E. Section 26 0534 - Conduit.
- F. Section 26 0537 - Boxes.
- G. Section 26 2717 - Equipment Wiring.

1.3 REFERENCE STANDARDS

- A. IEEE 515.1 - IEEE Standard for the Testing, Design, Installation, and Maintenance of Electrical Resistance Trace Heating for Commercial Applications; 2012.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordinate the work with other trades to provide ground fault protection for electric heat tracing circuits as required by NFPA 70.
- B. Coordinate the work with other trades to provide circuit breaker ratings suitable for installed circuit lengths.

1.5 SUBMITTALS

- A. Product Data: Provide data for electric heat tracing.
- B. Shop Drawings: Indicate electric heat tracing layout, electrical terminations, thermostats, controls, and branch circuit connections.
- C. Manufacturer's Installation Instructions: Indicate installation instructions and recommendations.

- D. Field Quality Control Submittals: Indicate test reports and inspection reports.
- E. Project Record Documents: Record actual locations of electric heat tracing lines and thermostats.
- F. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions of equipment and controls, maintenance and repair data, and parts listings.
- G. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 3 years documented experience.
- B. Acceptable Installers: Familiar with the installation of heat-trace cabling and equipment, subject to compliance with requirements of the Contract Documents.

1.7 WARRANTY

- A. Provide 2 year manufacturer warranty for cables, connection kits, accessories, and controls.

PART 2 PRODUCTS

2.1 SELF-REGULATING PARALLEL RESISTANCE ELECTRIC HEATING CABLE

- A. Manufacturers:
 - 1. Chromalox, Inc: www.chromalox.com.
 - 2. Thermon: www.thermon.com
 - 3. Pentair: www.pentairthermal.com
 - 4. Or approved equal.
- B. Provide products listed, classified, and labeled by Underwriters Laboratories Inc. (UL), Intertek (ETL), or testing firm acceptable to authority having jurisdiction.
- C. Factory Rating and Testing: Comply with IEEE 515.1.
- D. Heating Element:
 - 1. Provide pair of parallel No. 16 tinned or nickel coated stranded copper bus wires embedded in cross linked conductive polymer core with varying heat output in response to temperature along its length.
 - 2. Terminations: Waterproof, factory assembled, non-heating leads with connector at one end and water-tight seal at opposite end.
 - 3. Capable of crossing over itself without overheating.
- E. Insulated Jacket: Flame retardant polyolefin.
- F. Cable Cover: Provide tinned copper and polyolefin outer jacket with UV inhibitor.
- G. Maximum Power-On Operating Temperature: 150°F.
- H. Maximum Power-Off Exposure Temperature: 185°F.
- I. Electrical Characteristics:

1. 8 W/lineal feet.
2. 208 volts, single phase, 60 Hertz.

2.2 CABLE OUTER JACKET MARKINGS

- A. Name of manufacturer, trademark, or other recognized symbol of identification.
- B. Catalog number, reference number, or model.
- C. Month and year of manufacture, date coding, applicable serial number, or equivalent.
- D. Agency listing or approval.
- E. Applicable environmental or area use requirements, such as NEMA 4, Type 4, IP ratings, and hazardous (classified) location markings including temperature rating.
- F. Any applicable warning/caution statements such as "WARNING: De-energize circuit before removing cover.

2.3 CONNECTION KITS

- A. Provide power connection, splice/tee, and end seal kits compatible with the heating cable and without requiring cutting of the cable core to expose bus wires.
- B. Furnish with NEMA 4X rating for prevention of corrosion and water ingress.
- C. All components UV stabilized.

2.4 ACCESSORIES

- A. Provide Accessories As Indicated or As Required for Complete Installation, Including but Not Limited To:
 1. High temperature, glass filament tape for attachment of heating cable to metal piping.
 2. Aluminum self-adhesive tape for attachment of heating cable to plastic piping.
 3. Heat-conductive putty.
 4. Cable ties.
 5. Silicone end seals and splice kits.
 6. Installation clips.
 7. Warning labels for attachment to exterior of piping insulation. Refer to Section 22 0553.

2.5 CONTROLS

- A. Pipe Mounted Thermostats:
 1. Remote bulb unit with adjustable temperature range from 30°F to 50°F.
 2. Control Enclosure: Corrosion resistant and waterproof.
- B. Provide minimum 30 ampere contactor to indicate operational status and on/off control.
- C. Line sensing high-limit temperature control and high-limit alarm.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that piping and equipment are ready to receive work.
- B. Verify field measurements are as shown on shop drawings.
- C. Verify required power is available, in proper location, and ready for use.

3.2 PREPARATION

- A. Clean all surfaces prior to installation.
- B. Prepare surfaces using the methods recommended by the manufacturer.

3.3 INSTALLATION

- A. Install in accordance with manufacturer's recommendations.
- B. Comply with installation requirements of IEEE 515.1 and NFPA 70, Article 427.
- C. Apply heating cable linearly on pipe with fiberglass tape only after piping has successfully completed any required pressure testing.
- D. Comply with all national and local code requirements.
- E. Grounding: Refer to Section 26 0526.
- F. Identification:
 - 1. After thermal insulation installation, apply external pipeline decals to indicate presence of the thermal insulation cladding at intervals not to exceed 20 feet including cladding over each valve or other equipment that may require maintenance.

3.4 FIELD QUALITY CONTROL

- A. Perform start-up by factory technician or factory representative as per requirements.
- B. Field Testing and Inspections:
 - 1. Commission system in accordance with installation and operation manual.
 - 2. Inspect for sources of water entry and proper sealing.
 - 3. Inspect weather barrier to confirm that no sharp edges are contacting the trace heating.
 - 4. Minimum Acceptable Insulation Resistance: 20 megohms or greater at a test voltage of 2500 VDC for polymer insulated trace heaters.
 - 5. Test heating cable integrity with megohm meter at the following intervals:
 - a. Before installing the cable.
 - b. After cable has been installed onto the piping.
 - c. After installing the connection kits.
 - d. After the installation of thermal insulation onto the piping.
 - 6. Measure voltage and current at each unit.
 - 7. Controls:

a. Verify control parameters are set to the application requirements.

8. Submit written test report showing values measured on each test for each cable.

3.5 CLOSEOUT ACTIVITIES

A. Demonstrate operation of controls.

3.6 PROTECTION

A. Protect installed products from damage until completion of project.

END OF SECTION

SECTION 22 0548

VIBRATION AND SEISMIC CONTROLS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Equipment support bases.
- B. Vibration isolators.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.

1.3 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2011.
- B. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications; American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.; 2011.
- C. SMACNA (SRM) - Seismic Duct Restraint Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2008.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Provide manufacturer's product literature documenting compliance with PART 2 PRODUCTS.
 - 2. Include seismic rating documentation for each isolator and restraint component accounting for horizontal, vertical, and combined loads.

1.5 QUALITY ASSURANCE

- A. Perform design and installation in accordance with applicable codes.
- B. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than 3 years of documented experience.
 - 1. Member of Vibration Isolation and Seismic Control Manufacturers Association (VISCMA).

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. General:
 - 1. All vibration isolators, base frames and inertia bases to conform to all uniform deflection and stability requirements under all operating loads.
 - 2. Steel springs to function without undue stress or overloading.
 - 3. Steel springs to operate in the linear portion of the load versus deflection curve over deflection range of not less than 50% above specified deflection.
 - 4. Lateral to vertical stiffness ratio to not exceed 0.08 with spring deflection at minimum 75% of specified deflection.

5. All equipment mounted on vibration isolated bases to have minimum operating clearance of 2 inches between the base and floor or support beneath unless noted otherwise.

2.2 EQUIPMENT SUPPORT BASES

A. Concrete Inertia Bases:

1. Construction: Engineered, steel forms, with integrated isolator brackets and anchor bolts, welded or tied reinforcing bars running both ways in a single layer.
2. Size: 6 inches minimum depth and sized to accommodate elbow supports.
3. Mass: Minimum of 1.5 times weight of isolated equipment.
4. Connecting Point: Reinforced to connect isolators and snubbers to base including template and fastening devices for equipment.
5. Concrete: Filled on site with minimum 3000 psi concrete.

2.3 VIBRATION ISOLATORS

A. Non-Seismic Type:

1. All Elastomeric-Fiber Glass Pads:
 - a. Configuration: Flat or molded.
 - b. Thickness: 0.25 inch minimum.
 - c. Assembly: Single or multiple layers using bonded, galvanized sheet metal separation plate between each layer with load plate providing evenly distributed load over pad surface.
2. Elastomeric Mounts:
 - a. Material: Oil, ozone, and oxidant resistant compounds.
 - b. Assembly: Encapsulated load transfer plate bolted to equipment and base plate with anchor hole bolted to supporting structure.
3. Steel Springs:
 - a. Assembly: Freestanding, laterally stable without housing.
 - b. Leveling Device: Rigidly connected to equipment or frame.
4. Elastomeric Hangers:
 - a. Housing: Steel construction containing elastomeric isolation element to prevent rod contact with housing and short-circuiting of isolating function.
 - b. Incorporate steel load distribution plate sandwiching elastomeric element to housing.
5. Spring Hanger:
 - a. Housing: Steel construction containing stable steel spring and integral elastomeric element preventing metal to metal contact.
 - b. Bottom Opening: Sized to allow +/- 15 degrees rod misalignment.
6. Combination Elastomeric-Spring Hanger:

- a. Housing: Steel construction containing stable steel spring with elastomeric element in series isolating upper connection of hanger box to building structure.
- b. Bottom Opening: Sized to allow +/- 15 degrees rod misalignment.

2.4 SEISMIC RESTRAINTS FOR SUSPENDED COMPONENTS AND EQUIPMENT

A. Comply with:

1. ASHRAE Handbook - HVAC Applications.

PART 3 EXECUTION

3.1 INSTALLATION - GENERAL

A. Install in accordance with manufacturer's instructions.

B. Bases:

1. Set steel bases for 1 inch clearance between housekeeping pad and base.
2. Set concrete inertia bases for 2 inches clearance between housekeeping pad and base.
3. Adjust equipment level.

C. Support piping connections to equipment mounted on isolators using isolators or resilient hangers for scheduled distance.

1. Up to 4 Inches Pipe Size: First three points of support.

END OF SECTION

**SECTION 22 0700
PLUMBING INSULATION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install insulation to hot and cold surfaces of piping, tanks, fittings and other surfaces.
- B. Insulation shall include insulating materials, jackets, adhesive, mastic coatings, tie wire and other materials as required to complete the insulating work.

1.2 CODES AND STANDARDS

- A. Insulating materials, jackets and mastics shall meet flame spread, fuel contribution and smoke developed ratings in accordance with NFPA-90A. Flame spread rating in accordance with NFPA 255, ASTM E-84 or UL 723 of not more than 25; smoke developed rating of not more than 50, unless otherwise noted in this section.
- B. Insulation that has been treated with a flame-retardant additive to meet the flame spread and smoke developed ratings shown above is not permitted.
- C. Insulation materials shall be noncorrosive to the materials they are applied to, including stress corrosion cracking of stainless steel, and shall not breed or promote fungus and bacteria.
- D. Insulation shall meet or exceed all requirements of ASHRAE/IES 90.1.

1.3 QUALIFICATION

- A. Insulating materials by Owens-Corning, Armstrong, Pittsburgh-Corning, Knauf, Rubatex, Schuller, CertainTeed Manson, Pabco, and Thermacor or approved equal.
- B. Mastics and adhesives as recommended by insulation manufacturer.

PART 2 PRODUCTS

2.1 INSULATION

- A. Description
 - 1. Type A: Preformed, sectional, heavy density fiberglass insulation, suitable for operating temperatures form -20°F to $+850^{\circ}\text{F}$. Equipped with factory-applied, all-service vapor barrier jacket constructed of white Kraft paper bonded to aluminum foil reinforced with fiberglass yarn, with pressure-sensitive, self-sealing longitudinal laps and butt strips. Thermal conductivity of 0.23 BTU inch per hour per square foot $^{\circ}\text{F}$ @ 75°F mean temperature. Water vapor permeance of 0.02 perms.

2.2 INSULATION JACKETS

- A. 20 mil high impact PVC secured with spray contact adhesive. All PVC jacketing shall meet the 25/50 SDR.
- B. 6 ounces per square yard UL listed cotton canvas fabric secured with lagging adhesive.
- C. Provide reusable insulated wraps for unions, strainers, autoflow valves, circuit setters, check valves and components integral to heat pump hose kits.
- D. At wall penetrations provide an additional jacket of 0.020 inch thick smooth finish aluminum. Metal jacket shall have factory applied moisture barrier. Fitting and valve covers to be preformed of same material as adjacent metal jacket.

- E. Where PVC or metal jackets are used, delete the factory applied ASJ on pipe and equipment operating above 75° F.
- F. PVC jackets shall be used in the following areas and systems:
 - 1. Whenever piping is routed exposed through occupied spaces.
 - 2. Exposed piping.
- G. Insulated Fittings:
 - 1. Insulate fittings, joints, and valves with molded insulation of like material and thickness as adjacent pipe. Finish with glass cloth and vapor barrier adhesive or PVC fitting covers.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

- A. Use only experienced applicators regularly engaged in the trade. Rough work will be rejected. Application details shall be in accordance with the insulation materials supplier's recommendations, except where a higher standard is specified.
- B. Install materials after systems have been tested and approved. Material such as rust, scale, dirt and moisture shall be removed from surfaces to be insulated.
- C. Insulation shall be kept clean and dry at all times.
- D. Where pipes pass through fire rated walls, floors and partitions, a fire seal shall be provided.
- E. When flexible cellular insulation is used, it shall be installed with seams and joints sealed with contact adhesive.
 - 1. Wherever possible, the insulation shall be placed over the pipe before it is installed. Seal the butt joints with Armstrong 520 adhesive, or equal.
 - 2. Where the insulation cannot be slipped on, cut the insulation longitudinally and apply it to the piping. In all cases, the insulation protected with half-round PVC sleeves the length of three times the nominal pipe size, minimum length to be 8 inches.

3.2 PIPE INSULATION INSTALLATION

- A. Insulate fittings, valves, unions, flanges, strainers, flexible connections and expansion joints with premolded or mitered segments of same insulating material as for adjacent pipe covering.
- B. Pipe insulation shall continue through sleeves and hangers with vapor barrier and/or jacket.
- C. Pipe insulation shall be omitted on the following:
 - 1. Chromium plated pipe to plumbing fixtures, except exposed hot water supply and trap to fixtures for use by the physically handicapped.
 - 2. Vertical portions of interior roof drains.
 - 3. Sanitary drain lines.
 - 4. Vents and water hammer arrestors.
- D. Insert to be between support shield and piping but under the finish jacket. Provide an insert at hangers not less than 6 inches long, of same thickness and contour as adjoining insulation, to prevent insulation from sagging at support points. Inserts shall be cork or other heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.

- E. Neatly finish insulation at supports, protrusions and interruptions.
 - 1. On hot systems where fittings are to be left exposed, insulation ends shall be beveled away from bolts for easy access.
 - 2. On cold systems, valve stems shall be sealed with caulking which allows free movement of the stem, but provides a seal against moisture incursion.
- F. Type E and F insulation, 4 inches or more thick, shall be installed in two or more layers, maximum of 3 inches thick each with staggered joints. Insulation segments to be held in place with 16 gauge galvanized wire, 12 inches o.c., with skim coat of cement applied over the outer layer.
- G. Exterior metal jackets shall overlap at longitudinal and circumferential joints not less than 2 inches, and shall be secured with bands at not more than 12 inches centers. Longitudinal joints shall be overlapped down to shed water and shall be located at 4 or 8 o'clock positions. Joints shall be sealed with a moisture barrier. Installation shall include provision for thermal expansion.
- H. Wherever piping penetrates a floor or is exposed in a finished area such as kitchens, furnish a floor pipe escutcheon and/or PVC (white) jacket to protect insulation and allow for a smooth finish for cleaning.

3.3 EQUIPMENT INSULATION

- A. Do not insulate factory-insulated equipment.
- B. Apply insulation as close as possible to equipment by grooving, scoring and beveling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires or bands.
- C. Fill joints, cracks, seams and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- D. Cover insulation with metal mesh and finish with 1/4 inch coat of insulating cement applied in two 1/8 inch layers, if non-faced insulation is used.
- E. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.
- F. When equipment with insulation requires periodical opening for maintenance, repair or cleaning such as at manway covers or strainer plugs, install insulation in such a manner that it can be easily removed and replaced without damage. Removable insulation shall have a vapor-proof cover fabricated so as to allow it to be resealed to the equipment vapor barrier.
- G. Joints shall be sealed with 2 inches wide vapor barrier tape or strips to match insulation jacket, using a fire-resistive adhesive.

3.4 PIPE INSULATION SCHEDULE

- A. Use white PVC for all exposed piping in occupied spaces (Zeston 2000).
- B. No closed cell (i.e. Armaflex) shall be used on steel piping.

SERVICE	TYPE	INSULATION THICKNESS	PIPE SIZE
Cold condensate drains, horizontal roof drains, underside of roof drains. Provide PVC Jacket for exposed, insulated piping (interior).	A	1/2 inch	All pipe sizes

Storm, Overflow Piping (exterior): Provide SS Jacket with SS clamps.	A	2 inches	All pipe sizes
Domestic cold and hot water, hot water recirculation (105°F and greater). Provide PVC jacket for exposed, insulated piping (interior)	A	1 inch 1 1/2 inches	Up to 1 1/4 inches pipe size 1 1/2 inches & up pipe size

END OF SECTION

**SECTION 22 1316
SANITARY WASTE AND VENT PIPING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor, and supervision necessary to install soil, waste, and vent system.

1.2 CODES AND STANDARDS

- A. Current issue of building code.
- B. Current issue local and uniform plumbing code.

1.3 SUBMITTALS

- A. Submit product and performance data for equipment specified herein.

PART 2 PRODUCTS

2.1 SANITARY SEWERS, SOIL, WASTE AND VENT MATERIALS

A. Materials

MATERIAL	SERVICE
Clay sewer pipe, vitrified extra-strength bell and spigot ASTM C700.	Outside sanitary sewers beyond 5 feet 0 inches from foundation. Outside storm sewers up to and including 12 inches diameter beyond 5 feet 0 inches from foundation.
Concrete pipe, reinforced concrete pipe shall conform to ASTM C-76.	Outside storm and sanitary sewers 5 feet 0 inches beyond foundation wall. Larger than 12 inches diameter.
Cast iron soil pipe, service weight, bell and spigot, ASTM A74.	
Asphalt coated.	Sanitary and storm sewers
Uncoated.	Aboveground soil, waste, vent, and downspouts 3 inches diameter and over
Cast iron soil pipe, service weight, no hub, CISPI 301, ASTM A888	Aboveground sanitary and storm sewers. Soil, waste, vent, and downspouts as permitted by code.
Copper water tube, hard temper, ASTM B88. Type M	Aboveground soil, waste vent, and downspouts up to and including 3 inches diameter
Copper drainage tube, hard temper, Type DWV. ASTM B306.	Aboveground soil, waste, vent, and downspouts up to and including 2 1/2 inches diameter, as permitted by Code.
Solid wall schedule 40 PVC pipe ASTM D2665 drain waste and vent	Below ground soil, waste and vent piping.

B. Fittings

1. Material and strength of fittings for cast sewer pipes, clay sewer pipes, and concrete sewer pipe shall conform to pipe as per ASTM Standards.
2. Copper drainage tube (M) - Cast bronze fittings, solder joint fittings. ANSI B.16, 23-69.

3. Solid wall schedule 40 PVC DWV – solvent cemented joints per ASTM D2665.

C. Joints

1. Vitrified clay and concrete pipe - pipe manufacturer's standard preformed preset plastic or rubber joint, installed in accordance with manufacturer's instructions. Amvit, Tylox or Kent or approved equal.
2. Cast iron bell and spigot soil pipe - pipe manufacturer's standard preformed, preset plastic or rubber joint, installed in accordance with manufacturer's instructions.
3. Cast iron no-hub pipe - coupling assembly tightened by torque wrench.
 - a. ASTM C-564, one piece neoprene compression gasket, CISPI 310, type 304, 18-8 chromium nickel stainless steel shield secured by two or more stainless steel worm drive clamps, FM approved, or ASTM C-564, one piece neoprene compression gasket, covered by ASTM A48/A48M cast iron coupling and secured by 18-8 stainless steel bolts and nuts.
 - b. Manufacturers:
 - 1) Clamp All: Hi-Torq 80
 - 2) MG Coupling
 - 3) Fernco
 - 4) Or approved equal
4. Copper water and drainage tube - use 95-5 tin antimony or silver solder, cut pipe square, clean and polish tube ends and inner surface of fittings, apply flux and solder joint as recommended by manufacturer of solder type fittings. Use same methods for copper refrigerant pipe, except use silver solder with 15% silver content, equivalent to Sil-Flos 15.
5. Solid wall schedule 40 PVC DWV – solvent cemented joints per ASTM D2665.

2.2 VENTS

- A. Vents through the roof shall be cast iron and shall extend at least above the highest possible water level on the roof but in no case less than 12 inches.
- B. Provide a flashing of 4 pound sheet lead for each vent through the roof. The flashing shall extend up around the pipe and turn down into it at least 2 inches and shall extend over the roof deck at least 1 foot in each direction from the base.
- C. Coordinate flashing of vents through the roof with General Contractor.
- D. Where vents through the roof are subject to frost or snow closure the vent termination shall be increased beginning at least 12 inches under the roof with a cast iron long increaser. Size increasers as follows:

Vent Size	Increase To
1 1/4 inches and 1 1/2 inches	3 inches minimum
2 inches and 2 1/2 inches	4 inches minimum
3 inches	5 inches
4 inches	6 inches

2.3 SLEEVES

- A. Sleeves passing through non-load bearing walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: For pipes 2 1/2 inches in size and smaller – 24 gauge; 3 inches to 6 inches – 22 gauge; over 6 inches – 20 gauge.
- B. Sleeves passing through load bearing walls, concrete beams, fireproof walls, foundations, footings, and waterproof floors shall be Schedule 40 galvanized steel pipe or cast iron pipe.
- C. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material.
- D. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions and ceilings, and shall extend 1/2 inch above finished floors. Extend sleeves 1 inch above finished floors in areas likely to entrap water and fill space between sleeves and pipe with graphite packing and caulking compound.
- E. Sleeves passing through membrane waterproofing or roofing shall be flashed and sealed.

2.4 PIPE ESCUTCHEONS

- A. Provide pipe escutcheons with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extensions, if any. Furnish pipe escutcheons with chrome finish for occupied areas, prime paint finish for unoccupied areas.
- B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
- C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.
- D. Manufacturer: Chicago Specialty; Producers Specialty; Sanitary-Dash or approved equal.

2.5 GUARDS

- A. Where exposed insulated piping extends through floor, provide sheet metal guard around insulation to extend up from floor 60 inches. Guard to be galvanized sheet steel not less than 26-gauge.

2.6 FIRE SAFING

- A. Metal piping and sleeves passing through floors, roof, partitions and fire walls, shall be provided with firestop by packing space between pipe and sleeve with UL listed non-sag and self-leveling fire safing insulation per manufacturer's instructions.
- B. Plastic piping passing through fire rated floors and fire rated walls shall be provided with firestop by providing intumescent wrap strip around the pipe, enclosed in steel collar attached to structure.
- C. Cracks, Voids, or Holes Up to 4 inches Diameter: Use non-sag or self-leveling putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding ten times when exposed to flame or heat, UL listed.
- D. Openings 4 inches or Greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250°F to 350°F, UL listed.

- E. Seal all holes or voids made by penetrations to ensure an effective barrier against smoke, fire, toxic and combustible gases.
- F. Unless protected, from possible loading or traffic, install firestopping materials in floors having void openings or 4 inches or more to support the same floor load requirements.
- G. Manufacturer: Subject to compliance with requirements, provide non-sag and self-leveling fire barrier caulk, wrap/strip, moldable putty and sheet forms of one of the following:
 - 1. 3M Brand.
 - 2. Flame Stop.
 - 3. Dow Corning.
 - 4. Metacaulk.
 - 5. Or approved equal.

2.7 MECHANICAL SLEEVE SEALS

- A. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- B. Manufacturer: Thunderline, GPT, Metraflex or approved equal

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install underground building drains as shown and in accordance with the Uniform Plumbing Code. 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. Clean interior of piping of dirt and other superfluous material as work progresses. Maintain swab or drag in line and pull past each joint as it is completed. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
- B. Follow indicated lines generally, but make exact layout on the job to work actual fitting dimensions, align piping, and avoid interference. Provide proper support to maintain uniform fall of 1/4 inch per foot for lines 3 inches and smaller and 1/8 inch per foot for lines larger than 3 inches. Protect openings against the entrance of dirt.
- C. No soil or waste pipe shall be covered by earth or construction without first being proved free of leaks by a hydrostatic test of at least 15 feet head, witnessed by Architect/Engineer.
- D. Install vents in practical alignment and supported with constant pitch back to the drainage system, concealed from finished spaces, unless shown or directed otherwise.
- E. Soil, waste and vent connections to fixtures shall be accurately located and concealed from finished spaces, unless shown otherwise.
- F. Refer to Division 31 for excavating, trenching, and backfilling.
- G. Contractor shall verify existing tie-in invert elevations of sanitary sewer piping prior to installation of new piping. Coordinate the site sewer tie-in invert elevation with the site utility contractor. Existing tie-in inverts that are discovered to be different from the information on the bid documents shall be reported to the General Contractor and the Engineer immediately.

3.2 SLEEVES

- A. Install sleeves for piping passing through floors, roof, walls, concrete beams, and foundations.
- B. Install fire-proofing per manufacturer's written instructions.

3.3 ESCUTCHEONS

- A. Install escutcheons for pipes entering finished spaces.

3.4 MECHANICAL SLEEVE SEAL INSTALLATION

- A. Install mechanical sleeve seals at all pipe penetrations through foundations below grade.
- B. Loosely assemble rubber links around pipe and bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

3.5 PIPE PENETRATIONS

- A. Penetrations shall be free of debris and dirt. Dam the penetration (when required) with an acceptable material. Apply fire stop material to the penetration per manufacturer's installation instructions. Use a caulking gun, putty knife or other normal trade tools. Remove damming materials where necessary after cure. Clean up with Xylene.

3.6 FIRE SAFING

- A. Install fire safing at all penetrations through walls, floors, etc. per manufacturer's installation instructions as required to meet UL listing.

3.7 TESTING AND CLEANING

- A. Flush out piping system with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports and accessory items.
- B. Hydraulically pressure test each section or segment of the system prior to backfilling, encasing, enclosing or otherwise preventing visual observation of the section or segment being tested.
- C. Water test soil, waste and vent system at 10 feet of head for 4 hours. Test standpipe to be a minimum of 10 feet above the highest point of section being tested.
- D. Testing shall be done in compliance with the Uniform Plumbing Code.

END OF SECTION

**SECTION 22 1319
SANITARY WASTE PIPING SPECIALTIES**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following sanitary drainage piping specialties:
 - 1. Floor drains.
 - 2. Through-penetration firestop assemblies.
 - 3. Miscellaneous sanitary drainage piping specialties.
 - 4. Flashing materials.

1.2 SUBMITTALS

- A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, and accessories.
- B. Operation and Maintenance Data: For drainage piping specialties to include in emergency, operation, and maintenance manuals.

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NSF 14, "Plastics Piping Components and Related Materials," for plastic sanitary piping specialty components.

1.4 COORDINATION

- A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- B. Coordinate size and location of roof penetrations.

1.5 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Cultures: Provide 1 gallon bottles of bacteria culture recommended by manufacturer of FOG disposal systems equal to two 1 gallon bottles.

PART 2 PRODUCTS

2.1 CLEANOUTS

- A. In floors of finished areas – cast iron caulking ferrule for soil pipe hub with brass countersunk plug and cast brass round flush access cover with polished top.
- B. In floors of unfinished areas – cast iron with tapered body for caulking into soil pipe hub, with brass countersunk plug.

- C. In walls of finished areas – cast brass raised head plug and cast brass round cover plate with polished top and countersunk brass cover screw. Provide with caulking ferrule where installed in cast iron soil pipe.
- D. In walls of unfinished areas – cast brass raised head, iron pipe size male threads. Provide with caulking ferrule where installed in iron soil pipe.

2.2 FLOOR DRAINS

- A. Floor drains shall be Josam, J.R. Smith, Wade, Zurn, or as scheduled in contract documents or approved equal.
- B. Drains without integral traps shall have service weight cast iron P traps.
- C. Provide seepage pans of four pound sheet lead or chloraloy 240 plastic at least 3 feet 0 inches square for all floor drains over open space. Lead, if used, shall be thoroughly coated with asphaltum before it is placed in contact with concrete or concrete fill is poured over it.
- D. Provide seepage pans of four-pound sheet lead or chloraloy 240 plastic to cover total area of showers over open spaces. Pan shall turn up at ends at least 9 inches and corners shall be folded and properly sealed.
- E. Flashing clamps and auxiliary drainage rims shall be provided for all drains that are to receive seepage pans.
- F. Provide trap primers on all floor drains and on other drains as shown on Drawings.

2.3 ROOF FLASHING ASSEMBLIES

- A. Roof Flashing Assemblies
 - 1. Subject to compliance with requirements, provide a comparable product by one of the following:
 - a. Acorn Engineering Company; Elmdor/Stoneman Div.
 - b. Thaler Metal Industries Ltd.
 - c. F.J. Moore
 - d. Or approved equal.
 - B. Description: For built-up or modified bitumen roofing system, manufactured assembly made of 4.0 pounds per square foot, 0.0625 inch thick, lead flashing collar and skirt extending at least 8 inches from pipe, with galvanized-steel boot reinforcement and counterflashing fitting.
 - 1. Open-Top Vent Cap: Without cap.
 - 2. Low-Silhouette Vent Cap: With vandal-proof vent cap.
 - 3. Extended Vent Cap: With field-installed, vandal-proof vent cap.
 - 4. Or approved equal.
 - C. Description: For multi-ply PVC or EPDM membrane roof assembly, provide compatible boot assemblies with stainless steel flashing clamps.

2.4 THROUGH-PENETRATION FIRESTOP ASSEMBLIES

- A. Through-Penetration Firestop Assemblies

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ProSet Systems Inc.
 - b. 3M Fire Protection
 - c. A/D Fire Protection Systems Inc.
 - d. Or Engineer Approved equal.
2. Standard: UL 1479 assembly of sleeve and stack fitting with firestopping plug.
3. Size: Same as connected soil, waste, or vent stack.
4. Sleeve: Molded PVC plastic, of length to match slab thickness and with integral nailing flange on one end for installation in cast-in-place concrete slabs.
5. Stack Fitting: ASTM A 48, gray-iron, hubless-pattern, wye branch with neoprene O-ring at base and gray-iron plug in thermal-release harness. Include PVC protective cap for plug.
6. Special Coating: Corrosion resistant on interior of fittings.

2.5 MISCELLANEOUS SANITARY DRAINAGE PIPING SPECIALTIES

A. Open Drains

1. Description: Shop or field fabricate from ASTM A 74, Service class, hub-and-spigot, cast-iron, soil-pipe fittings. Include P-trap, hub-and-spigot riser section; and where required, increaser fitting joined with ASTM C 564, rubber gaskets.
2. Size: Same as connected waste piping with increaser fitting of size indicated.

B. Deep-Seal Traps

1. Description: Cast-iron or bronze casting, with inlet and outlet matching connected piping and cleanout trap-seal primer valve connection.
2. Size: Same as connected waste piping.
 - a. NPS 2: 4 inches minimum water seal.
 - b. NPS 2 1/2 and Larger: 5 inches minimum water seal.

C. Floor-Drain, Trap-Seal Primer Fittings

1. Description: Cast iron, with threaded inlet and threaded or spigot outlet, and trap-seal primer valve connection.
2. Size: Same as floor drain outlet with NPS 1/2 side inlet.

D. Air-Gap Fittings

1. Standard: ASME A112.1.2, for fitting designed to ensure fixed, positive air gap between installed inlet and outlet piping.
2. Body: Bronze or cast iron.
3. Inlet: Opening in top of body.
4. Outlet: Larger than inlet.

5. Size: Same as connected waste piping and with inlet large enough for associated indirect waste piping.
- E. Sleeve Flashing Device
1. Description: Manufactured, cast-iron fitting, with clamping device that forms sleeve for pipe floor penetrations of floor membrane. Include galvanized-steel pipe extension in top of fitting that will extend 1 inch or 2 inches above finished floor and galvanized-steel pipe extension in bottom of fitting that will extend through floor slab.
 2. Size: As required for close fit to riser or stack piping.
- F. Stack Flashing Fittings
1. Description: Counterflashing-type, cast-iron fitting, with bottom recess for terminating roof membrane, and with threaded or hub top for extending vent pipe.
 2. Size: Same as connected stack vent or vent stack.
- G. Vent Caps
1. Description: Cast-iron body with threaded or hub inlet and vandal-proof design. Include vented hood and setscrews to secure to vent pipe.
 2. Size: Same as connected stack vent or vent stack.
- H. Frost-Resistant Vent Terminals
1. Description: Manufactured or shop-fabricated assembly constructed of copper, lead-coated copper, or galvanized steel.
 2. Design: To provide 1 inch enclosed air space between outside of pipe and inside of flashing collar extension, with counterflashing.
- I. Expansion Joints
1. Standard: ASME A112.21.2M.
 2. Body: Cast iron with bronze sleeve, packing, and gland.
 3. End Connections: Matching connected piping.
 4. Size: Same as connected soil, waste, or vent piping.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install backwater valves in building drain piping. For interior installation, provide cleanout deck plate flush with floor and centered over backwater valve cover, and of adequate size to remove valve cover for servicing.
- C. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 2. Locate at each change in direction of piping greater than 45 degrees.

3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
4. Locate at base of each vertical soil and waste stack.
- D. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- E. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- F. Install floor drains at low points of surface areas to be drained. Set grates of drains flush with finished floor, unless otherwise indicated.
 1. Position floor drains for easy access and maintenance.
 2. Set floor drains below elevation of surrounding finished floor to allow floor drainage. Set with grates depressed according to the following drainage area radii:
 - a. Radius, 30 inches or Less: Equivalent to 1% slope, but not less than 1/4 inch total depression.
 - b. Radius, 30 inches to 60 inches: Equivalent to 1% slope.
 - c. Radius, 60 inches or Larger: Equivalent to 1% slope, but not greater than 1 inch total depression.
 3. Install floor-drain flashing collar or flange so no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes where penetrated.
 4. Install individual traps for floor drains connected to sanitary building drain, unless otherwise indicated.
- G. Install roof flashing assemblies on sanitary stack vents and vent stacks that extend through roof.
- H. Install flashing fittings on sanitary stack vents and vent stacks that extend through roof.
- I. Install through-penetration firestop assemblies in plastic at floor penetrations, conductors and stacks.
- J. Assemble open drain fittings and install with top of hub 1 inch or 2 inches above floor.
- K. Install deep-seal traps on floor drains and other waste outlets, if indicated.
- L. Install floor-drain, trap-seal primer fittings on inlet to floor drains that require trap-seal primer connection.
 1. Exception: Fitting may be omitted if trap has trap-seal primer connection.
 2. Size: Same as floor drain inlet.
- M. Install air-gap fittings on draining-type backflow preventers and on indirect-waste piping discharge into sanitary drainage system.
- N. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- O. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.
- P. Install wood-blocking reinforcement for wall-mounting-type specialties.

- Q. Install traps on plumbing specialty drain outlets. Omit traps on indirect wastes unless trap is indicated.
- R. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0 pounds per square foot, 0.0938 inch thickness or thicker. Solder joints of lead sheets 4.0 pounds per square foot, 0.0625 inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Install flashing for piping passing through roofs with counterflashing or commercially made flashing fittings, according to Division 07 Section "Sheet Metal Flashing and Trim."
- F. Extend flashing up vent pipe passing through roofs and turn down into pipe, or secure flashing into cast-iron sleeve having calking recess.
- G. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.3 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

**SECTION 22 1413
FACILITY STORM DRAINAGE PIPING**

GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install a complete piping system.

1.2 STANDARDS AND CODES

- A. Pipe materials specified in this Section shall apply to technical sections of Division 22 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein. Piping located in plenums shall be plenum rated for fire and smoke.
- B. Current issue local and Uniform Plumbing Code.

1.3 PRODUCT HANDLING

- A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. Submit piping schedule listing each pipe material used and systems served.
- B. Submit shop drawings at 1/4 inch per foot scale indicating exact routing and elevations for all piping systems.

PRODUCTS

2.1 MATERIAL

- A. Material Table
- B. Material Table

Material	Service
Cast iron soil pipe, service weight, bell and spigot, ASTM A74.	
Asphalt coated.	Storm sewers
Uncoated.	Aboveground downspouts 3 inches in diameter and over
Cast iron soil pipe, service weight, no hub, CISPI 301.	Aboveground storm sewers. Downspouts as permitted by code.

C. Fittings

- 1. Material and strength of fittings for cast sewer pipes, clay sewer pipes, and concrete sewer pipe shall conform to pipe as per ASTM Standards.

2. Cast iron water pipe - Class 250, ANSI A21.20, AWWA C110, standard mechanical joint fitting with lugs for connecting to pipe.

D. Joints

1. Vitrified clay and concrete pipe - pipe manufacturer's standard preformed preset plastic or rubber joint, installed in accordance with manufacturer's instructions. Amvit, Tylox or Kent.
2. Cast iron bell and spigot soil pipe - pipe manufacturer's standard preformed, preset plastic or rubber joint, installed in accordance with manufacturer's instructions.
3. Cast iron no-hub pipe - coupling assembly tightened by torque wrench.
 - a. ASTM C-564, one piece neoprene compression gasket, CISPI 310, type 304, 18-8 chromium nickel stainless steel shield secured by two or more stainless steel worm drive clamps, FM approved, or ASTM C-564, one piece neoprene compression gasket, covered by ASTM-48 cast iron coupling and secured by 18-8 stainless steel bolts and nuts.
 - b. Manufacturers:
 - 1) Clamp All: Hi-Torq 80
 - 2) MG Coupling
 - 3) Charlotte Pipe
 - 4) Or approved equal
4. Threaded pipe - make joints using approved pipe joint compound, applied to male threads only. Cut pipe square, cut threads clean, remove burrs, and ream ends to full size of bore. Threads shall not be exposed on chromium-plated pipe.

E. Nipples and Unions

1. Nipples shall conform to size, weight, and strength of adjoining pipe. When length of unthreaded portion of nipple is less than 1 1/2 inches, use extra strong nipple; do not use close nipples.
2. For pipe 3 inches and smaller, use screwed unions; over 3 inches, use flanged unions. For steel and wrought iron pipe, use malleable iron ground joint unions, black or galvanized, to conform to pipe. Cast iron flanged unions are to be gasket type. Install unions on equipment intended to be disassembled.
3. Dielectric unions shall be installed between connections of copper pipe and ferrous piping.

2.2 SLEEVES

- A. Sleeves passing through non-load bearing walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: For pipes 2 1/2 inches in size and smaller – 24 gauge; 3 inches to 6 inches – 22 gauge; over 6 inches – 20 gauge.
- B. Sleeves passing through load bearing walls, concrete beams, fireproof walls, foundations, footings, and waterproof floors shall be Schedule 40 galvanized steel pipe or cast iron pipe.
- C. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material.

- D. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions and ceilings, and shall extend 1/2 inch above finished floors. Extend sleeves 1 inch above finished floors in areas likely to entrap water and fill space between sleeves and pipe with graphite packing and caulking compound.
- E. Sleeves passing through membrane waterproofing or roofing shall be flashed and sealed.

2.3 PIPE ESCUTCHEONS

- A. Provide pipe escutcheons with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extensions, if any. Furnish pipe escutcheons with chrome finish for occupied areas, prime paint finish for unoccupied areas.
- B. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
- C. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.
- D. Manufacturer: Chicago Specialty; Producers Specialty; Sanitary-Dash or approved equal.

2.4 GUARDS

- A. Where exposed insulated piping extends through floor, provide sheet metal guard around insulation to extend up from floor 60 inches. Guard to be galvanized sheet steel not less than 26-gauge.

2.5 MECHANICAL SLEEVE SEALS

- A. Modular mechanical type, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
- B. Manufacturer: Thunderline, Fernco, GPT or approved equal.

2.6 INSULATION

- A. Reference Specification Section 22 0700 for Insulation Requirements.

EXECUTION

3.1 INSTALLATION

- A. Install storm building drains as indicated and in accordance with Uniform Plumbing Code. Lay storm building drains beginning at low point of systems, true to grade 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 with lubricants, cements, and other special installation requirements. Clear interior of piping of dirt and other superfluous material as work progressed. Maintain swab or drag in line and pull past each joint as it is completed. Place plugs in ends of uncompleted piping at end of day or whenever work stops.
- B. Comply with the requirements of the appropriate Division 22 sections for installation of basic piping materials, including hangers, supports, and accessories.
- C. Install horizontal piping as high as possible without sags or humps. Grade drainage at uniform slopes of 1/4 inch per foot where possible, but in no case less than 1/8 inch per foot.

- D. Install horizontal piping as high as possible without sags or humps so that proper grades can be maintained for drainage. Branch piping shall come off the tops of mains unless shown otherwise.
- E. Check piping for interference with other trades; avoid placing water pipes over electrical equipment.
- F. Where rough-ins are required for equipment furnished by others, verify exact rough-in dimensions with Owner or equipment supplier before roughing-in.
- G. Contractor shall verify existing tie-in invert elevations of sanitary sewer piping prior to installation of new piping. Coordinate the site sewer tie-in invert elevation with the site utility contractor. Existing tie-in inverts that are discovered to be different from the information on the bid documents shall be reported to the General Contractor or Construction Manager and the Engineer immediately.

3.2 SLEEVES

- A. Install sleeves for piping passing through floors, roof, walls, concrete beams, and foundations.
- B. Install fire-proofing per manufacturer's written instructions.

3.3 ESCUTCHEONS

- A. Install escutcheons for pipes entering finished spaces.

3.4 MECHANICAL SLEEVE SEAL INSTALLATION

- A. Install mechanical sleeve seals at all pipe penetrations through foundations below grade.
- B. Loosely assemble rubber links around pipe and bolts and pressure plates located under each bolt head and nut. Push into sleeve and center. Tighten bolts until links have expanded to form watertight seal.

3.5 PIPE PENETRATIONS

- A. Penetrations shall be free of debris and dirt. Dam the penetration (when required) with an acceptable material. Apply firestop material to the penetration per manufacturer's installation instructions. Use a caulking gun, putty knife or other normal trade tools. Remove damming materials where necessary after cure. Clean up with Xylene.

3.6 PIPING TESTS ALL STORM DRAINAGE SYSTEMS

- A. Provide labor, materials, facilities, and administration required to conduct the tests required under this section. Tests which fail to meet the specified performance shall be retested at no expense to the Owner. Repair all defective installation.
- B. Flush out piping system with clean water before proceeding with required tests. Inspect each run of each system for completion of joints, supports, and accessory items.
- C. Hydraulically pressure test each section of the system prior to backfilling, encasing, enclosing or otherwise preventing visual observation of the section or segment being tested. Backfill of underground systems, exposing joints only, is permitted on all systems required on systems having a pressure test exceeding 30 pounds per square inch, gage.
- D. Water test storm water system at 10 feet of head for 4 hours. Test standpipe to be a minimum of 10 feet above the highest point of section being tested.
- E. Testing shall be done in compliance with the Uniform Plumbing Code.

END OF SECTION

**SECTION 22 1423
STORM DRAINAGE PIPING SPECIALTIES**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following storm drainage piping specialties:
 - 1. Cleanouts.
 - 2. Downspouts and roof drains.
 - 3. Miscellaneous storm drainage piping specialties.
 - 4. Flashing materials.

1.2 SUBMITTALS

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

1.3 QUALITY ASSURANCE

- A. Drainage piping specialties shall bear label, stamp, or other markings of specified testing agency.

1.4 COORDINATION

- A. Coordinate size and location of roof penetrations.

PART 2 PRODUCTS

2.1 CLEANOUTS

- A. Exposed Metal Cleanouts:
 - 1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - e. Or approved equal.
 - 2. Standard: ASME A112.3.1 for stainless steel for cleanout test tee.
 - 3. Size: Same as connected drainage piping
 - 4. Body Material: Hub-and-spigot, cast-iron soil pipe T-branch, Hubless, cast-iron soil pipe test tee, or Stainless-steel tee with side cleanout as required to match connected piping.
 - 5. Closure: Countersunk, Countersunk or raised-head, Raised-head, brass, or cast iron plug.
 - 6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
 - 7. Closure: Stainless-steel plug with seal.

B. Cast-Iron Wall Cleanouts:

1. Basis-of-Design Product: Subject to compliance with requirements, provide a comparable product by one of the following:
 - a. Josam Company; Josam Div.
 - b. Smith, Jay R. Mfg. Co.; Division of Smith Industries, Inc.
 - c. Watts Drainage Products Inc.
 - d. Zurn Plumbing Products Group; Specification Drainage Operation.
 - e. Or approved equal.
2. Standard: ASME A112.36.2M. Include wall access.
3. Size: Same as connected drainage piping.
4. Body: Hub and spigot, cast iron soil pipe T-branch or Hubless, cast iron soil pipe test tee as required to match connected piping.
5. Closure: Countersunk, countersunk or raised head, raised head, drilled and threaded, brass, or cast iron plug.
6. Closure Plug Size: Same as or not more than one size smaller than cleanout size.
7. Wall Access: Round, deep, chrome plated bronze or flat, chrome plated brass or stainless steel cover plate with screw.
8. Wall Access: nickel bronze, copper alloy, or stainless steel wall-installation frame and cover.

2.2 DOWNSPOUTS AND ROOF DRAINS

- A. Roof drains shall be cast iron, bi-functional with two inlets and two outlets, deck clamp suitable for roof insulation thickness with no-hub connections, or engineer approved equivalent.
- B. Downspout nozzle shall have downspout nozzle, nickel bronze body, no-hub connections with removable stainless steel screen, or engineer approved equivalent.
- C. All piping connections thereto furnished and installed by this Contractor; flashing to be 4 pound lead and shall extend at least 12 inches onto roof in all directions from roof drain.
- D. Interior downspouts shall be located as indicated on the Plans, concealed.
- E. Roof drain installation shall be coordinated very closely with the General and Roofing Contractors.
- F. Dome shall be cast iron or bronze. No plastic or polyethylene domes.
- G. Extension shall be height as required to allow for proper flow into the drain.
- H. Test all downspouts as outlined in the Uniform Plumbing Code, latest edition, or the edition adopted by the local Code authorities.

2.3 FIRE SAFING

- A. Metal piping and sleeves passing through floors, roof, partitions and fire walls, shall be provided with firestop by packing space between pipe and sleeve with UL listed non-sag and self-leveling fire safing insulation per manufacturer's instructions.

- B. Plastic piping passing through fire rated floors and fire rated walls shall be provided with firestop by providing intumescent wrap strip around the pipe, enclosed in steel collar attached to structure.
- C. Cracks, Voids, or Holes Up to 4 inches Diameter: Use non-sag or self-leveling putty or caulking, one-piece intumescent elastomer, non-corrosive to metal, compatible with synthetic cable jackets, and capable of expanding ten times when exposed to flame or heat, UL listed.
- D. Openings 4 inches or greater: Use sealing system capable of passing 3-hour fire test in accordance with ASTM E814, consisting of wall wrap or liner, partitions, and end caps capable of expanding when exposed to temperatures of 250°F to 350°F, UL listed.
- E. Seal all holes or voids made by penetrations to ensure an effective barrier against smoke, fire, toxic and combustible gases.
- F. Unless protected from possible loading or traffic, install firestopping materials in floors having void openings of 4 inches or more to support the same floor load requirements.
- G. Manufacturer: Subject to compliance with requirements, provide non-sag and self-leveling fire barrier caulk, wrap/strip, moldable putty and sheet forms of one of the following:
 - 1. 3M Brand.
 - 2. Flame Stop.
 - 3. Dow Corning.
 - 4. Metacaulk.
 - 5. Or approved equal.

2.4 MISCELLANEOUS STORM DRAINAGE PIPING SPECIALTIES

- A. Expansion Joints:
 - 1. Standard: ASME A112.21.2M.
 - 2. Body: Cast iron with bronze sleeve, packing, and gland.
 - 3. End Connections: Matching connected piping.
 - 4. Size: Same as connected piping.
- B. Downspout Boots:
 - 1. Description: Manufactured, ASTM A 48, gray-iron casting, with strap or ears for attaching to building; NPS 4 outlet; and shop-applied bituminous coating.
 - 2. Size: Inlet size to match downspout.
 - 3. Description: ASTM A 74, Service class, hub-and-spigot, cast-iron soil pipe.
 - 4. Size: Same as or larger than connected downspout.
- C. Conductor Nozzles:
 - 1. Description: Bronze body with threaded inlet and bronze wall flange with mounting holes.
 - 2. Size: Same as connected conductor.

2.5 FLASHING MATERIALS

- A. Copper Sheet: ASTM B 152/B152M, 12 ounces per square foot thickness.
- B. Zinc-Coated Steel Sheet: ASTM A653, with 0.20% copper content and 0.04 inch minimum thickness, unless otherwise indicated. Include G90 hot-dip galvanized, mill-phosphatized finish for painting if indicated.
- C. Elastic Membrane Sheet: ASTM D4068, flexible, chlorinated polyethylene, 40 mil minimum thickness.
- D. Fasteners: Metal compatible with material and substrate being fastened.
- E. Metal Accessories: Sheet metal strips, clamps, anchoring devices, and similar accessory units required for installation; matching or compatible with material being installed.
- F. Solder: ASTM B 32, lead-free alloy.
- G. Bituminous Coating: SSPC-Paint 12, solvent-type, bituminous mastic.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Refer to Division 22 Section "Common Work Results for Plumbing" for piping joining materials, joint construction, and basic installation requirements.
- B. Install cleanouts in aboveground piping and building drain piping according to the following, unless otherwise indicated:
 - 1. Size same as drainage piping up to NPS 4. Use NPS 4 for larger drainage piping unless larger cleanout is indicated.
 - 2. Locate at each change in direction of piping greater than 45 degrees.
 - 3. Locate at minimum intervals of 50 feet for piping NPS 4 and smaller and 100 feet for larger piping.
 - 4. Locate at base of each vertical storm, soil and or waste stack.
- C. For floor cleanouts for piping below floors, install cleanout deck plates with top flush with finished floor.
- D. For cleanouts located in concealed piping, install cleanout wall access covers, of types indicated, with frame and cover flush with finished wall.
- E. Install trench drains at low points of surface areas to be drained. Set grates of drains flush with finished surface, unless otherwise indicated.
- F. Assemble FRP channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- G. Assemble plastic channel drainage system components according to manufacturer's written instructions. Install on support devices so that top will be flush with adjacent surface.
- H. Install sleeve flashing device with each riser and stack passing through floors with waterproof membrane.
- I. Install expansion joints on vertical stacks and conductors. Position expansion joints for easy access and maintenance.

- J. Install manufactured, gray-iron downspout boots at grade with top 6 inches, 12 inches, or 18 inches above grade. Secure to building wall.
- K. Install cast-iron soil pipe downspout boots at grade with top of hub 6 inches, 12 inches, or 18 inches above grade.
- L. Install conductor nozzles at exposed bottom of conductors where they spill onto grade.
- M. Install escutcheons at wall, floor, and ceiling penetrations in exposed finished locations and within cabinets and millwork. Use deep-pattern escutcheons if required to conceal protruding pipe fittings.

3.2 FIRE SAFING

- A. Install fire safing at all penetrations through walls, floors, etc. per manufacturer's installation instructions as required to meet UL listing.

3.3 CONNECTIONS

- A. Piping installation requirements are specified in other Division 22 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

3.4 FLASHING INSTALLATION

- A. Fabricate flashing from single piece unless large pans, sumps, or other drainage shapes are required. Join flashing according to the following if required:
 - 1. Lead Sheets: Burn joints of lead sheets 6.0 pounds per square foot, 0.0938 inch thickness or thicker. Solder joints of lead sheets 4.0 pounds per square foot, 0.0625 inch thickness or thinner.
 - 2. Copper Sheets: Solder joints of copper sheets.
- B. Install sheet flashing on pipes, sleeves, and specialties passing through or embedded in floors and roofs with waterproof membrane.
 - 1. Pipe Flashing: Sleeve type, matching pipe size, with minimum length of 10 inches, and skirt or flange extending at least 8 inches around pipe.
 - 2. Sleeve Flashing: Flat sheet, with skirt or flange extending at least 8 inches around sleeve.
 - 3. Embedded Specialty Flashing: Flat sheet, with skirt or flange extending at least 8 inches around specialty.
- C. Set flashing on floors and roofs in solid coating of bituminous cement.
- D. Secure flashing into sleeve and specialty clamping ring or device.
- E. Fabricate and install flashing and pans, sumps, and other drainage shapes.

3.5 PROTECTION

- A. Protect drains during remainder of construction period to avoid clogging with dirt or debris and to prevent damage from traffic or construction work.
- B. Place plugs in ends of uncompleted piping at end of each day or when work stops.

END OF SECTION

**SECTION 23 0500
COMMON WORK RESULTS FOR HVAC**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The work shall include the furnishings of systems, equipment and materials specified in this Division and as called for on the Mechanical Drawings to include supervision, quality control, operation, methods and labor for the fabrication, installation, start-up and tests for the complete mechanical installation. The work shall also include the furnishing of necessary hoisting facilities to set materials and equipment in place and the furnishing of any scaffolding and transportation associated with this work.
- B. Examine the project site and become familiar with existing conditions which will affect the work. Review the drawings and specifications of other trades and take note of conditions to be created which will affect the work. All conditions shall be considered in the preparation of bids; no additional compensation will be made on the behalf of this Contractor.
- C. Provide labor necessary to demolish the existing mechanical system as shown on the drawings, as described in Part 3, Existing Conditions, or as required.
- D. Where noted on the drawings or where called for in other sections of the specification, the Contractor for this division shall install equipment furnished by others, and shall make required service connections. Verify with the supplier of the equipment the requirements for the installation. This contractor shall be responsible for the removal and installation of railings, piping, ductwork, louvers, etc. as required to install new equipment. Coordinate shipping splits for all equipment provided by this contractor.

1.2 DAMAGE

- A. The Contractor shall be responsible for damage to the work of other trades, or to the building and its contents, caused by equipment installation.

1.3 PERMITS AND INSPECTIONS

- A. Obtain and furnish necessary permits and inspection certificates for material and labor furnished. Permits and certificates shall be obtained from the proper inspection authorities. The cost of permits, certificates and fees required in connection with the installation shall be borne by the Contractor, unless otherwise noted in the detailed contractual description preceding these specifications. Where applications are required for the procuring of utility services to the building, see that such application is properly filed with the utility, and that information required for such an application is presented to the extent and in the form required by the utility company.

1.4 CODES AND STANDARDS

- A. Applicable provisions of the following codes and standards are hereby imposed on a general basis for the mechanical work (in addition to specific applications specified by individual work sections of these specifications):
 - 1. ANSI/ASHRAE/IESNA 90.1-2004 Energy Standard for Buildings
 - 2. ANSI/ASHRAE 62.1-2004 Ventilation for Acceptable Indoor Air Quality
 - 3. ANSI/ASME B31 Standards of Pressure Piping (incl. all appendices)
 - 4. ASHRAE Safety Code for Mechanical Refrigeration (ANSI B9.1)

5. AWWA Standards
 6. American Gas Association
 7. AWS Standards for Welding
 8. Occupational Safety and Health Act (OSHA)
 9. 2015 International Building Code
 10. 2015 Uniform Plumbing Code
 11. Cedar Rapids Plumbing Code
 12. 2015 International Mechanical Code
 13. 2015 International Fuel Gas Code
 14. 2012 International Energy Conservation Code
 15. 2015 International Fire Code
 16. 2014 National Electric Code
 17. Cedar Rapids Electrical Code
 18. City amendments to Plumbing, Mechanical and Building Codes
 19. 2011 NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking
 20. Perations
 21. NFPA Standards and Pamphlets
- B. If any work indicated on the drawings or specified herein conflicts in any way with any of the rules and regulations of the above authorities, the Contractor shall notify the Engineer in writing 72 hours before bids are opened. In the event the Contractor fails to notify the Engineer and changes are required by said conflicts, the Contractor shall make such changes as are required without additional cost to this Contracting Authority.
- C. Installations must be safe in every respect, and must not create a condition which will be harmful to building occupants; to operating, installing or testing personnel; to workmen; or to the public. The contractor for each installation shall be solely responsible for providing installations which will meet these conditions. If the Contractor believes that the installation will not be safe for all parties, report these beliefs in writing to the Engineer before any equipment is purchased or work is installed, giving recommendations. The Engineer will work out required changes and adjustments in contract price where adjustments are warranted.

1.5 DRAWINGS

- A. A complete set of drawings shall be on the site at all times. Prior to installing any of the work, check the drawings for dimensions and see that the work does not interfere with clearance required for ceilings, beams, foundations, finished columns, pilasters, partitions and electrical equipment as shown on the drawings and details. After work is installed and it develops that interferences occur which have not been called to the Engineer's attention before the installation, the Contractor shall, at his own expense, make such changes in his work as directed by the Engineer.
- B. The contract drawings for mechanical work are in part diagrammatic, intended to convey the scope of work and indicate general arrangement and approximate sizes and locations of

equipment and materials. Where job conditions require reasonable changes in indicated locations and arrangement, the Contractor shall make such changes as directed by the Engineer, without additional cost to the Contracting Authority.

- C. Because of the scale of the drawings, certain basic items such as pipe fittings, access panels, and sleeves may not be shown; but where such items are required by other sections of these specifications or where they are required by the nature of the work, they shall be furnished and installed. Rough-in dimensions and locations shall be verified with the supplier of equipment furnished by other trades, or by the Contracting Authority, prior to the time of roughing-in.
- D. Equipment specification may not deal individually with minute items required such as components, parts, controls and devices which may be required to produce the equipment performance specified, or as required to meet the equipment warranties. Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for.
- E. The drawings and the specifications are cooperative and supplementary. It is the intent of both said drawings and specifications to cover all mechanical requirements in their entirety as nearly as possible. The Contractor shall closely check the drawings and specifications for any obvious errors or omissions and bring any such condition to the attention of the Engineer prior to the receipt of bids, in order to permit clarification by means of a mailed Addendum. If there is no question prior to the bid proposal date, the Engineer shall assume that the drawings and specifications are complete and correct and will expect the intent of said documents to be complied with, and the installation to be complete in all respects, according to said intent.
- F. Locate equipment which must be serviced, operated or maintained in fully accessible positions. Minor deviations from the contract drawings may be made to allow for better accessibility, but changes of magnitude, or which involve extra cost, shall not be made without prior approval. Ample space shall be allowed for removal of parts that may require replacement or service in the future.
- G. All valves, fire dampers, automatic dampers, smoke dampers, damper operators, reheat coils, etc. shall be accessible for maintenance purposes. Locate items carefully and coordinate with other trades so that each piece of equipment is accessible and functional. Items located above a non-accessible ceiling, chase, or soffit shall be accessible through an access door. Coordinate location of access doors with the general contractor.

1.6 RESPONSIBILITY

- A. The Contractor's responsibility shall not end with the installation and connecting of the various apparatus. It shall include the services of an experienced superintendent, who shall be constantly in charge of the work, together with the qualified journeymen, helpers and laborers required to properly unload, install, connect, adjust, start, operate and test the work involved, including equipment and materials furnished by other trades or by the Contracting Authority, until such time as the entire mechanical installation functions properly in every detail.

1.7 COORDINATION

- A. Coordinate the work with other trades prior to installation.
- B. No piping, ducts or equipment foreign to the electrical equipment or architectural appurtenances shall be run over the top of any electrical panels or electrical equipment, in accordance with NEC 110-16 and 384-4. This does not prohibit sprinkler protection for the installation.
- C. The determination of quantities of material and equipment required shall be made from the drawings. Schedules on the drawings and in the specifications are completed as an aid, but where discrepancies arise, it shall be the Contractor's responsibility to provide the required quantity.

- D. Where the specifications state that equipment shall be furnished, installed or provided, it shall be understood to mean this Contractor shall furnish and install completely, unless it is specifically stated that the equipment is to be furnished and installed by others.
- E. The Engineer reserves the right to determine space priority of the contractors in the event of interference between the piping and equipment of the various contractors. Conflicts between the drawings and specifications, or between requirements set forth for the various trades, shall be called to the attention of the Engineer. If clarification is not asked for prior to the taking of bids, it will be assumed that none is required, and that the Contractor has submitted his bid in conformance with plans and specifications as issued and that no interference exists.
- F. No piping, ducts or equipment foreign to an elevator hoistway and machine room shall be run inside the hoistway and machine room in accordance with NEC 620-37 and ASME A17.1, 102.2.
- G. With reference to 1.5F above, when setting suspended equipment in place, the contractor shall obtain the Engineer's approval of equipment location to ensure adequate clearance for maintenance access is provided – the Engineer's review and approval of each location is necessary prior to routing and connection of any services: piping, ductwork, controls and/or electrical. Access deemed necessary by the Engineer may differ from the manufacturer's recommendation. Failure to obtain Engineer's approval will result in relocation of the unit at the contractor's cost.

1.8 GUARANTEE AND MAINTENANCE

- A. Materials and equipment shall be guaranteed to be free from defects and to be new equipment; no secondhand, used or salvaged equipment will be allowed. The Contracting Authority's existing equipment which is to be relocated or reinstalled under this contract shall be refurbished, cleaned and repaired, and made subject to the guarantee and maintenance as herein specified, unless specifically noted otherwise.
- B. Keep the entire portion of the work in repair, without additional cost to the Contracting Authority, so far as defects in workmanship, apparatus, material or construction are concerned for 1 year from the date of final acceptance, except as otherwise specified herein.
- C. Equipment, which fails to meet performance ratings as specified and shown on the drawings, shall be removed and replaced by new equipment that meets the specified requirements, without additional cost to the Contracting Authority.
- D. Materials and workmanship shall be subject to the review of the Engineer, in whose presence various tests shall be made as required by these specifications.

PART 2 PRODUCTS

2.1 SUBMITTALS

- A. Contractor to provide an equipment schedule to include: Equipment Tag, Room Location, Model #, Serial #, Voltage/Ph, Location of respective electric panel, filter size and quantity. Refer to 23 0500A equipment schedule.
- B. Submit shop drawings and catalog data for equipment of this Division as called for in the individual sections.
- C. Submittal data for mechanical equipment shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment to include dimensions, wiring diagrams, performance curves, rating, control sequence, and other descriptive data necessary to describe fully the item proposed and its operating characteristics. Shop drawings shall be submitted on equipment and materials as required by the specifications.

- D. Approval of materials, including alternate or substitute items, shall be obtained in writing from the Engineer, verbal approval will not be considered binding.
- E. Shop drawings shall be submitted and shall have been signed, checked, approved, and initialed by the Contractor prior to submittal to the Engineer. The Engineer will review shop drawings to aid in interpreting the plans and specifications, and will in so doing assume that the shop drawings conform to specified requirements set forth in this specification. The approval of the shop drawing by the Engineer does not relieve the Contractor of the responsibility of complying with elements of the specification. The name of the job, Engineer, location, and specification section shall appear on all pages of shop drawings. Equipment marks (such as EF-1, RTU-1) shall be indicated for each item.
- F. At the completion of the job, prepare closeout documents to include parts lists, shop drawings, operating and maintenance instructions.
- G. At the completion of the project, prepare and submit to the Contracting Authority record drawings showing the location of piping, ductwork and accessories. Drawing shall give accurate dimensions of such equipment for future use by the Contracting Authority. This drawing shall be submitted as soon as work is completed and before authorization of final payment.

2.2 SUBCONTRACTORS AND MATERIALS

- A. Submit to the Engineer for review, when requested, a list of subcontractors, materials and equipment proposed to be used. The list must be reviewed by the Engineer before this Contractor may enter into any subcontractual agreement. Equipment, materials, and devices, etc. shall be subject to the review of the Engineer, whether or not said items are herein specified.

2.3 STANDARDS OF MATERIALS AND WORKMANSHIP

- A. Materials shall be new, complete with manufacturer's guarantee or warranty, and shall be as listed by Underwriters Laboratories (UL), Inc., Air Movement and Control Association (AMCA), American Gas Association (AGA), Air Conditioning and Refrigeration Institute (ARI), etc., if a standard has been established by that agency for the type of material.
- B. Materials shall also comply with applicable standards of the National Electrical Manufacturer's Association, National Board of Fire Underwriters, National Fire Protection Association, National Safety Council, National Bureau of Standards, the National Electrical Code and the Williams-Steiger Occupational Safety and Health Act of 1970. Such standards are hereby made a part of these specifications.
- C. Work shall be performed by workmen skilled in the particular craft, shall be executed in a workmanlike manner, and shall present a neat mechanical appearance when completed. Align, level and adjust equipment for satisfactory operation, and install so that connecting and disconnecting of piping and accessories can be made readily and so that parts are easily accessible for inspection, operation and maintenance. Methods and techniques of installation shall be subject to the review of the Engineer.
- D. Materials shall be the standard product of a reputable manufacturer regularly engaged in the manufacture of the specific product. Materials of the same type of class shall be the products of one manufacturer. For example, fans shall be from the same manufacturer and pumps from the same manufacturer.
- E. Materials shall be protected from damage, and stored indoors or protected from the weather at all times, unless other storage arrangements are approved by the Engineer.
- F. Bearing lubrication fittings shall be as recommended by the manufacturer and shall be extended, where necessary, to an accessible location.

- G. Material and equipment shall be installed in strict accordance with the manufacturer's recommendations.

2.4 MATERIAL SUBSTITUTIONS

- A. Proposals as submitted shall be based on the products specifically named in the specification or on the drawings. Material or equipment by manufacturers other than those specified may be used only by permission of the Engineer. Such permission for substitution must be requested, in writing.
- B. The Engineer reserves the sole right for the approval of proposed material or equipment, and the phrase, "or approved equivalent", used in these specifications, or on the drawings, shall be interpreted to mean an equivalent approved by the Engineer.
- C. Changes required by alternate equipment shall be made at no additional cost to the Contracting Authority; and costs incurred by other trades, public utilities or the Contracting Authority, as a result of the use of such equipment, shall be the responsibility of the Contractor.
- D. Furnish to the Engineer, when requested, samples of proposed material or equipment substitutions. These samples shall remain with the Engineer as long as needed.
- E. Identify the differences in alternate material or equipment as compared to that specified, and indicate the benefits to the project as a result of selecting the alternative.
- F. The Engineer reserves the right to refuse approval of equipment which does not meet the specification, in their opinion, or of equipment for which no local experience of satisfactory service is available. The Engineer further reserves the right to reject equipment for which maintenance service and the availability of replacement parts is questionable.

2.5 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8 inch maximum thickness unless 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. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.
- G. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

H. Solvent Cements for Joining Plastic Piping:

1. CPVC Piping: ASTM F 493.
2. PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

I. Fiberglass Pipe Adhesive: As furnished or recommended by pipe manufacturer.

2.6 DIELECTRIC FITTINGS

- A. Products: Victaulic Style 47 Waterway or equivalent by Anvil.

2.7 MECHANICAL SLEEVE SEALS

- A. Description: Modular sealing element unit, designed for field assembly, to fill annular space between pipe and sleeve.

1. Manufacturers:
 - a. Thunderline Fernco, GPT or approved equal
2. Sealing Elements: EPDM interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.
3. Pressure Plates: Carbon steel. Include two for each sealing element.
4. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.8 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239 inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- D. Stack Sleeve Fittings: Manufactured, cast-iron sleeve with integral clamping flange. Include clamping ring and bolts and nuts for membrane flashing.
 1. Underdeck Clamp: Clamping ring with set screws.
- E. Molded PVC: Permanent, with nailing flange for attaching to wooden forms.
- F. PVC Pipe: ASTM D 1785, Schedule 40.
- G. Molded PE: Reusable, PE, tapered-cup shaped, and smooth-outer surface with nailing flange for attaching to wooden forms.

2.9 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.

1. Finish: Polished chrome-plated.
- D. Split-Casting, Cast-Brass Type: With concealed hinge and set screw.
 1. Finish: Polished chrome-plated.
- E. One-Piece, Stamped-Steel Type: With set screw or spring clips and chrome-plated finish.
- F. Split-Plate, Stamped-Steel Type: With concealed hinge, set screw or spring clips, and chrome-plated finish.
- G. One-Piece, Floor-Plate Type: Cast-iron floor plate.
- H. Split-Casting, Floor-Plate Type: Cast brass with concealed hinge and set screw.

2.10 GROUT

- A. Description: ASTM C 1107, Grade B, nonshrink and nonmetallic, dry hydraulic-cement grout.
 1. Characteristics: Post-hardening, volume-adjusting, 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 EXISTING CONDITIONS

- A. Examine the existing site and become familiar with the conditions as they exist, or that will in any manner affect the work under this contract. No allowance will be made subsequently, in this connection, on behalf of the Contractor for any error or negligence by the Contractor.
- B. Existing equipment, such as duct or pipe, in or on the existing building and grounds which is to be replaced, or which interferes in any way with the remodeling of the existing facilities and/or installation of new equipment, shall be removed from the premises or relocated by this Contractor, as directed by the Engineer. Do not remove from the premises, any equipment that may have maintenance value to the Contracting Authority without permission of the Contracting Authority. Equipment, duct or pipe not to be reused shall be removed from the premises, unless otherwise noted herein or shown on the drawings.
- C. Where existing equipment is removed or changed, all duct and pipe no longer in service shall be removed and stubs plugged as directed by the Engineer. Building surfaces damaged and openings left by removal of equipment shall be repaired by the proper trades and paid for by this Contractor, unless otherwise noted on the drawings. The cutting and fitting shall be done by this Contractor. The cutting of floor, ceiling or wall surfaces shall be done by this Contractor with extreme care, in order to avoid any disrupting or damage of existing utility services which may be encountered. Coordinate with other trades and with the General Contractor, to minimize the damage to the building in order to reduce the amount of patching required.
- D. Where new openings are cut and concealed piping is encountered, such items shall be removed or relocated as required. Where systems to be removed stub through floors, walls or ceilings, openings shall be patched so that no evidence of the former installation remains.
- E. Existing active services (water, gas, sewer, electric), when encountered, shall be protected against damage. Do not prevent or disturb operation of active services that are to remain. If active services are encountered which require relocation, make request to authorities with jurisdiction for determination of procedures. Where existing services are to be abandoned, terminate in conformance with requirements of the utility or municipality having jurisdiction.

- F. The location, size and elevation of underground utilities shown on the drawings are in accordance with data supplied by the Contracting Authority and/or the various utility companies. The Contractor shall verify this data and shall report any discrepancies to the Engineer before submitting his bid.

3.2 INTERRUPTION OF SERVICE

- A. Changes in service shall be made so as to provide a minimum of interference with the operation of services in the building. When changes require shutdown of building services, such shutdowns shall be scheduled for weekends or holidays: all associated costs for shutdowns shall be the responsibility of the contractor. Notify the Contracting Authority in writing 14 days in advance of shutdown, also providing duration, systems affected and nature of shutdown. Temporary arrangements shall be approved by the Engineer.
- B. Any and all interruptions to building services shall be in coordinated with Contracting Authority.

3.3 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.
- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.

- e. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, stamped-steel type.
 - f. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting, cast-brass type with chrome-plated finish.
 - g. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-plate, stamped-steel type with concealed hinge and set screw.
 - h. Bare Piping in Unfinished Service Spaces: Split-casting, cast-brass type with rough-brass finish.
 - i. Bare Piping in Unfinished Service Spaces: Split-plate, stamped-steel type with concealed or exposed-rivet hinge and set screw or spring clips.
 - j. Bare Piping in Equipment Rooms: Split-casting, cast-brass type.
 - k. Bare Piping in Equipment Rooms: Split-plate, stamped-steel type with set screw or spring clips.
 - l. Bare Piping at Floor Penetrations in Equipment Rooms: Split-casting, floor-plate type.
- M. Sleeves are not required for core-drilled holes.
- N. Permanent sleeves are not required for holes formed by removable PE sleeves.
- O. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
- P. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
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 if ring is specified.
 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 3. Install sleeves that are large enough 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 NPS 6.
 - b. Steel Sheet Sleeves: For pipes NPS 6 and larger, penetrating gypsum-board partitions.
 - c. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level.
 - d. Seal space outside of sleeve fittings with grout.
 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint.
- Q. Aboveground, Exterior-Wall Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Select sleeve size to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

1. Install steel pipe for sleeves smaller than 6 inches in diameter.
 2. Install cast-iron "wall pipes" for sleeves 6 inches and larger in diameter.
 3. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- R. Underground, Exterior-Wall Pipe Penetrations: Install cast-iron "wall pipes" for sleeves. Seal pipe penetrations using mechanical sleeve seals. Select sleeve size to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.
1. Mechanical Sleeve Seal Installation: Select type and number of sealing elements required for pipe material and size. Position pipe in center of sleeve. Assemble mechanical sleeve seals and install in annular space between pipe and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.
- S. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials.
- T. Verify final equipment locations for roughing-in.
- U. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.4 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 23 Sections specifying piping systems.
- B. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
- C. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- D. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- E. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- F. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
 2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.
- G. Welded Joints: Construct joints according to AWS D10.12, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.
- H. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

- I. Plastic Piping Solvent-Cement Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F 402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. CPVC Piping: Join according to ASTM D 2846/D 2846M Appendix.
 - 3. PVC Pressure Piping: Join schedule number ASTM D 1785, PVC pipe and PVC socket fittings according to ASTM D 2672. Join other-than-schedule-number PVC pipe and socket fittings according to ASTM D 2855.
 - 4. PVC Nonpressure Piping: Join according to ASTM D 2855.
- J. Plastic Pressure Piping Gasketed Joints: Join according to ASTM D 3139.
- K. Plastic Nonpressure Piping Gasketed Joints: Join according to ASTM D 3212.
- L. PE Piping Heat-Fusion Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join according to ASTM D 2657.
 - 1. Plain-End Pipe and Fittings: Use butt fusion.
 - 2. Plain-End Pipe and Socket Fittings: Use socket fusion.
- M. Fiberglass Bonded Joints: Prepare pipe ends and fittings, apply adhesive, and join according to pipe manufacturer's written instructions.

3.5 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
 - 2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.
 - 3. Dry Piping Systems: Install dielectric unions and flanges to connect piping materials of dissimilar metals.
 - 4. Wet Piping Systems: Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
- B. Size bases to extend minimum of 4 inches beyond equipment base in any direction, and 4 inches above finished floor elevation. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.
- C. Keep the premises clean of all debris caused by the work at all times, and keep materials stored, in areas designated by the Contracting Authority, in such a manner as not to interfere with the progress of the work of other Contractors or with the operation of existing facilities.

3.6 OPENINGS, CUTTING, AND PATCHING

- A. The General Contractor shall coordinate the placing of openings in the new structure, as required for the installation of the mechanical work.
- B. Furnish to the General Contractor the accurate locations and sizes for required openings. This shall not relieve this Contractor of the responsibility of checking to assure that proper size openings are provided. When additional patching is required due to this Contractor's failure to

inspect this work, this Contractor shall make arrangements for the patching required to properly close the opening, to include patch painting. This Contractor shall pay any additional cost incurred in this respect.

- C. When cutting and patching of the structure is made necessary due to this Contractor's failure to install piping, ducts, sleeves or equipment on schedule, or due to this Contractor's failure to furnish, on schedule, the information required for the leaving of openings, it shall be this Contractor's responsibility to make arrangements for this cutting and patching. This Contractor shall pay any additional cost incurred in this respect.
- D. Provide cutting and patching and patch painting in the existing structure, as required for the installation of the work. Furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Engineer. Extent of cutting shall be minimized. Use core drills, power saws or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

3.7 EXCAVATION AND BACKFILL

- A. See Division 31 for requirements for trench excavation, backfill, and compaction.

3.8 CONCRETE AND MASONRY WORK

- A. Concrete bases and pads for mechanical equipment will be furnished by General Contractor. This Contractor shall coordinate size. Size bases to extend minimum of 4 inches beyond equipment base in any direction, and 4 inches above finished floor elevation. Construct of reinforced concrete, roughen floor slab beneath base for bond, and provide steel rod anchors between floor and base. Locate anchor bolts using equipment manufacturer's templates. Chamfer top and edge corners.
- B. Furnish equipment anchor bolts and be responsible for their proper installation and accurate location.

3.9 ROOF OPENINGS

- A. Roof openings required by this Contractor that are not shown on the contract documents shall be cut and (if necessary) reinforced by an experienced roofing contractor.
- B. Roof penetrations for duct and piping shall be through curbed roof openings. Equipment supports shall be by curbed and flashed runners meeting current National Roofing Contractor Association (NRCA) standards and details. Pitch pockets, pitch pans, and wood blocking are not acceptable.
- C. All roof work shall be completed such that it does not void any existing roof warranty.

3.10 PAINTING

- A. The finish of any item that has been marred, scratched or damaged in any way by this Contractor shall be repainted at the expense of this Contractor, and to the satisfaction of the Engineer.
- B. Painting and finishing of exposed mechanical systems (including but not limited to piping, ducting and supports) shall be provided. Finishes shall be as defined in Division 09 - Finishes. Exposed shall be defined as where accessible or visible to occupants of the building and/or the public.

3.11 CLEANING

- A. Keep the premises clean of all debris caused by the work at all times, and keep materials stored, in areas designated by the Contracting Authority, in such a manner as not to interfere with the progress of the work of other Contractors or with the operation of existing facilities.
- B. At the conclusion of the construction, the site shall be thoroughly cleaned of all rubble, debris and unused material and shall be left in good order. Closed off spaces shall be cleaned of waste such as material, cartons, and wood frame members used in the construction.

3.12 SUSPENSION FROM WOOD STRUCTURAL MEMBERS

- A. In general, concentrated or other loads shall not be suspended directly from the bottom of wood structural members, unless approved by the Engineer. Loads suspended from open web joists or trusses may be transferred to the bottom chord of the structural member at the panel points. Loads suspended from solid web joists shall be transferred to the joists only through the top flange or web. Suspension systems shall be reviewed by the Engineer.

3.13 WIRING FOR MECHANICAL EQUIPMENT

- A. The electrical contractor will provide power to and connection of motors and equipment furnished by this Contractor. Where disconnect switches are not specified to be furnished with the equipment, the electrical Contractor will furnish disconnect switches for equipment furnished by this Contractor.
- B. Provide integral wiring, alarm wiring, control wiring, temperature control wiring and interlock wiring for equipment furnished, whether or not such wiring is furnished by the equipment vendor.
- C. Except where other Sections call for starters to be furnished by manufacturers as part of their equipment, the electrical contractor will furnish motor starters for motors furnished by this Contractor.
- D. Furnish to the electrical contractor, shop drawings and a schedule for motors and other mechanical equipment furnished, which require electrical services. The schedule shall include the locations for rough-ins, electrical loads, size, and electrical characteristics for services required.
- E. Additional costs incurred, where motors or equipment furnished by this Contractor require larger services or services of different electrical characteristics than those called for on the Electrical Drawings, due to the Contractor furnishing substitute equipment, shall be paid for by this Contractor.
- F. Review the Electrical Drawings and call to the attention of the Engineer, prior to bidding, omissions of electrical services required for equipment.
- G. Mechanical equipment which requires fuse protection, to maintain UL listing, shall be coordinated with the electrical contractor to provide such protection.

3.14 PROTECTION

- A. Special care shall be taken for the protection of equipment furnished by this Contractor. Equipment and material shall be protected from elements such as weather, painting and plastering until the project is completed. Damage from rust, paint or scratches shall be repaired as required to restore equipment to original condition.
- B. Protection of equipment during the plastering and painting of the building shall be the responsibility of the contractor performing that work, but this shall not relieve this Contractor of the responsibility of checking to assure that adequate protection is being provided.

- C. Where the installation or connection of equipment requires this Contractor to work in areas previously finished by other contractors, this Contractor shall be responsible that such areas are protected and are not marred, soiled or otherwise damaged during the course of such work. This Contractor shall arrange with the other contractors for repairing and refinishing of such areas which may be damaged.
- D. When heavy materials must be placed upon or transported over the roof deck, sheeting shall be placed to distribute the weight and support such materials. Any damage shall be immediately corrected at no cost to the Contracting Authority.

3.15 NOISE AND VIBRATION

- A. Be responsible for the installation of all equipment in such a manner as to control the transmission of noise and vibration from any installed equipment or system, so that the sound level does not exceed NC35 in any occupied space. Be responsible for the correction of any objectionable noise in any occupied area due to improperly installed equipment.

3.16 MANUFACTURER'S START-UP

- A. Where indicated, manufacturer shall provide a factory authorized service representative or factory engineer as specified, for unit start up. Startup procedure and respective documentation shall be submitted as part of shop drawing review process. Completed start-up documentation shall be submitted directly to the Engineer by the manufacturer.
- B. Start-up shall be scheduled only once electrical, mechanical, sheet metal and temperature controls contractors' are confirmed complete, AND the Contracting Authority approves proceeding with start-up; confirmation by each shall be made to the GC in writing.
- C. Contractor's confirmation of complete installation prior to scheduling the start-up shall include:
 - 1. All aspects of equipment installation shall be completely installed in permanent condition, to include but not limited to: sheet metal, piping, final heat transfer fluids installed, controls and associated programming, insulation and electrical.
 - 2. The Engineer shall confirm all aspects complete, prior to start-up being scheduled. The Contracting Authority's signature on the manufacturer's satisfactorily completed prestart-up checklist will allow the manufacturer to then confirm start-up availability and schedule.
- D. Both the equipment start-up and temperature controls contractor start-up personnel shall be onsite together to assist each other as required for start-up.
- E. No portion of onsite test and balance shall proceed until start-up of all equipment has been satisfactorily documented by the manufacturer, and confirmed by the Contracting Authority.

3.17 TEST AND BALANCE

- A. No portion of onsite test and balance shall proceed until satisfactory start-up of all equipment has been satisfactorily documented by the manufacturer, and confirmed by the Contracting Authority.

3.18 TESTS AND DEMONSTRATIONS

- A. Systems shall be tested and placed in proper working order prior to demonstrating systems to the Contracting Authority.
- B. Prior to acceptance of the mechanical installation, demonstrate to the Contracting Authority or his designated representatives essential features and functions of all systems installed, and instruct the Contracting Authority in the proper operation and maintenance of such systems.

- C. Furnish the necessary trained personnel to perform the demonstrations and instructions, and arrange to have the manufacturer's representatives for the system present to assist with the demonstrations. The Contracting Authority and Contractor shall each sign a certification stating that the training has been performed and the Contracting Authority accepts same.

3.19 EQUIPMENT LIST

- A. Consistent with the Valve & Damper schedule (Section 23 0553), submit an equipment list identifying all equipment on and consistent with the mechanical schedule: by equipment tag, room location, model number, serial number, number & size of filters, voltage/phase with respective electrical panel & panel location.

3.20 UTILITY REBATE APPLICATIONS

- A. This contractor shall be responsible for gathering all information necessary for and completion of utility rebate applications. Potential rebates include but not limited to: high efficiency gas boilers, chillers, heat pumps, ventilation equipment, energy recovery equipment, water heaters, thermostats, timeclocks, motors, variable speed drives, and other items furnished by the contractor of this Division. Submit to Contracting Authority copies of all documentation provided to the utilities.

END OF SECTION

SECTION 23 0529
HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install pipe hangers and supports.
- B. Pipe support systems shall secure pipes in place, prevent pipe vibration, provide vertical adjustment for maintaining required grades, and provide for expansion and contraction.
- C. Where supports are attached to concrete or other structural members, care shall be taken to prevent damage or weakening of the structural members.
- D. Where concrete inserts are to be used, it shall be this Contractor's responsibility to accurately locate and attach inserts to concrete forms.

1.2 REFERENCES

- A. American National Standards Institute, ANSI:
- B. ANSI B31.1: Power Piping
- C. Manufacturers Standardization Society of the Valve and Fittings Industry, MSS, 1815 North Fort Myer Drive, Arlington, VA 22209.
 - 1. MSS SP-58: Materials Standardization Society: Pipe Hangers and Supports-Materials, Design, and Manufacturer.
 - 2. MSS SP-69: Materials and Standardization Society: Pipe Hangers and Supports - Selection and Application.
 - 3. NFPA 13-Standard for the Installation of Sprinkler Systems.
 - 4. ASTM A123-Specification for Zinc Hot-Galvanized Coatings by the Hot Dip Process.
 - 5. ASTM A653 G90-Specification for Steel Sheet, Zinc on Iron and Steel.

1.3 SUBMITTALS

- A. Submit manufacturer's product data on all hangers and support devices. Product data to include, but not be limited to materials, finishes, approvals, load ratings, and dimensional information.

PART 2 PRODUCTS

2.1 HANGERS AND SUPPORTS

- A. Hangers and support devices shall be Anvil International Inc., Tolco, Fee and Mason, Michigan, B-Line or approved equal. Figure numbers based on Anvil.
- B. All hangers and support devices shall be of stainless steel construction. This note shall supersede any other hanging material specified below.

PART 3 EXECUTION

3.1 INSTALLATION - HORIZONTAL PIPE SUPPORTS

- A. Hanger rods for steel, wrought iron and brass pipe shall be installed in accordance with MSS SP-69 Tables 3 and 4 and the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1 1/4 inches	3/8 inch	7 feet 0 inches
1 1/2 inches and 2 inches	3/8 inch	9 feet 0 inches
2 inches	3/8 inch	10 feet 0 inches
2 1/2 inches, 3 inches and 3 1/2 inches	1/2 inch	10 feet 0 inches
4 inches and 5 inches	5/8 inch	12 feet 0 inches
6 inches	3/4 inch	12 feet 0 inches
8 inches	7/8 inch	14 feet 0 inches
10 inches and 12 inches	7/8 inch	16 feet 0 inches
14 inches and 16 inches	1 inch	16 feet 0 inches
18 inches	1 1/8 inches	18 feet 0 inches
20 inches and 24 inches	1 1/4 inches	20 feet 0 inches

Pipe Size	Rod Diameter	Maximum Spacing
1/2 inch and 3/4 inch	3/8 inch	5 feet 0 inches
1 inches	3/8 inch	6 feet 0 inches
1 1/4 inches	3/8 inch	7 feet 0 inches
1 1/2 inches	3/8 inch	8 feet 0 inches
2 inches	3/8 inch	8 feet 0 inches
2 1/2"	1/2 inch	9 feet 0 inches
3 inches, 3 1/2 inches and 4 inches	1/2 inch	10 feet 0 inches
5 inches	1/2 inch	13 feet 0 inches
6 inches	5/8 inch	14 feet 0 inches
8 inches	3/4 inch	16 feet 0 inches

- B. Support horizontal cast iron soil pipe with two hangers for each pipe length. Locate hangers close to couplings.
- C. In addition to the above specified spacings, install additional hangers at change in pipe direction and at concentrated loads, large valves and strainers.
- D. Where more than one pipe is to be run parallel together, they may be supported on trapeze type hangers. Trapeze bar angles and hanger rods shall be of sufficient size to support the particular group of pipes. Trapeze hanger spacing shall be based on the smallest pipe on the rack. When hanging from light gauge metal trusses, coordinate pipe hanger spacing and hanger rod connection points with the truss manufacturer.
- E. For suspending hanger rods from brackets attached to walls, use welded steel brackets; Fig. 194 for loads up to 750 pounds; Fig. 195 for loads up to 1500 pounds; Fig 199 for loads up to 3000 pounds.
- F. Where pipes are to be racked along walls, use 12 gauge steel strut channel, 1 5/8 inches by 1 5/8 inches minimum.
 - 1. Mount pipes to strut channel with two-piece pipe straps to match outside diameter of pipe including insulation.

- G. Attach all pipe hangers from support rods using double locknuts tightened to prevent loosening.

3.2 INSTALLATION - VERTICAL PIPE SUPPORTS

- A. Support vertical steel, wrought iron, copper and brass pipe at every other floor line.
- B. Support vertical cast iron soil pipe at every floor line.
- C. In addition to the above, support vertical pipes at base of riser with base fitting set on concrete or brick pier, or by hanger located on horizontal connection close to riser.
- D. Where pipe sleeves extend above floor, place pipe clamps at ceiling below and support clamp extensions from inserts or other approved attachment.

3.3 PIPE ATTACHMENTS

- A. For horizontal steel and wrought iron pipe, use carbon steel adjustable clevis hanger, Fig. 260. For floor support or support directly above steel beams, use pipe roll stand, Fig. 177.
- B. For horizontal copper pipe and tube, use copper-plated adjustable swivel ring, Fig. CT-69.
- C. When thermal expansion for horizontal pipe is in excess of 1/2 inch axially, use adjustable swivel pipe roll, Fig. 181, or pipe roll stand, Fig. 177.
- D. For horizontal cast iron soil pipe, use clevis hanger, Fig. 260.
- E. For vertical, steel, wrought iron and cast iron pipe, use extension pipe clamps, Fig. 261.
- F. For vertical copper pipe and tube, use copper-plated extension pipe clamp, Fig. CT-121.

3.4 INTERMEDIATE ATTACHMENTS

- A. Hanger rods: use carbon steel single or double end threaded, Figs. 140, 253 as required. Continuous threaded rod: Fig. 146 may be used wherever possible.
- B. Chain wire or perforated strap hangers will not be permitted. One pipe shall not be suspended from another pipe.

3.5 STRUCTURAL ATTACHMENTS

- A. For attaching steel or copper plated hanger rods to reinforced concrete, use galvanized malleable iron concrete inserts; Fig. 282 for loads up to 1140 pounds.
- B. For attaching steel hanger rods to structural steel beams, use malleable iron C-clamps; Fig. 92, Fig. 93 or Fig. 94 with retaining clip Fig. 89 or Fig. 89X for loads up to 500 pounds; Fig. 218 with extension piece for loads up to 1365 pounds. For copper plated hanger rods, use copper plated malleable iron C-clamps; Fig. CT-138R for loads up to 180 pounds.
- C. Vertical expansion shields or toggles shall not be used for suspending hanger rods, except with permission in cases where inserts have been omitted or cannot be used. If permitted, use expansion shields; for rod sizes up to 1/2 inch, 320 pounds maximum load. For hanger rods larger than 1/2 inch use attachment plate, Fig. 52, with wedge anchors.
- D. Powder actuated anchoring methods shall not be used.

3.6 PIPE COVERING PROTECTION

- A. Hangers and supports for insulated piping shall not injure or pierce insulation. Provide insulation protection shields in conjunction with hanger or roll device. Use Fig. 160 and 165, Protection Saddles.

3.7 SUPPLEMENTAL STEEL

- A. Provide supplemental steel required to hang or support mechanical equipment or piping.

END OF SECTION

SECTION 23 0548

VIBRATION AND SEISMIC CONTROLS FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This specification pertains to the furnishing and installation of vibration isolation devices for HVAC piping and rotating or reciprocating mechanical equipment.
- B. This work shall include all material and labor required for installation of the resilient mounting and suspension systems, adjusting each mounting system, and measurement of isolator system performance when so requested by the Engineer. Specific mounting arrangements for each item of mechanical equipment shall be as described herein and as indicated by schedules and details on the drawings.

1.2 QUALIFICATIONS

- A. All rotating mechanical equipment shall be isolated from the structure by means of vibration isolators. The isolators and bases shall be as tabulated on the Vibration Isolation Schedule in this section. Any equipment not listed in this schedule shall be isolated with the isolator type and deflection shown in the 2007 ASHRAE HVAC Applications Handbook, Chapter 47, Table 48.
- B. Vibration isolators and bases shall be as manufactured by Kinetics Noise Control, Mason Industries, Amber Booth or approved equivalent, and shall all be provided by the mechanical contractor from a single manufacturer to assure single responsibility for the performance of all isolation equipment. The isolator manufacturer's submittal shall include a tabulation of the design data with dimensions for both free and operating heights of the isolators.
- C. Engage manufacturer to provide technical supervision of installation of support isolation units produced, and of associated inertia bases.
- D. The Contractor and the vibration isolation manufacturer or his regularly designated and factory authorized representative shall perform the following tasks in addition to the supply and installation of isolation equipment:
 - 1. Obtain from the Engineer the approved manufacturer's name, model number, and other necessary identifying data for each item of mechanical equipment to be resiliently mounted. Coordinate resilient mounting systems with the exact equipment to be furnished in regard to physical size, isolator locations, weight, rotating speed, etc. Direct contact and cooperation between the vibration isolation device fabricator and the equipment manufacturer will be required.
 - 2. Select piping systems isolators for proper coordination with the physical arrangement of pipe lines and with the physical characteristics of the building.
 - 3. Provide on-the-job supervision as required during installation of resiliently mounted equipment and piping to assure that vibration isolators are installed in strict accordance with normally accepted practices for critical environments.
 - 4. Replace, at no extra cost to the Contracting Authority, isolators which do not produce the required deflection, are improperly loaded above or below their correct operating height, or which do not produce the required isolation.
 - 5. Cooperate with other contractors engaged in this project so that the installation of vibration isolation devices will proceed in a manner that is in the best interests of the Contracting Authority.

6. Notify the Engineer of project conditions which affect vibration isolation system installation of performance and which are found to be different from conditions indicated by the drawings or described by the specifications. Should vibrations isolation system installation proceed without such notifications, remedial work required to achieve proper isolator performance shall be accomplished by the contractor at no additional cost to the Owner.
 7. Be alert for possible short-circuiting of vibration isolation systems by piping supports, electrical connections, temperature control connections, drain lines, building construction, etc., and notify the involved contractor as to these problems or potential problems. Where such situations cannot be easily resolved, notify the Engineer so that preventive or remedial action can take place on a timely basis. Remedial measures required shall be undertaken by the contractor responsible at no additional cost to the Owner.
- E. Vibration isolation products furnished as part of factory-fabricated equipment are specified as part of the equipment assembly in other Division 23 sections.
 - F. Refer to other sections of these specifications for equipment foundations, hangers, sealants, gaskets and other work related to vibration isolation work.
 - G. Where equipment manufacturer's recommendations differ from specified vibration isolation, submit to Architect for approval.
 - H. Furnish templates to fabricators of equipment bases, foundations and other support systems, as needed for coordination of vibration isolation units with other work.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's specifications, detailed drawings, performance characteristic data and installation instructions for each type of unit required. Indicate equipment to be installed with isolator, tabulation of design data with dimensions for both free and operating heights of isolators, and load on each.

1.4 PERFORMANCE REQUIREMENTS

- A. Seismic-Restraint Loading:
 1. Site Class as Defined in the IBC: A.

PART 2 PRODUCTS

2.1 GENERAL

- A. The vibration isolation systems described herein and identified by type number designations shall be applied to specific classifications of mechanical equipment as indicated in the Vibration Isolation Schedule.

2.2 TYPE 1 ISOLATORS (RUBBER & GLASS FIBER PADS AND HANGERS)

- A. Pre-compressed Molded Fiberglass Vibration Isolation Pads, individually coated with a flexible moisture impervious elastomeric membrane. Pads shall be fine (0.00018 inch diameter) bonded annealed glass fibers which have been stabilized during manufacture by overloading the material ten times. Pads shall have a constant natural frequency over the operating load range, and the stiffness shall increase proportionately with load applied. Pads shall be no taller than the shortest horizontal dimension. Where the equipment base does not provide a uniform load surface, steel plates shall be bonded to the top of the pads. Alternately, Neoprene Mounts incorporating completely enclosed metal inserts to permit bolting the supported unit may be used.

2.3 TYPE 2 ISOLATORS (PAD AND HANGER TYPE)

- A. Molded isolators shall come in a range of 30 to 70 durometer and shall be designed for up to 1/2 inch deflection.
- B. Hangers shall be designed for a 20 degree to 35 degree misalignment.

2.4 TYPE 3 ISOLATORS (SPRINGS)

- A. Freestanding, Unhoused, Laterally Stable Steel Springs with leveling bolts and 1/4 inch thick ribbed isolation pads. To assure stability, the spring shall have a lateral spring stiffness equal to the rated vertical stiffness, and shall be designed to provide 50% overload capacity. In capacities up to 5000 pounds, springs shall be replaceable. In capacities over 5000 pounds, springs shall be welded to the top and bottom load plate assemblies.
- B. Combination Spring and Rubber Hangers. The pre-compressed fiberglass shall be coated with a moisture impervious elastomeric membrane in series with springs, all encased in welded steel brackets. Springs shall be as specified for Type 3 isolators. Hangers shall be designed for 50% overload capacity, and shall accommodate rod misalignment over a 30 degree arc. Brackets shall be designed to carry 500% overload without failure.

2.5 TYPE 4 ISOLATORS

- A. Freestanding, Laterally Stable Spring Isolators with vertical limit stops to assure a constant operating height if the supported weight is removed, and to reduce movement due to wind loads. Limit stops shall be isolated from the housing to prevent short-circuiting.

2.6 TYPE A BASES

- A. No base required. Isolators may be attached directly to the supported equipment.

2.7 TYPE B BASES

- A. Structural Steel Base, designed and supplied by reducing the mounting height of equipment. To assure adequate stiffness, the height of the members shall be a minimum of 8% of the longest span between isolators, or at least 6 inches. Where thinner sections are necessary due to head room limitations, the section modulus of the members selected shall be equivalent to or exceed the section modulus of wide flange steel members whose thickness is 8% of the longest span between isolators.

2.8 TYPE C BASES

- A. Reinforces Concrete Inertia Base, the steel members of which are designed and supplied by the isolator manufacturer. The concrete shall be poured into a welded steel frame with pre-located equipment anchor bolts, 1/2 inch diameter reinforcing bars on nominal 8 inch centers each way, and recessed isolator mounting brackets to reduce the mounting height of the equipment, but yet remain within the confines of the base. The thickness of the base shall be a minimum of 8% of the longest span between isolators, at least 6 inches, or as indicated on the drawings. Where inertia bases are used to mount pumps, the bases shall be wide enough to support piping elbows.

2.9 TYPE D BASES

- A. Roof Curb Isolators: Fabricated frame units sized to match roof curbs as shown, formed with isolation springs between extruded aluminum upper and lower sections, which are shaped and positioned to prevent metal-to-metal contact. Provide continuous airtight and waterproof seal between upper and lower extrusions. Include provisions for anchorage of frame unit to roof curb, and for anchorage of equipment to unit. Equivalent to Mason Type CMAB or RSC as required.

2.10 DUCTWORK ISOLATION

- A. Provide flexible duct connections wherever ductwork connects to vibration isolated equipment. Construct flexible connections of neoprene-coated flameproof fabric crimped into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal, axial, transverse, and torsional movement, and also capable of absorbing vibrations of connected equipment.
- B. Manufacturer: Subject to compliance with requirements, provide flexible connections of one of the following:
 - 1. Elgen Manufacturing Co.
 - 2. Duro Dyne Corporation
 - 3. Ventfabrics, Inc.
 - 4. Or approved equal.

2.11 PIPING ISOLATION

- A. Piping over 1 inch diameter in mechanical equipment rooms, and piping three supports away from other mechanical equipment shall be isolated from the structure by means of vibration and noise isolators.
- B. Suspended piping shall be isolated with Type 2 Hangers.
- C. Floor mounted piping shall be isolated with Type 2 Isolators (spring mounts).
- D. Flexible members shall be incorporated in the piping adjacent to all equipment housing pipe connections (cooling tower, unit heaters, air handling units, chillers, etc.).

2.12 PUMP CONNECTORS

- A. Provide flexible connectors at suction and discharge of circulating pumps.
- B. Pipe connectors shall be 18 inches for pipe sizes 6 inches and larger, and 12 inches for smaller pipes.
- C. Pipe connectors shall be of Butyl rubber material with reinforced carcasses and integral rubber and duck flanges. Connectors shall be suitable for 200°F water at 150 psi working pressure.
- D. Protection against elongation shall be provided by tie rod control units with rubber grommets.
- E. Pipe connectors shall be Type 150 B with split galvanized retaining ring as manufactured by Mercer or approved equivalent.

2.13 ELECTRICAL CONNECTIONS TO RESILIENTLY MOUNTED EQUIPMENT

- A. Electrical connections to equipment which is supported or suspended by vibration isolators shall be made with long lengths of flexible conduit or flexible armored cable. These flexible connections must be located so as to prevent rigid conduit connections between the resiliently mounted equipment and the building structure.

2.14 VIBRATION ISOLATION SCHEDULE

EQUIPMENT TYPE	ON GRADE		UP TO 20 FT FLR SPAN		20 TO 30FT FLR SPAN		20 TO 30FT FLR SPAN	
	TYPE B-I	MIN DFL	TYPE E B-I	MIN DFL	TYPE E B-I	MIN DFL	TYPE E B-I	MIN DFL
AXIAL FANS, FAN HEADS, CABINET FANS & FAN SECTIONS								
< OR = 22 INCH DIA.	A-2	0.25	A-3	0.75	A-3	0.75	C-3	0.75
>=24 INCH DIA., <=2 INCHS.P. & <=300 RPM	B-3	2.50	C-3	3.50	C-3	3.50	C-3	3.50
>=24 INCH DIA., <=2 INCHS.P. & 300 - 500RPM	B-3	0.75	B-3	1.75	C-3	2.50	C-3	2.50
>=24 INCH DIA., <=2 INCHS.P. & >500 RPM	B-3	0.75	B-3	1.75	B-3	1.75	B-3	1.75
>=24 INCH DIA., >=2 INCHS.P. & <=300 RPM	C-3	2.50	C-3	3.50	C-3	3.50	C-3	3.50
>=24 INCH DIA., >=2 INCH S.P. & 300 - 500RPM	C-3	1.75	C-3	1.75	C-3	2.50	C-3	2.50
>=24 INCH DIA., >=2 INCH S.P. & >500 RPM	C-3	0.75	C-3	1.75	C-3	1.75	C-3	2.50
CENTRIFUGAL FANS								
< OR = 22 IN. DIA.	B-2	0.25	B-3	0.75	B-3	0.75	C-3	1.75
>=24 INCH DIA., <=2 INCH S.P. & <=300 RPM	B-3	2.50	B-3	3.50	B-3	3.50	B-3	3.50
>=24 INCH DIA., <=2 INCH S.P. & 300 - 500RPM	B-3	1.75	B-3	1.75	B-3	2.50	B-3	2.50
>=24 INCH DIA., <=2 INCH S.P. & >500 RPM	B-3	0.75	B-3	0.75	B-3	0.75	B-3	1.75
>=24 INCH DIA., >=2 INCH S.P. & <=300 RPM	C-3	2.50	C-3	3.50	C-3	3.50	C-3	3.50
>=24 INCH DIA., >=2 INCH S.P. & 300 - 500RPM	C-3	1.75	C-3	1.75	C-3	2.50	C-3	2.50
>=24 INCH DIA., >=2 INCH S.P. & >500 RPM	C-3	1.00	C-3	1.75	C-3	1.75	C-3	2.50
CONDENSING UNITS								
CONDENSING UNITS	A-1	0.25	A-4	0.75	A-4	1.75	A/D-4	1.75

PACKAGED AH, AC, H AND V UNITS	TYPE B-I	MIN DFL	TYPE E B-I	MIN DFL	TYPE E B-I	MIN DFL	TYPE E B-I	MIN DFL
< OR = 10 HP.	A-3	0.75	A-3	0.75	A-3	0.75	A-3	0.75
>=15 HP, <=4 INCH S.P. & <=300 RPM	A-3	0.75	A-3	3.50	A-3	3.50	C-3	3.50
>=15 HP, <=4 INCH S.P. & 300 - 500RPM	A-3	0.75	A-3	2.50	A-3	2.50	A-3	2.50
>=15 HP, <=4 INCH S.P. & >500 RPM	A-3	0.75	A-3	1.75	A-3	1.75	A-3	1.75
>=15 HP, >=4 INCH S.P. & <=300 RPM	B-3	0.75	C-3	3.50	C-3	3.50	C-3	3.50
>=15 HP, >=4 INCH S.P. & 300 - 500RPM	B-3	0.75	C-3	1.75	C-3	2.50	C-3	2.50
>=15 HP, >=4 INCH S.P. & >500 RPM	B-3	0.75	C-3	1.75	C-3	1.75	C-3	2.50

BASE TYPES:

- A. NO BASE, ISOLATORS ATTACHED DIRECTLY TO EQUIPMENT
- B. +PAD, RUBBER, OR GLASS FIBER
- C. CONCRETE INERTIA BASE
- D. CURB-MOUNTED BASE

ISOLATOR TYPES:

- 1. PAD, RUBBER, OR GLASS FIBER
- 2. RUBBER FLOOR ISOLATOR OR HANGER
- 3. SPRING FLOOR ISOLATOR OR HANGER
- 4. RESTRAINED SPRING ISOLATOR
- 5. THRUST RESTRAINT (SEE ASHRAE HANDBOOK)

PART 3 INSTALLATION

3.1 EXECUTION

- A. General: Except as otherwise indicated, comply with manufacturer's instructions for the installation and load application to vibration isolation materials and units. Adjust to ensure that units do not exceed rated operating deflections or bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices (if any) intended for temporary protection against overloading during installation.
- B. Anchor and attach units to substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.
- C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where leveling devices cannot be used to distribute loading properly.
- D. Flexible Pipe Connectors: Refer to other section of these Specifications for the installation of flexible pipe connectors.
- E. Install vibration isolators that are furnished with equipment.

END OF SECTION

SECTION 23 0553
IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide materials, equipment labor and supervision necessary to install piping identification products.
- B. Comply with ANSI A13.1 for lettering size, length or color field, colors, and installed viewing angles of identification devices.

1.2 QUALIFICATIONS

- A. Brady Corp., Industrial Safety Supply, Emedco, Seton or Brimar or approved equal.

1.3 SCHEDULES

- A. Submit valve and damper schedule for each system, typewritten and reproduced on 8 1/2 inches by 11 inches bond paper. Tabulate valve and damper number, system, system abbreviation (as shown on tag), location of valve and damper (room or space), and variations for identification (if any). Mark valves and dampers that are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule.

1.4 SUBMITTALS

- A. Submit manufacturer's product data.
- B. Submit sample of each type of identification product and clearly identify the contents in a schedule.

PART 2 PRODUCTS

2.1 PIPE MARKERS

- A. Provide manufacturer's standard preprinted, semi-rigid snap-on or self-sticking, color-coded pipe markers, complying with ANSI A13.1.
- B. Provide full-band pipe markers, extending 360 degrees around pipe at each location or self-sticking pipe markers, fastened in the following method:
 - 1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
 - 2. Secure to piping and install banding tape on both ends of each pipe label.
- C. Lettering shall be manufacturer's pre-printed nomenclature which best describes piping system in each instance, as selected by Engineer in cases of variance.
- D. Print each pipe marker with arrows indicating direction of flow, integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic or on banding tape.

2.2 EQUIPMENT MARKERS

- A. Provide engraved signage nameplates and tags constructed of multi-layered acrylic that has been treated for outdoor use and can withstand temperatures up to 160°F. Nameplates shall have beveled edges with contrasting color core, letters, and border. Minimum size of nameplate shall be 3 inches high by 6 inches long. The minimum letter height shall be 3/4 inch. Attachment shall be by double faced 2 mil permanent acrylic adhesive. For equipment that doesn't allow for direct attachment, furnish sheet metal backing to integrate with

equipment such that signage can be read from 5 feet above the finished floor. Unless noted otherwise, signage shall be provided with black lettering, black border, and yellow core. All signage shall include up to 14 characters per line, minimum of three lines per tag. Furnish signage for equipment shown in Section 3:

1. All pumps shall include the full name description for system served such as "*Primary Chilled Water Pump – 1.*"
 2. All air handling unit filter sections shall be labeled with the exact quantity of filters, size, and type of filter such as "*14 – 24"x24"x2", 30% Pleated Filters.*"
- B. All equipment shall be named consistent with the plans and specifications as indicated on the schedules or as directed by the Engineer.

2.3 VALVE AND DAMPER TAG FASTENERS

- A. Manufacturer's standard solid brass chain or solid brass S-hooks of sizes required for proper attachment of tags to valves and dampers, and manufactured specifically for that purpose.

2.4 VALVE AND DAMPER SCHEDULE FRAMES

- A. For each page of schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSD-grade sheet glass.

PART 3 EXECUTION

3.1 INSTALLATION OF MECHANICAL IDENTIFICATION

- A. Where identification is to be applied to surfaces that require insulation, painting or other covering or finish, including valve tags in finished mechanical spaces, install identification after completion of covering and painting. Install identification prior to installation of acoustical ceilings and similar removable concealment.
- B. Install pipe markers on each system, and include arrows to show normal direction of flow.
- C. Locate pipe markers as follows: wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) above lay-in type ceilings and exterior non-concealed locations.
1. Near each valve and control device.
 2. Near each branch, excluding short take-offs for fixtures, mark each pipe at branch where there could be question of flow pattern.
 3. Near locations where pipes pass through walls or floors/ceilings, (both sides) or center 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. At each pipe passage to underground.
 7. Spaced intermediately at maximum spacing of 50 feet along each piping run, except reduce spacing to 25 feet in congested areas of piping and equipment.
 8. On piping above removable acoustical ceilings, maximum spacing of 20 feet along each piping run.

9. Where self-sticking labels are used, the pipe or its covering surface shall be properly prepared. This consists of removal of loose dirt, oil and grease, loose paint or peeling insulation covering. This can be done with a brush and cloth; washing is not required. Use solvent for removal of oil or grease.
 10. Banding tape must be used on both ends of all self-sticking labels. The tape shall encircle the pipe completely and overlap itself so the banding tape can adhere to itself.
- D. Provide valve tags for all major valves 3/4 inch size or larger. Included are all main, zone and branch valves, valves in all equipment rooms, etc. All types of valves, ball, globe, butterfly, cocks, control, regulating, relief, reducing, solenoid, etc. are to be identified except check valves. Do not identify end use point valves for plumbing fixtures, and similar rough-in connections.
 - E. Provide damper tags on all automatic control dampers, motorized dampers, and smoke dampers.
 - F. List each tagged valve and damper in schedule for each system showing function and location. Provide separate charts for mechanical divisions of work. Charts shall be installed on a conspicuous wall in the main mechanical equipment room. Provide unframed copies of valve and damper lists as part of closeout documents.

3.2 ADJUSTING AND CLEANING

- A. Relocate any mechanical identification device which has become visually blocked by work of this division or other divisions.
- B. Clean face of identification devices and glass frames of valve schedules.

3.3 PIPING DUCTWORK, AND EQUIPMENT IDENTIFICATION

- A. Piping systems that shall be identified by their controls (including directional arrows) on this project shall include, but are not necessarily limited to, the following:
 1. Natural Gas
 2. Storm, Overflow Storm
- B. Equipment/Ductwork
 1. Outdoor air intake plenums.
 2. Air handling unit sections.
 3. Condensing Units and Associated DX Coils
 4. Furnaces
 5. Directional arrows indicating flow of air at discharge and inlet of air handling units.
 6. Provide name plates for all equipment scheduled on the drawings.

END OF SECTION

SECTION 23 0593
TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Testing, adjustment, and balancing of air systems.
- B. Testing, adjustment, and balancing of refrigeration systems.
- C. Measurement of final operating condition of HVAC systems.
- D. Vibration measurement of equipment operating conditions.

1.2 QUALIFICATIONS

- A. Testing and balancing shall be performed by an independent certified testing and balancing contractor. The Contractor shall be certified by the AABC (American Association of Balancing Contractors), NEBB (National Environmental Balancing Bureau), or SMARTA (Sheet Metal and Air Conditioning and Roofing Trade Association). The Balancing Contractor shall provide labor, services, and test equipment required to test, adjust, and balance the specified systems. Personnel involved in the execution of the work under the Balancing Contract shall be experienced and trained in the total balancing of mechanical systems, as well as being regular employees of the Balancing Contractor.

1.3 SUBMITTALS

- A. Submit name of adjusting and balancing agency for approval within 30 days after award of Contract.
- B. Field Reports: Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
- C. Prior to commencing work, submit report forms or outline indicating adjusting, balancing, and equipment data required.
- D. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer and for inclusion in operating and maintenance manuals.
- E. Provide reports in soft cover, letter size, three-ring binder manuals, complete with index page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets, and indicating thermostat locations.
- F. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty prior to commencing system balance.
- G. Test Reports: Indicate data on forms containing information indicated in Schedules.

1.4 SEQUENCING

- A. Sequence work to commence after completion of systems installation and schedule completion of balancing work before Substantial Completion of Project.
- B. Do not proceed with balancing work until systems scheduled for testing, adjusting, and balancing are clean and free from debris, dirt, and discarded building materials.
- C. Complete all testing and balancing before start of commissioning functional performance tests.

PART 2

2.1 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.1 OTHER CONTRACTOR RESPONSIBILITIES

- A. The Mechanical and Plumbing Contractors shall cooperate with the balancing agency by:
 - 1. Including balancing dampers as required by the Drawings and Specifications.
 - 2. Putting complete system into operation during duration of balancing period.
 - 3. Providing up-to-date set of Drawings and advising immediately of changes made to the system during construction.
 - 4. Providing labor and equipment and cost of performing corrections such as dampers, belts, and pulley changes, etc. as required without undue delay.
 - 5. Providing complete submittal information for mechanical equipment complete with pertinent engineering information.

3.2 EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions.
 - 1. Systems are started and operating in a safe and normal condition.
 - 2. Temperature control systems are installed complete and operable.
 - 3. Proper thermal overload protection is in place for electrical equipment.
 - 4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 - 5. Duct systems are clean of debris.
 - 6. Fans are rotating correctly.
 - 7. Fire and volume dampers are in place and open.
 - 8. Air coil fins are cleaned and combed.
 - 9. Access doors are closed and duct end caps are in place.
 - 10. Air outlets are installed and connected.
 - 11. Duct system leakage is minimized.
- B. Submit field reports. Report defects and deficiencies noted during performance of services which prevent system balance.
- C. Beginning of work means acceptance of existing conditions.

3.3 PREPARATION

- A. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Engineer to facilitate spot checks during testing.
- B. Provide additional balancing devices as required.

3.4 INSTALLATION TOLERANCES

- A. Air Handling Systems: Adjust to within +/- 5% of design for supply systems and +/- 10% of design for return and exhaust systems.
- B. Diffusers, Registers and Grilles: Adjust total to within 10% and 5% of design to space. Adjust diffusers, registers and grilles in space to within +/-10% of design.
- C. Hydronic Systems: Adjust to within +/- 10% of design.

3.5 ADJUSTING

- A. Ensure recorded data represents actual measured or observed conditions.
- B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
- C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
- D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostat to specified settings.
- E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by the Contracting Authority.
- F. Check and adjust systems approximately six months after final acceptance and submit report.

3.6 AIR SYSTEM PROCEDURE

- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
- B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
- C. Measure air quantities at air inlets and outlets.
- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to the extent that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.
- H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowance for 50% loading of filters.
- I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

- K. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- L. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches positive static pressure near the building entries, 0.02 inches positive static pressure in common spaces and -0.02 inches negative static pressure at restrooms.
- M. For variable air volume system powered units set volume controller to air flow setting indicated. Confirm connections properly made and confirm proper operation for automatic variable air volume temperature control.

3.7 SCHEDULES

A. Equipment Requiring Testing, Adjusting, and Balancing

- 1. Forced Air Furnaces
- 2. Direct Fired Furnaces
- 3. Unit Air Conditioners
- 4. Air Coils
- 5. Air Filters
- 6. Diffusers, Registers and Grilles

B. OUTDOOR AIR VENTILATION DATA

- 1. Air Handling Units shall be tested and balanced for the following conditions:
 - a. Leakage when the outdoor air damper is in the closed position and the unit is operating at 100% scheduled speed. Adjust damper if required to reduce leakage to the maximum allowable leakage rate as specified.
 - b. Capacity as scheduled on the drawings
 - c. VAV systems only: Capacity of outdoor air when the air handling unit is at 50% capacity and outdoor air damper is set for the scheduled air flow.
- 2. Coordinate testing with the temperature controls contractor and identify the percent actuator stroke correlating with the above capacities.
- 3. Submit this in report form to the engineer prior to submitting final report.

C. REPORT FORMS

- 1. Title Page:
 - a. Name of Testing, Adjusting, and Balancing Agency
 - b. Address of Testing, Adjusting, and Balancing Agency
 - c. Telephone number of Testing, Adjusting, and Balancing Agency
 - d. Project name
 - e. Project location
 - f. Project Architect

- g. Project Engineer
 - h. Project Contractor
 - i. Project altitude
 - j. Report date
2. Summary Comments:
- a. Design versus final performance
 - b. Notable characteristics of system
 - c. Description of systems operation sequence
 - d. Summary of outdoor and exhaust flows to indicate amount of building pressurization
 - e. Nomenclature used throughout report
 - f. Test conditions
3. Instrument List:
- a. Instrument
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Range
 - f. Calibration date
4. Electric Motors:
- a. Manufacturer
 - b. Model/Frame
 - c. HP/BHP.
 - d. Phase, voltage, amperage; nameplate, actual, no load
 - e. RPM
 - f. Service factor
 - g. Starter size, rating, heater elements
 - h. Sheave Make/Size/Bore
5. V-Belt Drive:
- a. Identification/location
 - b. Required driven RPM
 - c. Driven sheave, diameter and RPM
 - d. Belt, size and quantity

- e. Motor sheave diameter and RPM
 - f. Center to center distance, maximum, minimum, and actual
6. Air Cooled Condenser:
- a. Identification/number
 - b. Location
 - c. Manufacturer
 - d. Model number
 - e. Serial number
 - f. Entering DB air temperature, design and actual
 - g. Leaving DB air temperature, design and actual
 - h. Number of compressors
 - i. Refrigerant type
7. Cooling Coil Data:
- a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air DB temperature, design and actual
 - g. Entering air WB temperature, design and actual
 - h. Leaving air DB temperature, design and actual
 - i. Leaving air WB temperature, design and actual
 - j. Saturated suction temperature, design and actual
 - k. Air pressure drop, design and actual
 - l. Type of refrigerant for DX coils
8. Heating Coil Data:
- a. Identification/number
 - b. Location
 - c. Service
 - d. Manufacturer
 - e. Air flow, design and actual
 - f. Entering air temperature, design and actual

- g. Leaving air temperature, design and actual
 - h. Air pressure drop, design and actual
9. Air Moving Equipment
- a. Location
 - b. Manufacturer
 - c. Model number
 - d. Serial number
 - e. Arrangement/Class/Discharge
 - f. Supply air flow, specified and actual
 - g. Return air flow, specified and actual
 - h. Outside air flow, specified and actual
 - i. Total static pressure (total external), specified and actual
 - j. Inlet pressure
 - k. Discharge pressure
 - l. Sheave Make/Size/Bore
 - m. Number of Belts/Make/Size
 - n. Fan RPM
 - o. Fan BHP
10. Return Air/Outside Air Data:
- a. Identification/location
 - b. Design air flow
 - c. Actual air flow
 - d. Design return air flow
 - e. Actual return air flow
 - f. Design outside air flow
 - g. Actual outside air flow
 - h. Return air temperature
 - i. Outside air temperature
 - j. Required mixed air temperature
 - k. Actual mixed air temperature
 - l. Design outside/return air ratio
 - m. Actual outside/return air ratio

11. Duct Traverse:
 - a. System zone/branch
 - b. Duct size
 - c. Area
 - d. Design velocity
 - e. Design air flow
 - f. Test velocity
 - g. Test air flow
 - h. Duct static pressure
 - i. Air temperature
 - j. Air correction factor
12. Air Monitoring Station Data:
 - a. Identification/location
 - b. System
 - c. Size
 - d. Area
 - e. Design velocity
 - f. Design air flow
 - g. Test velocity
 - h. Test air flow
13. Flow Measuring Station:
 - a. Identification/number
 - b. Location
 - c. Size
 - d. Manufacturer
 - e. Model number
 - f. Serial number
 - g. Design flow rate
 - h. Design pressure drop
 - i. Actual/final pressure drop
 - j. Actual/final flow rate
 - k. Station calibrated setting

14. Air Distribution Test Sheet (Diffusers, Registers and Grilles):

- a. Air terminal number
- b. Room number/location
- c. Terminal type
- d. Terminal size
- e. Area factor
- f. Design velocity
- g. Design air flow
- h. Test (final) velocity
- i. Test (final) air flow
- j. Percent of design air flow

15. Vibration Test:

- a. Location of points:
 - 1) Fan bearing, drive end
 - 2) Fan bearing, opposite end
 - 3) Motor bearing, center (if applicable)
 - 4) Motor bearing, drive end
 - 5) Motor bearing, opposite end
 - 6) Casing (bottom or top)
 - 7) Casing (side)
 - 8) Duct after flexible connection (discharge)
 - 9) Duct after flexible connection (suction)
- b. Test readings:
 - 1) Horizontal, velocity and displacement
 - 2) Vertical, velocity and displacement
 - 3) Axial, velocity and displacement
- c. Normally acceptable readings, velocity and acceleration
- d. Unusual conditions at time of test
- e. Vibration source (if non-complying)

END OF SECTION

**SECTION 23 0700
HVAC INSULATION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, labor and supervision necessary to install insulation to hot and cold surfaces of piping, tanks, ductwork, fittings and other surfaces.
- B. Insulation shall include insulating materials, jackets, adhesive, mastic coatings, tie wire and other materials as required to complete the insulating work.

1.2 CODES AND STANDARDS

- A. Insulating materials, jackets and mastics shall meet flame spread, fuel contribution and smoke developed ratings in accordance with NFPA-90A. Flame spread rating in accordance with NFPA 255, ASTM E-84 or UL 723 of not more than 25; smoke developed rating of not more than 50, unless otherwise noted in this section.
- B. Insulation that has been treated with a flame-retardant additive to meet the flame spread and smoke developed ratings shown above is not permitted.
- C. Insulation materials shall be noncorrosive to the materials they are applied to, including stress corrosion cracking of stainless steel, and shall not breed or promote fungus and bacteria.
- D. Insulation shall meet or exceed all requirements of ASHRAE 90.1-2010
- E. Insulation shall meet or exceed all requirements of International Energy Conservation Code.

1.3 QUALIFICATION

- A. Insulating materials by Owens-Corning, Armacell Armstrong, Pittsburgh-Corning, Knauf, Johns Manville, or approved equivalent.
- B. Mastics and adhesives as recommended by insulation manufacturer.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation. Submit schedule showing manufacturer's product number, flame spread and smoke development rating, k-value, density, temperature limitations, sound absorption coefficients, thickness, and furnished accessories for each mechanical system requiring insulation.

PART 2 PRODUCTS

2.1 PRODUCTS

- A. Description:
 - 1. Type A: Preformed, sectional, heavy density fiberglass insulation, suitable for operating temperatures from -20° F to $+850^{\circ}$ F. Equipped with factory-applied, all-service vapor barrier jacket constructed of white Kraft paper bonded to aluminum foil reinforced with fiberglass yarn, with pressure-sensitive, self-sealing longitudinal laps and butt strips. Thermal conductivity of 0.23 BTU inch per hour per square foot $^{\circ}$ F @ 75° F mean temperature. Water vapor permeance of 0.02 perms.
 - 2. Type B: Flexible, elastomeric pipe and sheet insulation with closed-cell structure. Shall comply with ASTM C534, Type I, Grade 1 for tubular materials and ASTM C534 Type II,

Grade 1 for sheet materials. Suitable for operating temperatures from -40°F to 220°F . Outdoor applications, and where otherwise noted, shall receive a weather-resistant, protective, latex enamel finish. Thermal conductivity of 0.28 BTU inch per hour per square foot $^{\circ}\text{F}$ @ 75°F mean temperature. Water vapor permeance of 0.08 perms. Adhesive shall be Low-VOC Contact Adhesive.

3. Type C: Flexible, elastomeric thermal insulation with an expanded, closed-cell structure. Pre-slit tubular form with a pressure-sensitive adhesive strip for closure and vapor sealing of the longitudinal joint. Butt joints, sealed with tape. White color. Suitable for operating temperature of 40°F to 200°F . Thermal conductivity of 0.28 BTU inch per hour per square foot $^{\circ}\text{F}$ mean temperature. Water vapor permeance of 0.20 perms.
4. Type G: Semi-rigid fiberglass board with factory applied foil Skrim-Kraft (FSK) suitable for operating temperature of -20°F to $+650^{\circ}\text{F}$. Thermal conductivity of 0.27 BTU inch per hour per square foot $^{\circ}\text{F}$ @ 75°F mean temperature. Water vapor permeance of 0.02 perms.
5. Type I: Fiberglass duct wrap, 1.5 PCF density, fabricated of inorganic glass fibers bonded with thermosetting resin with factory applied foil Skrim-Kraft facing, suitable for operating temperature up to $+250^{\circ}\text{F}$. Thermal conductivity of 0.26 BTU inch per hour per square foot $^{\circ}\text{F}$ @ 75°F mean temperature. Water vapor permeance of 0.02 perms.
6. Type J: Flexible fiberglass duct liner, 1.5 PCF density, fabricated of inorganic glass fibers bonded with thermosetting resin, with mat face suitable for air velocities up to 4000 FPM and operating temperatures up to $+250^{\circ}\text{F}$. Thermal conductivity of 0.25 BTU inch per hour per square foot $^{\circ}\text{F}$ @ 75°F mean temperature.
7. Type L: Fire protective grease duct wrap, two-hour fire-rated, zero-inch clearance to combustibles, compliant with UL 1978, NFPA 96, and ASTM E119. Service range to 2300°F , melting point 3200°F , foil-faced.
8. Type Z: Custom fabricated equipment insulation enclosure. Celotex Thermax Polyisocyanurate, 2 inch clad in 0.040 inch stucco embossed aluminum sheet grade 304 on exterior surface and aluminum foil faced on the inside surface. Panel to panel joints shall be sealed with 1/8 inch insulating tape and fastened using stainless steel spring tension hook latches. Enclosure shall cover all surfaces except bottom.

2.2 INSULATION JACKETS

- A. 20-mil high impact PVC secured with spray contact adhesive. All PVC jacketing shall meet the 25/50 SDR.
- B. 6-ounce per square yard UL listed cotton canvas fabric secured with Childers CP50 lagging adhesive.
- C. Fitting and valve jackets shall be premolded PVC with joints and seams sealed with a spray contact adhesive or vapor barrier mastic.
- D. At wall penetrations and on exterior pipe, provide an additional jacket of 0.020 inch thick smooth finish aluminum. Metal jacket shall have factory applied moisture barrier. Fitting and valve covers to be preformed of same material as adjacent metal jacket
- E. Where PVC or metal jackets are used, delete the factory applied ASJ on pipe and equipment operating above 75°F .
- F. PVC jackets shall be used in the following areas and systems:
 1. Whenever piping is routed exposed through occupied spaces.
 2. Exposed piping in kitchens and dishwasher rooms.

3. Premolded PVC at all fittings and valve jackets.
- G. Insulated Fittings:
1. Use valve insulated wraps at all fittings and valves. Provide reusable insulated wraps for unions, strainers, autoflow valves, circuit setters, check valves and components integral to heat pump hose kits.
 2. Provide with insulation values (i.e. thickness) consistent with insulation specified for associated piping service. Valve wrap shall be provided in sufficient length to completely conceal all integral components including 2 inches minimum overlap on pipe at each end.
 3. Wraps shall be sized and installed per manufacturer's recommendations.
 4. Ensure locations of all wrapped components are clearly identified on mechanical contractors' record drawings.

PART 3 EXECUTION

3.1 INSTALLATION, GENERAL

- A. Use only experienced applicators regularly engaged in the trade. Rough work will be rejected. Application details shall be in accordance with the insulation materials supplier's recommendations, except where a higher standard is specified.
- B. Install materials after systems have been tested and approved. Material such as rust, scale, dirt and moisture shall be removed from surfaces to be insulated.
- C. Insulation shall be kept clean and dry at all times.
- D. Where pipes and ducts pass through fire rated walls, floors and partitions, a fire seal shall be provided.
- E. When flexible cellular insulation is used, it shall be installed with seams and joints sealed with contact adhesive.
 1. Wherever possible, the insulation shall be placed over the pipe before it is installed. Seal the butt joints with Low-VOC Contact Adhesive or equal.
 2. Where the insulation cannot be slipped on, cut the insulation longitudinally and apply it to the piping. Seal longitudinal seam and butt joints with Low-VOC Contact Adhesive or equal. In all cases, the insulation protected with half-round PVC sleeves the length of three times the nominal pipe size, minimum length to be 8 inches.

3.2 PIPE INSULATION INSTALLATION

- A. Insulate fittings, valves, unions, flanges, strainers, flexible connections and expansion joints with premolded or mitered segments of same insulating material as for adjacent pipe covering.
- B. Pipe insulation shall continue through sleeves and hangers with vapor barrier and/or jacket.
- C. Insert to be between support shield and piping but under the finish jacket. Provide an insert at hangers not less than 6 inches long, of same thickness and contour as adjoining insulation, to prevent insulation from sagging at support points. Inserts shall be heavy density insulating material suitable for the planned temperature range. Factory fabricated inserts may be used.
- D. Neatly finish insulation at supports, protrusions and interruptions.
 1. On hot systems where fittings are to be left exposed, insulation ends shall be beveled away from bolts for easy access.

2. On cold systems, valve stems shall be sealed with caulking which allows free movement of the stem, but provides a seal against moisture incursion.
- E. For outdoor pipe insulation, increase pipe insulation thickness by 1/2 inch from thickness listed in schedule.
- F. Exterior metal jackets shall overlap at longitudinal and circumferential joints not less than 2 inches, and shall be secured with bands at not more than 1/2 inch centers. Longitudinal joints shall be overlapped down to shed water and shall be located at 4 or 8 o'clock positions. Joints shall be sealed with moisture barrier. Installation shall include provision for thermal expansion.
- G. Wherever piping penetrates a floor or is exposed in a finished area such as kitchens, furnish a floor pipe escutcheon and/or PVC (white) jacket to protect insulation and allow for a smooth finish for cleaning.

3.3 EQUIPMENT INSULATION

- A. Do not insulate factory-insulated equipment.
- B. Apply insulation as close as possible to equipment by grooving, scoring and beveling insulation, if necessary. Secure insulation to equipment with studs, pins, clips, adhesive, wires or bands.
- C. Fill joints, cracks, seams and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- D. Cover insulation with metal mesh and finish with 1/4 inch coat of insulating cement applied in two 1/8 inch layers, if non-faced insulation is used.
- E. Do not insulate over nameplate or ASME stamps. Bevel and seal insulation around such.
- F. When equipment with insulation requires periodical opening for maintenance, repair or cleaning such as at manway covers or strainer plugs, install insulation in such a manner that it can be easily removed and replaced without damage. Removable insulation shall have a vapor-proof cover fabricated so as to allow it to be resealed to the equipment vapor barrier.
- G. Joints shall be sealed with 2 inches wide vapor barrier tape or strips to match insulation jacket, using a fire-resistive adhesive.

3.4 DUCT LINER APPLICATION

- A. Apply duct liner with coat or surface designed to be exposed, facing the air stream and adhered with 100% coverage of fire-retardant adhesive. When width exceeds 12 inches or height exceeds 24 inches, additionally secure liner with mechanical fasteners spaced on 12 inches maximum centers. Fasteners shall start within 3 inches of leading edge of transverse joints. Coat exposed joints and edges of transverse joints with a fire-retardant adhesive.
- B. Apply apparatus casing liner same as item A above and apply 1/2 inch mesh galvanized, 16 gauge wire over the entire surface and fasten with speed washers.
- C. Duct sizes shown on drawings are net inside dimensions, and sheet metal size shall be increased to allow for duct lining.

3.5 DUCT COVERING APPLICATION

- A. Covering shall be cut slightly longer than circumference of duct to ensure full thickness at corners. Insulation shall be applied with edges tightly banded, and shall be adhered to duct with fire-resistant adhesive. Adhesive shall be applied so that insulation conforms to duct surfaces uniformly and firmly.

- B. In addition to the adhesive, the insulation shall be additionally secured to the bottom of ducts 18 inches or wider by means of adhesive pins and speed clips. The protruding ends of the pins shall be cut off flush after the speed clips have been applied. The vapor barrier facing shall be thoroughly sealed with a vapor barrier mastic and tape where the pins have pierced through. The vapor barrier shall be continuous to prevent condensation. Insulation shall not be compressed at any location so as to reduce insulating characteristics.
- C. Joints shall be sealed with 2 inches wide pressure-sensitive tape or vapor barrier tape or strips, using a fire-resistive adhesive. Cuts or tears shall be sealed with strips of vapor barrier jacket applied with adhesive or pressure-sensitive tape.

3.6 DUCT INSULATION SCHEDULE (IECC)

SERVICE	TYPE	THICKNESS
Low Pressure Supply Duct	I	1 1/2 inches
Low Pressure Return Duct, Relief Duct, Transfer Duct	J	1 inches
Outdoor Air Intake and Exhaust including associated plenums	I	1 1/2 inches
Flexible Duct Spin-in Fittings	I	1 inches
Exhaust Duct	I	1 inches

END OF SECTION

SECTION 23 1123
FACILITY NATURAL GAS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install a complete Natural Gas piping system.

1.2 STANDARDS AND CODES

- A. Pipe materials specified in this Section shall apply to technical sections of Division 23 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein. Piping located in plenums shall be plenum rated for fire and smoke.
- B. Gas piping and connections to equipment shall be in accordance with NFPA-54 and the City of Cedar Rapids Gas Code and the local utility company.

1.3 PRODUCT HANDLING

- A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. Submit piping schedule listing each pipe material used and systems served.
- B. Submit shop drawings at 1/4 inch per foot scale indicating exact routing and elevations for all piping systems.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Material and Service
- B. Aboveground natural gas.
 - 1. Black steel pipe, welded, seamless, Schedule 40, ASTM A53.
- C. Gas vents and underground gas piping within 5 feet 0 inches of building.
 - 1. Welded black steel Schedule 40, coated with asphalt and wrapped, ASTM A120.
- D. Fittings
 - 1. Welded pipe - welded neck fittings and welded neck flanges, same material and strength as pipe.
 - 2. Carbon steel pipe - material and strength shall correspond to pipe specifications. ANSI B31.5.

E. Joints

1. Welded pipe - welding shall conform to welding section of ANSI B31.1 "Code for Power Piping". Pipe up to 2 inches diameter shall be screwed. Pipe 2 1/2 inches diameter and over shall be welded.

F. Nipples and Unions

1. Nipples shall conform to size, weight, and strength of adjoining pipe. When length of unthreaded portion of nipple is less than 1 1/2 inches, use extra strong nipple; do not use close nipples.
2. For pipe 3 inches and smaller, use screwed unions; over 3 inches, use flanged unions. For steel and wrought iron pipe, use malleable iron ground joint unions, black or galvanized, to conform to pipe. Cast iron flanged unions are to be gasket type. For threaded brass pipe, use bronze ground joint unions with octagon ends. Install unions on equipment intended to be disassembled.
3. Dielectric unions shall be installed between connections of copper pipe and ferrous piping.

2.2 PLUG VALVES

- A. Plug valves shall not be furnished unless specifically shown on the Drawings. When so indicated, this type of valve shall meet the following specifications:
1. Smaller than 2 inches: Tapered plug valves, semi-steel, screwed, wrench operated with wrench.
 2. 2 inches and larger: Tapered plug valves, carbon steel, flanged, lubricated plug wrench operated with a wrench.

2.3 PRESSURE REGULATING VALVE (NATURAL GAS)

- A. Gas regulators shall be furnished and installed to maintain the gas pressure to the pilot supply and main burner supply line within +10% of the operating pressure from maximum to minimum firing rates at inlet operating pressures of 1 1/2 to 2 pounds per square inch, gage.
- B. Regulators shall be of the spring-loaded or pressure balanced type. Under no circumstances shall a dead weight or a weight and level type of regulator be used.
- C. Gas regulators shall be suitable for operation with electronic ignition "dead end" conditions.
- D. Gas pressure regulators shall be AGA and CGA certified for scheduled operating conditions.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install piping and make service connection as shown on the Drawings.
- B. Pipe size 2 inches and larger or 2 pounds per square inch, gage and greater shall have welded joints; pipe less than 2 inches and less than 2 pounds per square inch, gage shall have threaded joints made up with gas resistant joint compound.
- C. Gas piping on the exterior of the parking garage structure shall be welded. This statement shall supersede any other sizing information listed in this specification.
- D. Install gas shutoff plug valve in main, in each branch line and at each appliance.
- E. Install service plug valve at each outlet.

- F. General: Comply with requirements of basic piping material sections for installation of piping materials. Install piping products in accordance with manufacturer's written instructions, with applicable installation requirements of ANSI Z 223.1, and in accordance with recognized industry practices to insure that products serve intended functions.
- G. Use sealants on metal gas piping threads that are chemically resistant to LP and natural gas. Use sealants sparingly and apply to only male threads of metal joints.
- H. Remove cutting and threading burrs before assembling piping.
- I. Do not install defective piping or fittings. Do not use pipe with threads that are chipped, stripped or damaged.
- J. Plug each gas outlet, including valves, with a threaded plug or cap immediately after installation, and retain until continuing piping or equipment connections are completed.
- K. Install dirt-legs in gas piping at connections to equipment and elsewhere as indicated, and where required by code or regulation.
- L. Install tee fittings with bottom outlet plugged, or capped, at bottom of pipe risers.
- M. Do not install gas piping through foundations or under buildings. Where unavoidable, install in welded conduit, ventilated to outdoors on both ends, and tested to same requirements as gas piping.
- N. Gas piping shall be electrically grounded and continuously grounded within the project, and bonded tightly to the grounding connection.
- O. Use dielectric unions where dissimilar metals are joined together.
- P. Install piping with 1/64 inch per foot (1/8%) downward slope in direction flow.
- Q. Install piping parallel to other piping, but maintain minimum of 12 inches clearance between gas piping and steam or hydronic piping above 200°F.
- R. Gas Service:
 - 1. General: Arrange with utility company to provide gas service to indicated location with shutoff at terminus. Consult with utility as to extent of its work, costs, fees and permits involved. Pay such costs and fees; obtain permits.
 - 2. Extend service pipe from utility's terminus to inside building wall, under utility's direction.
 - 3. Provide shutoff outside building where indicated. Provide shutoff in gas service pipe at entry in building.
 - 4. Provide concrete foundations and pads for gas meters per utilities directions.
- S. Installation of Valves:
 - 1. Gas Cocks: Provide at connection to gas train for each gas-fired equipment item; and on risers and braces where indicated.
 - 2. Locate gas cocks where easily accessible, and where they will be protected from possible injury.
 - 3. Pressure Regulating Valves: Install where shown and where required; comply with Utility requirements. Pipe atmospheric vent to outdoors, full size of outlet. Install gas shutoff valve upstream of each pressure regulating valve.

3.2 EQUIPMENT CONNECTIONS

- A. Fuel Gas Piping Tightness Test: Prior to initial operation, test and purge fuel gas piping in accordance with ANSI Z 223.1, National Fuel Gas Code.
- B. General: Connect gas piping to each gas-fired equipment item, with dirt leg and shutoff gas cock and pressure regulator where required. Comply with equipment manufacturer's instructions.
- C. Piping Tests:
 - 1. Using dry nitrogen, purge each segment to be tested. Cap or otherwise seal the segment to be tested. Fill system with dry nitrogen and test in accordance with NFPA 54.
 - 2. Repair or replace fuel gas piping as required to eliminate leaks, and retest as specified to demonstrate compliance.
 - 3. All welded pipe shall be pressure tested to 90 pounds per square inch, gage for a minimum period of one hour. Submit test results.
- D. Purge System:
 - 1. After all segments have been tested and entire system completed, purge the system free of air in accordance with NFPA 54. Do not leave purge discharge points unattended.
- E. Spare Parts:
 - 1. Furnish to Contracting Authority, with receipt, two valve wrenches for each type of gas valve installed, requiring same.

END OF SECTION

SECTION 23 2300
REFRIGERANT PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Provide equipment, materials, tools, labor, and supervision necessary to furnish, fabricate, and install complete piping system.

1.2 STANDARDS AND CODES

- A. Pipe materials specified in this Section shall apply to technical sections of Division 23 of the Project Manual where applicable. Special requirements as may be called for in the technical sections, or shown on the Drawings, shall take precedence over General Requirements herein. Piping located in plenums shall be plenum rated for fire and smoke.

1.3 PRODUCT HANDLING

- A. Provide factory-applied plastic end-caps on each length of pipe and tube. Maintain end-caps through shipping, storage, and handling as required to prevent pipe-end damage and eliminate dirt and moisture from inside of pipe and tube.
- B. Where possible, store pipe and tube inside and protected from weather. Where necessary to store outside, elevate well above grade and enclose with durable, waterproof wrapping.
- C. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packaging with durable, waterproof wrapping.

1.4 SUBMITTALS

- A. Submit piping schedule listing each pipe material used and systems served.
- B. Submit shop drawings at 1/4 inch per foot scale indicating exact routing and elevations for all piping systems.

PART 2 PRODUCTS

2.1 MATERIAL

- A. Material and Service
- B. Copper refrigeration tube, hard temper, Type L-ACR, ASTM B88: Refrigerant lines.
- C. Fittings
 - 1. Copper water tube, cast bronze or wrought copper, and solder joint type. ANSI B16.18 and B16.22.
- D. Joints
 - 1. Copper water and drainage tube - use 95-5 tin antimony or silver solder, cut pipe square, clean and polish tube ends and inner surface of fittings, apply flux and solder joint as recommended by manufacturer of solder type fittings. Use same methods for copper refrigerant pipe, except use silver solder with 15% silver content, equivalent to Sil-Flos 15.
- E. Nipples and Unions

1. Nipples shall conform to size, weight, and strength of adjoining pipe. When length of unthreaded portion of nipple is less than 1 1/2 inches, use extra strong nipple; do not use close nipples.
2. For pipe 3 inches and smaller, use screwed unions; over 3 inches, use flanged unions. For steel and wrought iron pipe, use malleable iron ground joint unions, black or galvanized, to conform to pipe. Install unions on equipment intended to be disassembled.
3. Dielectric unions shall be installed between connections of copper pipe and ferrous piping.

2.2 REFRIGERATION ACCESSORIES

- A. Refrigerant Liquid Line Filter Driers: Provide refrigerant liquid line drier as recommended by equipment manufacturer for use in service indicated. Provide manual by-pass around each filter dryer.
- B. Solenoid Valves: Provide solenoid valves of type, size, and rating as recommended by equipment manufacturer for use in service indicated.
- C. Moisture-Liquid Indicators: Provide moisture-liquid indicators as recommended by equipment manufacturer for use indicated, double port, color-coded, U.L. listed.
- D. Thermal Expansion Valves: Provide thermal expansion valves of type, size, and rating as recommended by equipment manufacturer for use in service indicated.
- E. Strainers: 500 pounds per square inch, gage maximum working pressure; forged brass body with Monel 80-mesh screen, and screwed cleanout plug; Y-pattern, with solder end connections.
- F. Provide UL listed valves (globe, check, hot gas by-pass, etc.) where required or recommended by manufacturer.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install pipe for plumbing and mechanical systems as shown on the Drawings, as called for in other Sections, and as specified herein.
- B. Arrange and install piping approximately as indicated, straight, plumb, and as direct as possible, form right angles on parallel lines with building walls. Keep pipes close to walls, partitions, and ceilings, offsetting only where necessary to follow walls and avoid interference with other mechanical items. Locate groups of pipes parallel to each other; space at a distance to permit applying full insulation and to permit access for servicing valves. Piping to be run in concealed locations unless indicated exposed, or in equipment rooms.
- C. Install horizontal piping as high as possible without sags or humps so that proper grades can be maintained for drainage. Branch piping shall come off the tops of mains unless shown otherwise.
- D. Locate valves within reachable distance from equipment being served for easy access and operation. Do not locate valves with stems below horizontal.
- E. Check piping for interference with other trades.
- F. Where rough-ins are required for equipment furnished by others, verify exact rough-in dimensions with Contracting Authority or equipment supplier before roughing-in.

- G. Install automatic temperature control valves, separable wells, pressure taps, and other items as called for and furnished by the temperature controls section.
- H. Slope refrigerant piping as follows:
 - 1. Install horizontal hot-gas discharge piping with a uniform slope downward away from compressor.
 - 2. Install horizontal suction lines with a uniform slope downward to compressor.
 - 3. Install traps and double risers to entrain oil in vertical runs.
 - 4. Liquid lines may be installed level.
- I. When brazing or soldering, remove solenoid-valve coils and sight glasses; also remove valve stems, seats, and packing, and accessible internal parts of refrigerant specialties. Do not apply heat near expansion-valve bulb.
- J. Before installation of steel refrigerant piping, clean pipe and fittings using the following procedures:
 - 1. Shot blast the interior of piping.
 - 2. Remove coarse particles of dirt and dust by drawing a clean, lintless cloth through tubing by means of a wire or electrician's tape.
 - 3. Draw a clean, lintless cloth saturated with trichloroethylene through the tube or pipe. Continue this procedure until cloth is not discolored by dirt.
 - 4. Draw a clean, lintless cloth, saturated with compressor oil, squeezed dry, through the tube or pipe to remove remaining lint. Inspect tube or pipe visually for remaining dirt and lint.
 - 5. Finally, draw a clean, dry, lintless cloth through the tube or pipe.
 - 6. Safety-relief-valve discharge piping is not required to be cleaned but is required to be open to allow unrestricted flow.

3.2 INSTALLATION OF REFRIGERATION ACCESSORIES

- A. Refrigerant Liquid Line Filter Driers: install in refrigerant liquid lines as indicated, and in accessible location for service. Provide with valve bypass.
- B. Solenoid Valves: Install in refrigerant piping as indicated with stem pointing upwards.
- C. Moisture-Liquid Indicators: Install as indicated on refrigerant liquid lines, in accessible locations.
- D. Thermal Expansion Valves: Install in refrigerant piping as indicated.
- E. Install strainers immediately ahead of each expansion valve, solenoid valve, hot gas bypass valve, compressor suction valve, and as required to protect refrigerant piping system components.

END OF SECTION

**SECTION 23 3113
METAL DUCTS**

PART 1 GENERAL

1.1 SUMMARY

- A. Provide material, devices, labor, and supervision necessary to fabricate and erect ductwork as required by the Drawings and this Section.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.
- B. Shop Drawings: Submit ductwork shop drawings for entire facility, to scale, double line, indicating duct sizes, locations, fittings, equipment, accessories, structural clearances, etc. Do not install ductwork prior to approval of shop drawings by Engineer.

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. Ducts, plenums, apparatus casings, metal gauges, reinforcing, methods of supporting and hanging, and other sheet metal work as called for shall meet all functional criteria defined in Section VII, of the SMACNA "HVAC Duct Construction Standards Metal and Flexible" 1985 Edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.
 - 2. Comply with applicable requirements of NFPA 91.

1.4 DESCRIPTION

- A. Air ducts shall be constructed as follows:
 - 1. Supply and return duct in Mechanical Rooms +6 inches w-g
 - 2. Supply and return duct in shaft +4 inches w-g.
 - 3. Miscellaneous duct (exhaust, transfer grille, etc.) ±2 inches w-g.
 - 4. Return duct ±2 inches w-g.
 - 5. OA ducts and plenums ±3 inches w-g.

PART 2 PRODUCTS

2.1 GENERAL

- A. Shop fabricated sheet metal work shall be constructed of prime quality resquared tight coat galvanized steel, except where other type material is specified. Manufacturer's name and U.S. gauge number shall appear on each sheet.
- B. Duct sealant shall be installed per SMACNA Class A-all transverse joints, longitudinal seams and duct wall penetrations.
- C. Duct Sealant for Low Pressure Duct: UL labeled non-hardening, non-migrating mastic or liquid elastic sealant, type applicable for fabrication/installation detail, as compounded and recommended by manufacturer specifically for sealing joints and seams in ductwork.
- D. Duct sealing tape and adhesive for high-pressure duct.

1. Use pressure less tape in conjunction with adhesive on all fittings and joint connections.
2. Use full strength. Dip tape in solution until saturated.
3. Apply two wraps of wet tape on duct joint sections and fittings. Stretch tight to assure positive adhesion contact with the duct and to smooth out wrinkles.
4. Follow manufacturer's written instructions.

2.2 DUCT

A. Rectangular Duct:

1. Sheet Metal: Except as otherwise indicated, fabricate ductwork from minimum 24 gage galvanized sheet steel complying with ASTM A527, lock forming quality; with G90 zinc coating in accordance with ASTM A525; and mill phosphatized for exposed locations.
2. Rectangular duct shall be fabricated to the SMACNA functional criteria for the pressure class indicated on the Drawings.
3. Pittsburgh lock shall be used on all longitudinal seams. All longitudinal seams will be sealed with mastic sealant. Snaplock is not acceptable.

B. Rectangular Duct Fittings:

1. Elbows shall be constructed with centerline radius of not less than 1.5 times duct width; where space conditions will not permit this radius or where indicated on the Drawings, square elbows with single thickness streamline turning vanes shall be used. Provide trailing edge extension for elbows in series.
2. Slopes for transitions or other changes in dimension shall be minimum 1 to 3.
3. All duct seams and joints shall be sealed to SMACNA Class A requirements.
4. Rectangular branch taps from mains shall be 45 degree entry fittings.

C. Round Duct:

1. Round Duct shall be spiral lock seam type, fabricated of galvanized steel strip with airtight four-ply lock seams Minimum 24 gage.
2. Metal gauges shall be as listed in the SMACNA Standard for the pressure class indicated on the Drawings.
3. Round duct shall be externally insulated.

D. Round Fittings:

1. Elbows for round ducts shall have a center line radius of 1.5 times the duct diameter.
2. 45 degree and 90 degree elbows for ducts up to 8 inches diameter shall be die stamped two-piece with welded longitudinal seams.
3. Elbows for round ducts over 8 inches diameter shall be formed of segments with welded seams and following numbers of segments:
 - a. 90 degree elbow: five segments
 - b. 60 degree elbow: three segments
 - c. 45 degree elbow: three segments

- d. 30 degree elbow: two segments
- e. 22½ degree elbow: two segments
- 4. Tees, crosses and lateral cross fittings for round duct shall be of the conical type.
- 5. Reducers, increasers, offsets, wyes, crosses, divided flow fittings and similar fittings for round duct shall be one-piece construction with welded seams.
- 6. Metal gauges for fittings for round duct shall be as listed in SMACNA Standard for the pressure class indicated on the Drawings.
- 7. Duct and fitting welds shall be painted after fabrication to prevent corrosion where zinc has been burned by welding.
- 8. No bull headed tees shall be used.
- 9. Pipe-to-pipe joints for round ducts up to 50 inches diameter shall be made with male sleeve couplings reinforced by rolled bead.
- 10. Pipe-to-fitting joints for round ducts up to 50 inches shall be made by slip-fit of projecting collar of fitting into the duct.
- 11. Slip-fit joints shall be fastened with sheet metal screws, place 1/2 inch from fitting or coupling head.
- 12. Joints shall be sealed with duct sealant installed as recommended by the manufacturer.
- 13. Duct reinforcing, size of reinforcing angles and spacing shall be as recommended by SMACNA.

2.3 PLENUMS AND APPARATUS CASINGS

- A. Plenums shall be fabricated of same material as duct connecting to plenum and shall be two metal gauges heavier than gauge of largest duct connecting to plenum. Plenums used for connecting to exterior louvers shall have all seams welded watertight at the floor and 6 inches up the wall. In addition, plenums used for connection to exterior intake louvers shall have the floors sloped to a drain pipe connection and the drain piped to the nearest floor drain.
- B. Apparatus Casings shall be fabricated of not less than 18 gauge galvanized steel and shall be braced for rigidity. Bracing shall consist of not less than 2 inches by 2 inches by 1/4 inch galvanized structural steel angles, spaced not more than 3 feet 0 inches on center. Main entry doors shall be provided for access to all apparatus and shall be fabricated of two thicknesses of not less than 22 gauge galvanized steel with 1 inch thick rigid glass filler. Provide 2 inches by 2 inches by 1/4 inch galvanized welded, angle frames, hinges, airtight gaskets and two latches.

2.4 GAS FLUE/VENT

- A. General: Provide double wall gas vents, UL listed for Type B, consisting of double wall metal construction pipe sections and fittings and accessories required for complete installations.

- B. Material: Construct inner pipe of sheet aluminum, and outer pipe of galvanized sheet steel, both of the following minimum thickness:

SIZE	INNER PIPE	OUTER PIPE
Round Sizes up to 6 inches	0.012 inch	28 gauge
Round Sizes 7 inches to 18 inches	0.014 inch	28 gauge

- C. Accessories: Provide manufacturer's standard accessory items as required, for complete installation.
- D. Manufacturer: Subject to compliance with requirements, provide Type B double wall gas vents of one of the following: Hart & Cooley Manufacturing Co., Metalbestos Systems, or Metal-Fab, Inc.

2.5 DUCTWORK SUPPORT MATERIALS

- A. Except as otherwise indicated, provide hot-dipped galvanized steel fasteners, anchors, rods, straps, trim and angles for support of ductwork.

2.6 DUCT ACCESSORIES

- A. Transverse Duct Joints:
 1. Meets Mil-C 18969B, Type II Class B, T-C-1796 A, Type II Class B, and TTS-S-001657 must also pass UL-723. This material, in addition to the above, shall not contain vegetable oils, fish oils, or any other type vehicle that will support fungal and/or bacterial growth associated with dark, damp areas of ductwork. The recommended test procedure for bacterial and fungal growth is found in 21CFR 177, 1210 closures with sealing gaskets for food containers.
 2. Duct constructed using these systems shall refer to the manufacturer's guidelines for sheet gauge, intermediate reinforcement size and spacing, and joint reinforcements.
 3. Formed on flanges (T.D.C./T.D.F./T-25A/T-25B) are acceptable. Formed on flanges shall be constructed as SMACNA T-25 flanges, whose limits are defined on Page 1.36 1985 SMACNA Manual, First Edition. No other construction pertaining to formed on flanges will be accepted. Formed on flanges shall be accepted for use on ductwork 42 inches wide or less, 2 inches static positive pressure or less, and shall include the use of corners, bolts and cleat. (Over 42 inches, the reinforcement/joint deflection criteria no longer conform to the UMC).
- B. Insulated Roof Cap: Provide insulated roof caps with 3 inches of R-5 insulation fastened to the underside of the cap to maintain the thermal integrity of the roof/structure. Roof cap shall be constructed with structural steel reinforcements to prevent damage and shall be continuous across the cap. The cap flanges shall be welded at the seams for a watertight installation. Cap shall be fastened down to curb with a minimum of four screws every 24 inches around the cap perimeter.
- C. Gooseneck: Provide gooseneck air intake/exhaust where noted on drawings. Duct passing through roof / roof membrane shall maintain the net area through the roof and shall terminate with a 180 degree gooseneck in accordance with SMACNA. Construction shall have waterproof seems and joints. Gooseneck shall include miscellaneous support steel and 1/2 inch bird screen. Coordinate exact size and roof curb requirements with the Contractor.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Assemble and install ductwork in accordance with recognized industry practices which will achieve airtight (5% leakage for systems rated 3 inches and under; 1% for systems rated over 3 inches) and noiseless (no objectionable noise) systems, capable of performing each indicated service. Install each run with minimum number of joints. Align ductwork accurately at connections, within 1/8 inch misalignment tolerance and with internal surfaces smooth. Support ducts rigidly with suitable ties, braces, hangers and anchors of type which will hold ducts true-to-shape and to prevent buckling. Support vertical ducts at every floor.
- B. Inserts: Install concrete inserts for support of ductwork in coordination with form work, as required to avoid delays in work.
- C. Field Fabrication: Complete fabrication of work at project as necessary to match shop-fabricated work and accommodate installation requirements.
- D. Locate ductwork runs, except as otherwise indicated, vertically and horizontally and avoid diagonal runs wherever possible. Locate runs as indicated by diagrams, details and notations or, if not otherwise indicated, run ductwork in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Install offsets, angles, and transitions as may be required to avoid interferences with other work, install streamlined easements around obstructions where necessary to pass obstructions through ducts. Maintain full capacity of ducts at offsets, angles, transitions and easements, except where Drawings indicated use of reducing or increasing transitions. Hold ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- E. Limit clearance to 1/2 inch where furring is shown for enclosure or concealment of ducts, but allow for insulation thickness, if any. Where possible, locate insulated ductwork for 1 inch clearance outside of insulation. Wherever possible in finished and occupied spaces, conceal ductwork from view, by locating in mechanical shafts, hollow wall construction or above suspended ceilings. Do not encase horizontal runs in solid partitions, except as specifically shown. Coordinate layout with suspended ceiling and lighting layouts and similar finished work.
- F. Where ducts pass through interior partitions and exterior walls, conceal the space between the construction opening and the duct or duct-plus-insulation with sheet metal flanges of the same gauge as the duct. Overlap the opening on all sides by at least 1 1/2 inches.
- G. Coordinate duct installations with installation of accessories, equipment, controls and other associated work of the ductwork system.
- H. Each duct section shall be rigidly supported from structure. Attach hangers to structure with expansion plugs, concrete inserts, beam clamps or other approved means. Rubber-in-shear isolators shall be installed in hangers for ducts in equipment rooms, to prevent vibration transmission to the structure.
- I. Install as indicated on the Drawings duct mounted equipment as specified in other Sections.
- J. Duct sizes shown on Drawings are net inside dimensions. Increase duct sizes as required to allow for installation of duct liner, where specified.
- K. Application of Duct Sealant: All ducts to be properly sealed. Specified duct sealant to be pumped or painted into all joints and seams on all ductwork systems. Sealant shall be allowed to set 48 hours before any air pressure is applied to system.
- L. Electrical Equipment Spaces: Do not route ductwork through electrical equipment spaces and enclosures. Do not run ductwork above electrical panels.

- M. Install Type B double wall gas vents in accordance with manufacturer's installation instructions. Maintain UL listed minimum clearances for combustibles. Assemble pipe and accessories as indicated for complete installation.

3.2 EQUIPMENT CONNECTIONS

- A. General: Connect metal ductwork to equipment as indicated; provide flexible connection for each ductwork connection to equipment mounted on vibration isolators, and/or equipment containing rotating machinery.

3.3 ADJUSTING AND CLEANING

- A. Clean ductwork internally, unit by unit as it is installed, of dust and debris. Clean external surfaces of foreign substances which might cause corrosive deterioration of metal or, where ductwork is to be painted, might interfere with painting or cause paint deterioration.
- B. Temporary Closure: At ends of ducts which are not connected to equipment or air distribution devices at time of ductwork installation, provide temporary closure of polyethylene film or other covering which will prevent entrance of dust and debris until time connections are to be completed.
- C. Balancing: Refer to Section P2 23 0593, "Testing, Adjusting and Balancing for HVAC" for air distribution balancing of metal ductwork; not work of this section. Seal any leaks in ductwork that become apparent during the balancing process.

3.4 DUCTWORK LEAKAGE CRITERIA

- A. All transverse joints and longitudinal seams shall conform to SMACNA's sealing requirements as defined on page 1-6 of the 1985 SMACNA Manual, First Edition. Duct sealing shall be per paragraph 2.1B.
- B. Variable Air Volume Systems/Return Ductwork
 1. Ductwork shall be leak tested according to SMACNA HVAC Air Duct Leakage Test Manual.
 2. Ducts having a pressure class of +/-3 inches water column, or higher shall have representative sections tested. A minimum of 25% of the total installed duct area for the designated pressure class shall be tested. This is not necessarily 25% of each floor. Include ducts in shafts in the representative sample.
 3. The maximum permissible duct leakage class of the tested duct shall be as follows:
 - a. 3 inches pressure class – rectangular: leakage class 8
 - b. 3 inches pressure class – round: leakage class 4
 - c. 4 inches and 6 inches pressure class – rectangular: leakage class 4
 - d. 4 inches and 6 inches pressure class – round: leakage class 2
 4. Negative pressure systems may be tested with positive pressure tests.
 5. Submit report to Engineer at the end of the project in O&M Manuals. Highlight duct sections that were tested.

3.5 DUCTWORK LEAKAGE TESTING

- A. Installed ductwork shall be tested prior to installation of access doors, take-offs, etc.

- B. All leak testing shall be witnessed by the engineer or representative of the engineer. The contractor shall give the engineer 72 hour notice prior to testing. Any testing not witnessed by the engineer or his/her representative shall be considered invalid and will be redone.
- C. The testing shall be performed as follows:
 - 1. Perform testing in accordance with HVAC Air Duct Leakage Test Manual.
 - 2. Use a certified orifice tube for measuring the leakage.
 - 3. Define section of system to be tested and blank off.
 - 4. Determine the percentage of the system being tested.
 - 5. Using that percentage, determine the allowable leakage (cfm) for that section being tested.
 - 6. Pressurize to operating pressure and repair any significant or audible leaks.
 - 7. Repressurize and measure leakage.
 - 8. Repeat steps 6 and 7 until the leakage measured is less than the allowable defined in Step 5.
- D. Major supply, return and exhaust duct runs or ducts running through chases shall be pressure tested before branch ducts are added or chases are closed. It is recommended that the first 100 feet to 300 feet of ductwork installed be tested to insure the quality of the workmanship at an early stage.

END OF SECTION

**SECTION 23 3300
AIR DUCT ACCESSORIES**

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes the following:
 - 1. Backdraft dampers.
 - 2. Volume dampers.
 - 3. Motorized control dampers.
 - 4. Fire dampers.
 - 5. Ceiling fire dampers.
 - 6. Smoke dampers.
 - 7. Combination fire and smoke dampers.
 - 8. Turning vanes.
 - 9. Duct-mounting access doors.
 - 10. Flexible connectors.
 - 11. Flexible ducts.

1.2 SUBMITTALS

- A. Product Data: For the following:
 - 1. Backdraft dampers.
 - 2. Volume dampers.
 - 3. Motorized control dampers.
 - 4. Fire dampers.
 - 5. Ceiling fire dampers.
 - 6. Smoke dampers.
 - 7. Combination fire and smoke dampers.
 - 8. Turning vanes.
 - 9. Duct-mounting access doors.
 - 10. Flexible connectors.
 - 11. Flexible ducts.
- B. Shop Drawings:
 - 1. Product Data: Submit manufacturer's technical product data and installation instructions for metal ductwork materials and products.

1.3 QUALITY ASSURANCE

A. Codes and Standards

1. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
2. Fire, Smoke, and Combination Dampers:
 - a. Constructed and tested in accordance with UL Safety Standard 555 and 555S, for 1 1/2 hour fire protection rating, with 165°F fusible link, and shall bear UL label.
3. Ducts, plenums, apparatus casings, metal gauges, reinforcing, methods of supporting and hanging, and other sheet metal work as called for shall meet all functional criteria defined in the SMACNA "HVAC Duct Construction Standards Metal and Flexible" 2005, 3rd Edition. This shall be subsequently referred to as the SMACNA Manual. All ductwork must comply with all local, state and federal code requirements.
4. Comply with applicable requirements of NFPA 91.

PART 2 PRODUCTS

2.1 BACKDRAFT DAMPERS

- A. Furnish and install a heavy-duty counterbalanced backdraft damper with steel frame and steel airfoil type 18 gauge steel blades. Blades shall have EPDM seals and jamb seals and be spaced a maximum width of 7 inches with 3/4 inch diameter plated steel axles. The bearings shall be ball bearings pressed into the frame. Damper shall be Ruskin CBS8 or approved equal.

2.2 VOLUME DAMPERS

- A. Manual Volume Dampers: Fabricated of same material as ducts, two metal gauges heavier than duct and hemmed 1 inch all around, mounted on 3/8 inch square rod with saw slot position indicated. Pivot bearings, relocking position regulator, Young Regulator Co., Series 443.
 1. Where positioning regulator is not accessible, provide coupling and extension rod with regulator for ceiling wall or floor installation, as required. Young Series 301 and 315 for ceiling, Series 270-302 for walls.

2.3 FIRE DAMPERS

A. Manufacturers:

1. Ruskin Manufacturing Company, Air Balance, Prefco, Pottorf, or approved equal.
2. Design, specification and model numbers based on Ruskin Manufacturing Company.

B. Materials

1. Fire dampers shall be of the Class II dynamic rated curtain type, suitable for either vertical or horizontal installation, with 20 gauge steel channel frames, 24 gauge steel blades, and 18 gauges steel enclosure with duct collars. All parts galvanized mill finish.
2. Fire dampers shall be Type D-IBD2 of the following style enclosures:
 - a. Style B or C; for square and rectangular ducts.
 - b. Style CR; for round ducts.

c. Style CO; for oval ducts.

C. Provide thin-line type fire dampers in all transfer grilles and sidewall grilles installed in fire rated walls. Provide with maximum 2 inches frames, Type IB DT2.

2.4 SMOKE AND COMBINATION FIRE AND SMOKE DAMPERS

A. Manufacturers:

1. Ruskin Manufacturing Company, Air Balance, Prefco. Pottorff, Leader Industries and United Enertec or approved equal.
2. Provide Belimo damper actuators for all fire/smoke and smoke dampers.
3. Design, specification and model numbers based on Ruskin Manufacturing Company.

B. Materials:

1. Combination smoke and fire damper assemblies shall consist of a multi blade pivot type damper, suitable for either vertical or horizontal installation with 16 gauge steel channel frames, 16 gauge steel blades, stainless steel bearings, 1/2 inch steel shafts, 18 gauge steel enclosure with duct collars, operator mounting bracket, factory installed damper operator and linkage, and fusible link.
2. Combination smoke and fire dampers shall be Type FSD 36 with Class II blade and jamb seals.
3. The damper actuator shall be electric, 120V, and shall be arranged for normally closed (NC) operation. The operator shall traverse the damper from fully open to fully closed and vice versa in no less than 30 seconds to allow a gradual decrease in duct pressure and airflow. The operator shall allow the smoke damper to be automatically reset upon clearance of alarm conditions or restoration of power.

2.5 TURNING VANES

A. Manufacturers:

1. Aero Dyne; Ductmate; Anemostat; Barber Coleman; Duro Dyne; Hart & Cooley or approved equal.

B. Provide single thickness streamline type, except provide turning vanes with trailing edge at elbows which change dimensions or at consecutive elbows.

C. Provide manufactured turning vanes and vane runners, fabricated from the same material as the duct, and constructed in accordance with SMACNA "HVAC Duct Construction Standards". Tab spacing shall be SMACNA standard. Rail systems with non-standard tab spacings shall not be accepted. All tabs shall be used, do not skip tabs. Mounting rails shall have friction insert tabs which align the vanes automatically. Vanes shall be subjected to tensile loading and be capable of supporting 250 pounds when fastened per the manufacturer's instructions.

2.6 DUCT-MOUNTING ACCESS DOORS

A. General:

1. Shall be of same material as ducts in which they are installed, fabricated of two thicknesses of not less than 22 gauge, with 1 inch thick rigid glass fiber filler. Provide sheet metal frame, airtight gasket and two cam latches. Access doors and panels shall be 2 inches smaller than duct width and square for ducts 18 inches wide and larger, maximum size shall be 24 inches by 24 inches unless noted otherwise. For ducts less than 18 inches wide, access doors and panels shall be 2 inches smaller than duct width

and 18 inches long. Pre-manufactured doors shall be hinged and shall be of adequate size to allow easy access to hardware which needs to be maintained.

2.7 FLEXIBLE DUCT CONNECTIONS

A. Manufacturers:

1. Ventfabric, Inc., Ventglass, Duro Dyne, Ductmate, American/Elgin or approved equal.

B. General:

1. 30 ounce woven glass fiber, double neoprene coated, fire retardant, waterproof and airtight, suitable for temperatures to 200°F, UL approved.

2.8 FLEXIBLE DUCTS

A. Manufacturers:

1. Flexible duct shall be by Thermaflex, Semco, Wiremold or approved equal.

B. General:

1. Acceptable in supply ductwork only where shown (not allowed in exposed occupied areas). Flexible duct shall include wire, core, insulation, and vapor barrier and the composite assembly shall meet requirements of NFPA-90A and UL181 and shall be UL listed for flame spread rating of not more than 25 and smoke developed rated of not more than 50.

C. Minimum length of flexible duct shall be 3 feet.

D. Maximum length of flexible duct shall be 8 feet.

E. Flexible duct shall have a minimum R-value of 4.2.

F. Flexible duct shall have a maximum vapor transmission rating of 0.1 perms.

G. Flexible duct shall be rated for operating temperatures between -20°F and 250°F.

H. All flexible duct shall be connected to metal fittings with stainless steel bands equal to snaplock. The use of duct tape to secure the core is not acceptable.

I. Flexible duct shall have an operating positive pressure rating of 16 inches water gage for nominal sizes 4 inches thru 10 inches and 10 inches water gage for nominal sizes 12 inches thru 16 inches, and a negative pressure rating of 2 inches water gage for sizes 4 inches thru 16 inches. Duct shall be rated for a velocity of 6000 feet per minute.

2.9 QUADRANT LOCKS

A. Provide for each damper, quadrant lock device on one end of shaft; and end bearing plate on other end for damper lengths over 12 inches.

B. Provide extended quadrant locks and end extended bearing plates for externally insulated ductwork.

PART 3 EXECUTION

3.1 APPLICATION AND INSTALLATION

A. Install manual volume dampers in all supply, return and exhaust duct systems as required for controlling air volumes to trunk ducts, branch ducts, outlets and inlets. Contractor shall install a complete system of dampers as required for balancing air systems.

- B. Coordinate duct installations with installation of accessories, equipment, controls and other associated work of the ductwork system.
- C. Install access panels for inspection and servicing of duct mounted equipment; reheat coils, sound attenuators, and smoke and fire dampers.
- D. Install flexible connections in ducts at connections to plenums, apparatus casings, fan housings, roof top units, air handling units, exhaust fans and other equipment which could transmit vibrations to the duct systems. Crimp into duct flanges for attachment to duct and equipment. Make airtight joint. Provide adequate joint flexibility to allow for thermal axial, transverse, and torsional movement, and also capable of absorbing vibration of connected equipment.
- E. Install turning vanes in all square or rectangular 90 degree elbows in supply, return, and exhaust air systems.
- F. Installation of Flexible Ducts: Flexible Ducts are to be installed only where indicated on Drawings.
 - 1. Maximum length of flexible duct is 8 feet 0 inches OAL.
 - 2. Minimum length of flexible duct is 3 feet 0 inches OAL.
 - 3. Square to round transition gages to comply with SMACNA rectangular duct (minimum 24 gauge).
 - 4. Flexible duct must meet UL 181 and be installed per SMACNA using a clamp for securing duct to collar and a supplemental clamp for securing the insulation and vapor barrier.
 - 5. Support flexible ductwork with minimum 2 inches wide sheet metal bands, secured to structure with ductwork support materials. Maximum spacing shall be 4 feet on center.
 - 6. The flexible duct shall be installed with a minimum centerline radius equal to 1.5 times the diameter of the duct.
 - 7. When connecting flexible duct to diffusers, the duct shall be installed with a minimum of 6 inches straight flex at the diffuser.
- G. Installation of Fire Dampers:
 - 1. Install fire dampers in all locations where ducts penetrate fire walls and floors, as indicated on the Drawings.
 - 2. Install dampers in accordance with manufacturer's recommendations, utilizing steel sleeves, angles, and practices as required to provide an installation equivalent to that utilized by the manufacturer when the dampers are UL tested.
 - 3. At each damper, install access panel arranged for servicing fusible link.
 - 4. Contractor shall demonstrate, in presence of Owner's Representative, the operation of each fire damper. Fusible link shall be disconnected and damper shall be allowed to close. If no binding or sticking is evident, damper shall be set in the open position and fusible link reinstalled.
- H. Installation of Smoke or Combination Fire and Smoke Dampers:
 - 1. Install smoke or combination smoke and fire dampers in locations where ducts penetrate smoke walls, as indicated on the Drawings.

2. Install dampers in accordance with manufacturer's recommendations, utilizing steel sleeves, angles, and practices as required to provide an installation equivalent to that utilized by the manufacturer when the dampers were UL tested.
3. At each damper, install access panel arranged for servicing fusible link.
4. Contractor shall demonstrate, in presence of Engineer, the operation of each combination smoke and fire dampers. Fusible link shall be disconnected and damper shall be allowed to close. If no binding or sticking is evident, damper shall be set in the open position and fusible link reinstalled.
5. Final electrical connections to the damper operator shall be by the Electrical Fire Alarm Contractor.
6. Smoke dampers shall be controlled and reset by the fire alarm system.

END OF SECTION

SECTION 23 3713
DIFFUSERS, REGISTERS, AND GRILLES

PART 1 GENERAL

1.1 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.
 - 1. Provide materials, devices, labor and supervision necessary for the installation of diffusers, registers and grilles
 - 2. Provide diffusers, registers and grilles as per schedule on Drawings.

1.2 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for diffusers, registers and grilles including the following:
 - 1. Schedule of diffusers, registers and grilles indicating drawing designation, room location, and number furnished, model number, size and accessories furnished.
 - 2. Data sheet for each type of grille, register and diffuser and accessory furnished; indicating construction, finish and mounting details.
 - 3. Performance data for each type of grille, register and diffuser furnished, including aspiration ability, temperature and velocity traverses, throw and drop, and noise criteria ratings. Indicate selections on data.
- B. Shop Drawings: Submit manufacturer's assembly-type shop drawing for each type of grille, register and diffuser, indicating materials and methods of assembly of components.

1.3 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. ARI Compliance: Test and rate diffusers, registers and grilles in accordance with ARI 650 "Standard for Air Outlets and Inlets".
 - 2. ASHRAE Compliance: Test and rate diffusers, registers and grilles in accordance with ASHRAE 70 "Method of Testing for Rating the Air Flow Performance of Outlets and Inlets".
 - 3. NFPA Compliance: Install diffusers, registers and grilles in accordance with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems".

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Products by Titus, Krueger, Carnes, Metal-aire, Nailor, Price or approved equal.

2.2 CEILING AIR DIFFUSERS

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling air diffusers where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation. Provide O.B. volume damper in each supply diffuser, unless noted otherwise.

- B. Performance: Provide ceiling air diffusers that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Ceiling Compatibility: Provide diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of ceiling air diffuser.
- D. Types: Provide ceiling diffusers of type, capacity and with accessories and finishes as listed on diffuser schedule.

2.3 GRILLES AND REGISTERS

- A. General: Except as otherwise indicated, provide manufacturer's standard ceiling and wall registers and grilles where shown; of size, shape, capacity and type indicated; constructed of materials and components as indicated, and as required for complete installation. Provide O.B. volume damper for each supply grille and register, unless noted otherwise.
- B. Performance: Provide registers and grilles that have, as minimum, temperature and velocity traverses, throw and drop, and noise criteria ratings for each size device as listed in manufacturer's current data.
- C. Wall and Ceiling Compatibility: Provide registers and grilles with border styles that are compatible with adjacent wall and ceiling systems, and that are specifically manufactured to fit into wall and ceiling construction with accurate fit and adequate support. Refer to general construction drawings and specifications for types of wall and ceiling construction which will contain each type of register and grille.
- D. Types: Provide registers and grilles of type, capacity and with accessories and finishes as listed on register and grille schedule.

2.4 CEILING DIFFUSERS – SQUARE PANEL

- A. Architectural square panel ceiling diffusers shall be of the sizes and mounting types shown on the plans and outlet schedule. The diffuser shall have a heavy gauge aluminum face panel that captures a secondary heavy gauge aluminum panel. The face panel is removable by means of four hanger brackets. The exposed surface of the face panel shall be smooth, flat, and free of visible fasteners.
- B. The face panel shall project ¼ inch below the outside border of the diffuser backpan. The back of the face panel shall have an aerodynamically shaped, rolled edge to ensure a tight horizontal discharge pattern. Ceiling diffusers with a 24 inch by 24 inch full face shall have no less than an 18 inch by 18 inch face panel size. Ceiling diffusers with a 12 inch by 12 inch full face shall have no less than a 9 inch by 9 inch face panel size.
- C. The backpan shall be one piece precision die-stamped and shall include an integrally drawn inlet. The diffuser backpan shall be constructed of 22-gauge aluminum. The diffuser neck shall have a minimum of 1 1/4 inches depth available for duct connection.
- D. The finish shall be #26 white. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H.
- E. The paint must pass a 100 hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint shall pass a 250 hour ASTM D870 Water Immersion Test and pass the ASTM D2794 Reverse Impact Cracking Test with a 50 inch pound force applied.

- F. Optional round damper shall be constructed of heavy gauge steel. Damper must be operable from the face of the diffuser. Optional Directional Blow clips shall be available to restrict the discharge air in certain directions.
- G. Diffuser shall include a molded insulation blanket, R-6, foil-backed. Provide an additional 1 inch gap around the neck to install insulated flex duct.
- H. The manufacturer shall provide published performance data for the square panel diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

2.5 EGG CRATE GRILLE

- A. Furnish Eggcrate Grille with Aluminum Grid and Aluminum Border. Return grilles shall be the sizes and mounting types as shown on the plans and outlet schedule. Return grilles shall provide a free area of at least 90%. Outer borders shall be constructed of heavy extruded aluminum with a thickness of 0.040 to 0.050 inch and shall have countersunk screw holes for a neat appearance. Border width shall be 1 1/4 inches on all sides and shall be interlocked at the four corners and mechanically staked to form a rigid frame.
- B. Provide opposed-blade volume damper where indicated. OBD shall be constructed of heavy gauge aluminum. Damper must be operable from the face of the grille.
- C. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness shall be HB to H. The paint shall pass a 100-hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250 hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50 inches pound force applied.

2.6 CEILING SIDEWALL EXHAUST/RETURN

- A. Aluminum return grilles shall be equal to Titus Series Model 4F. The fixed deflection blades shall be available parallel to the short dimension of the grille. Construction shall be of extruded aluminum with a 1 1/4 inch wide border on all sides and shall be interlocked at the four corners and mechanically staked to form a rigid frame. Minimum border thickness shall be 0.040 to 0.050 inch. Screw holes shall be countersunk for a neat appearance.
- B. Blades shall be contoured to a specifically designed and tested cross-section to meet published performance data. Blades shall be firmly held in place by mullions from behind the grille and fixed in place by crimping or welding. Blade shall have a fixed deflection angle as noted on the schedule.
- C. Opposed-blade volume damper shall be constructed of heavy gauge aluminum. Damper must be operable from the face of the grille.
- D. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100 hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250 hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50 inch pound force applied.
- E. The manufacturer shall provide published performance data for the grille. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

2.7 DOUBLE DEFLECTION SUPPLY

- A. Aluminum supply grilles shall be for the sizes and mounting types as shown on the plans and schedules. The deflection blades shall be available parallel to the long dimension of the grille. All supply grilles shall be constructed with a 1 1/4 inch wide heavy aluminum border having a minimum thickness of 0.040 to 0.050 inch. Outer borders shall be assembled and interlocked

- at the four corners and mechanically staked to form a rigid frame. Screw holes shall be countersunk for a neat appearance.
- B. Blades shall be constructed of heavy duty aluminum and shall be contoured to a specifically designed airfoil cross-section to meet published performance data. Hollow blades are not acceptable. Blades must be solid. Blades shall be spaced $\frac{3}{4}$ inch apart. Blades shall extend completely through the side frame on each side to ensure stability throughout the complete cfm operating range of the grille. Blades shall be individually adjustable without loosening or rattling and shall be securely held in place with tension wire.
 - C. Opposed-blade volume damper shall be constructed of heavy gauge steel or aluminum. Damper must be operable from the face of the grille.
 - D. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100 hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250 hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50 inch pound force applied.
 - E. The manufacturer shall provide published performance data for the grille. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

2.8 ALUMINUM RETURN GRILLES

- A. Aluminum return grilles shall be of the sizes and mounting types shown on the plans and outlet schedule. The fixed deflection blades shall be available parallel to the long or short dimension of the grille. Construction shall be of extruded aluminum with a 1 1/4 inch wide border on all sides. Minimum border thickness shall be 0.040 to 0.050 inch. Sizes 24 inches by 24 inches and smaller shall be constructed using a roll-formed frame.
- B. Corners shall be welded with full penetration resistance welds. Sizes larger than 24 inches by 24 inches shall be constructed by using heavy aluminum extrusions and shall be interlocked at the four corners and mechanically staked to form a rigid frame. Screw holes shall be countersunk for a neat appearance.
- C. Deflection blades shall be contoured to a specifically designed and tested cross-section to meet published test performance data. Blades shall be firmly held in place by mullions from behind the grille and fixed in place by crimping or welding. Blade deflection angle shall be available at 0°.
- D. Opposed blade volume damper shall be constructed of heavy gauge steel or aluminum. Damper must be operable from the face of the grille.
- E. The finish shall be an anodic acrylic paint, baked at 315°F for 30 minutes. The pencil hardness must be HB to H. The paint must pass a 100 hour ASTM B117 Corrosive Environments Salt Spray Test without creepage, blistering or deterioration of film. The paint must pass a 250 hour ASTM D870 Water Immersion Test. The paint must also pass the ASTM D2794 Reverse Impact Cracking Test with a 50 inch pound force applied.
- F. The manufacturer shall provide published performance data for the grille. The grille shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

PART 3 EXECUTION

3.1 INSTALLATION

- A. General: Install diffusers, registers and grilles in accordance with manufacturer's written instructions and in accordance with recognized industry practices to insure that products serve intended functions.

- B. Coordinate with other work, including ductwork and duct accessories, as necessary to interface installation of air outlets and inlets with other work.
- C. Install wall mounted grilles and registers plumb and level and flush to surface. Locations may be altered slightly, as acceptable to the Engineer so as to fit portions of the structure.
- D. In grid panel type ceilings, lay-in metal pan, acoustical, etc., diffusers, registers and grilles shall be located as shown on the reflected ceiling plan or as directed by the Engineer typically to minimize cutting of ceiling panels.
- E. Coordinate location of ceiling diffusers and registers with Architect's reflected ceiling plan.
- F. Provide transitions as required for connections to ductwork, including square to round.
- G. Coordinate wall grilles and registers with thin-line type fire dampers in fire rated walls.
- H. Install diffusers, registers, and grilles level and plumb.
- I. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.2 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION

**SECTION 23 5400
FURNACES**

PART 1 GENERAL

1.1 SUMMARY

- A. Provide material, equipment, labor, and supervision as necessary for complete installation of furnaces, devices, controls, filters, air conditioning, and flues.

1.2 SUBMITTALS

- A. Submit manufacturer's product, performance and installation data.

1.3 QUALITY ASSURANCE

A. Standards and Codes

- 1. Gas furnaces shall be in accordance with American Gas Association and NFPA standards and have been tested and certified by the Department of Energy.

- B. All units shall be furnished by the same manufacturer.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Furnaces by Trane, Amana, Carrier, Lennox or approved equal.

2.2 GAS FURNACE

- A. Units shall be high efficiency natural gas fired downflow or upflow as scheduled on plans.
- B. Casing to be one piece Uniweld and heat exchanger compartment shall be fully insulated for maximum heat retaining efficiency. Provide heavy duty motor for air conditioning service with adjustable V belt drive. All moving parts to be rubber isolated for quiet operation.
- C. Provide hot surface ignition system, wiring, and integrated system control center, dual solenoid combination gas valve and regulator, low energy power ventilator, slotted port burners, manual gas valve, fan control relay, adjustable fan control, filter rack, and filters. A.G.A. approved.
- D. Provide additional controls required to meet local, city and utility requirements.

2.3 CONDENSING UNIT AND EVAPORATOR COIL

- A. Condensing units shall have capacity as scheduled on plans. Unit shall have rigid welded weatherproof casing construction with removable panels for complete access. Minimum 20 gauge cabinet with attractive finish coat of paint. Provide coil protection guards.
- B. Condensing units shall be quiet operating with slow speed condenser fan. Shall be suitable for operation down to 0° F with automatic thermal cutout, automatic reset high and low refrigerant pressure switches. Provide unit with timer off control, low ambient controls and hard start kit.
- C. Compressors shall be hermetic with suction and liquid line service valves, full refrigerant charge, internal overload protection, copper tube aluminum fin condenser coil. Provide crankcase heater. Compressor shall be served by a 5 year replacement warranty.
- D. Cooling coils shall be cased A type configuration copper tube aluminum fin leak tested at factory. Drip pans shall be galvanized steel coated with waterproof enamel paint or mastic.

- E. Refrigerant lines shall be sized and installed per manufacturer's recommendations. Suction line to be insulated. Insulate fittings as required to prevent sweating.
- F. Condensing unit shall meet or exceed efficiency values as scheduled on mechanical drawings.

2.4 CONTROLS

- A. Furnish, install, and wire combination heating and cooling thermostats. Thermostat sub-base shall have fan on off automatic and system heating cooling switches.
- B. Combination heating and cooling thermostats shall have locking, vandal-proof cover.
- C. Thermostat shall be commercial 7 day programmable thermostat.
- D. Furnish, install, and wire optional remote discharge air (duct mount) temperature sensor for each furnace and at least one outdoor temperature sensor.

2.5 FLUE

- A. Type B UL listed prefabricated sectional type with sections up to 3 feet 0 inches length.
- B. Provide side-wall support assembly.
- C. Accessories required are:
 - 1. Base section with bottom drain.
 - 2. Rain cap.
 - 3. Sidewall concentric or low-profile fitting.
- D. Joints shall be sealed per manufacturer's recommendations.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install furnace and condenser equipment as indicated on Drawings in accordance with manufacturer's recommendations. Run condensate line to floor drain with minimum 4 inch deep trap.
- B. Install Type B gas vents per manufacturer's instructions.
- C. Install clean filters at end of construction.
- D. Install furnaces and condensing units on 6 inch concrete pads.

END OF SECTION

**SECTION 26 0500
COMMON WORK RESULTS FOR ELECTRICAL**

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Electrical equipment coordination and installation.
 - 2. Sleeves for raceways and cables.
 - 3. Sleeve seals.
 - 4. Grout.
 - 5. Submittals
 - 6. Permits and Inspections

1.2 DEFINITIONS

- A. EPDM: Ethylene-propylene-diene terpolymer rubber.
- B. NBR: Acrylonitrile-butadiene rubber.

1.3 SUBMITTALS

- A. Product Data: For sleeve seals.
- B. Submit to Engineer for review, prior to the placing of orders for any equipment, a complete schedule of electrical fixtures, materials and panels to be installed. Schedule shall consist of catalog cuts, diagrams, shop drawings, performance curves, and any other descriptive material necessary to fully describe the equipment proposed and its operating characteristics. Refer to Article 1105.03 of the Standard Specifications.
- C. Review of the materials, including alternate or substitute items, shall be obtained in writing from Engineer; verbal review will not be considered binding.
- D. Submittals shall have been reviewed and signed by the Contractor, prior to submittal to Engineer. Faxes or copies of faxes are not acceptable. Engineer will review submittals to aid in interpreting the drawings and specifications, and in so doing will assume that the submittals conform to the specified requirements set forth in this specification. Review of submittals by Engineer does not relieve the Contractor of the responsibility of complying with the elements of the specifications.
- E. Furnish copies of parts lists and operating and maintenance instructions and manuals, and furnish the services of a competent, trained individual thoroughly familiar with the operation of each special system. Special systems shall include electrical and communications equipment requiring operating instructions, inspection or periodic maintenance. The person instructing the Contracting Authority shall see that the Contracting Authority is conversant with the operation of the system and its various controls; the company from whom maintenance service and repairs may be obtained; and the location and function of switches, devices and accessories, contained in the system.

1.4 PERMITS AND INSPECTIONS

- A. Obtain, furnish and include the costs of necessary permits, fees and inspection certificates for material and labor furnished. Include costs of permits, certificates and inspection fees required

in connection with the installation, unless otherwise noted in the detailed contractual description preceding these Electrical Specifications.

- B. Obtain, furnish and include the costs of necessary permits, fees and inspections required by the local Fire Marshall.
- C. On completion of work, furnish satisfactory evidence that work is acceptable to regulatory authorities having jurisdiction.
- D. Be responsible to see that the proper inspection authorities are notified when inspections are required by Code, and provide necessary assistance to the inspector during inspection.

1.5 COORDINATION

- A. Coordinate arrangement, mounting, and support of electrical equipment:
 - 1. To allow maximum possible headroom unless specific mounting heights that reduce headroom are indicated.
 - 2. To provide for ease of disconnecting the equipment with minimum interference to other installations.
 - 3. So connecting raceways, cables, wireways, cable trays, and busways will be clear of obstructions and of the working and access space of other equipment.
- B. Coordinate installation of required supporting devices and set sleeves in cast-in-place concrete, masonry walls, and other structural components as they are constructed.

PART 2 PRODUCTS

2.1 SLEEVES FOR RACEWAYS AND CABLES

- A. Steel Pipe Sleeves: ASTM A 53, Type E, Grade B, Schedule 40, galvanized steel, plain ends.
- B. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.
- C. Sleeves for Rectangular Openings: Galvanized sheet steel.
 - 1. Minimum Metal Thickness:

2.2 SLEEVE SEALS

- A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.
 - 1. Sealing Elements: EPDM or NBR interlocking links shaped to fit surface of cable or conduit. Include type and number required for material and size of raceway or cable.
 - 2. Pressure Plates: Carbon steel. Include two for each sealing element.
 - 3. Connecting Bolts and Nuts: Carbon steel with corrosion-resistant coating of length required to secure pressure plates to sealing elements. Include one for each sealing element.

2.3 GROUT

- A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107, factory-packaged, nonmetallic aggregate grout, noncorrosive, nonstaining, mixed with water to consistency suitable for application and a 30-minute working time.

PART 3 EXECUTION

3.1 COMMON REQUIREMENTS FOR ELECTRICAL INSTALLATION

- A. Comply with NECA 1.
- B. Comply with applicable provisions of Occupational Safety and Health Act (OSHA), NFPA Standards and Pamphlets, NEIS Standards, and common work place practice.
- C. Headroom Maintenance: If mounting heights or other location criteria are not indicated, arrange and install components and equipment to provide maximum possible headroom consistent with these requirements.
- D. Equipment: Install to facilitate service, maintenance, and repair or replacement of components of both electrical equipment and other nearby installations. Connect in such a way as to facilitate future disconnecting with minimum interference with other items in the vicinity.

3.2 SLEEVE INSTALLATION FOR ELECTRICAL PENETRATIONS

- A. Electrical penetrations occur when raceways, cables, wireways, cable trays, or busways penetrate concrete slabs, concrete or masonry walls, or fire-rated floor and wall assemblies.
- B. Concrete Slabs and Walls: Install sleeves for penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of slabs and walls.
- C. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.
- D. Fire-Rated Assemblies: Install sleeves for penetrations of fire-rated floor and wall assemblies unless openings compatible with firestop system used are fabricated during construction of floor or wall.
- E. Cut sleeves to length for mounting flush with both surfaces of walls.
- F. Extend sleeves installed in floors 2 inches above finished floor level.
- G. Size pipe sleeves to provide 1/4 inch annular clear space between sleeve and raceway or cable, unless indicated otherwise.
- H. Seal space outside of sleeves with grout for penetrations of concrete and masonry
 - 1. Promptly pack grout solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect grout while curing.
- I. Interior Penetrations of Non-Fire-Rated Walls and Floors: Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Division 07 Section "Joint Sealers".
- J. Fire-Rated-Assembly Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at raceway and cable penetrations. Install sleeves and seal raceway and cable penetration sleeves with firestop materials. Comply with requirements in Division 07 Section "Firestopping."
- K. Aboveground, Exterior-Wall Penetrations: Seal penetrations using cast-iron pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1 inch annular clear space between pipe and sleeve for installing mechanical sleeve seals.

3.3 SLEEVE-SEAL INSTALLATION

- A. Install to seal exterior wall penetrations.

- B. Use type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.4 FIRESTOPPING

- A. Apply firestopping to penetrations of fire-rated floor and wall assemblies for electrical installations to restore original fire-resistance rating of assembly. Firestopping materials and installation requirements are specified in Division 07 Section "Firestopping."

END OF SECTION

**SECTION 26 0501
MINOR ELECTRICAL DEMOLITION**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical demolition.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that abandoned wiring and equipment serve only abandoned facilities.
- B. Demolition drawings are based on casual field observation and existing record documents.
- C. Report discrepancies to Engineer before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service: Maintain existing system in service until new system is complete and ready for service. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 48 hours before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
 - 1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
 - 2. PCB- and DEHP-containing lighting ballasts.
 - 3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
- B. Remove, relocate, and extend existing installations to accommodate new construction.

- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- F. Repair adjacent construction and finishes damaged during demolition and extension work.
- G. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.

3.4 CLEANING AND REPAIR

- A. Clean and repair existing materials and equipment that remain or that are to be reused.
- B. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

END OF SECTION

SECTION 26 0519
LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Electrical tape.
- D. Wire pulling lubricant.

1.2 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.

1.3 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specifications for Soft or Annealed Copper Wire; 2013.
- B. ASTM B8 - Standard Specifications for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
- C. ASTM B33 - Standard Specifications for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).
- D. ASTM B787 - Standard Specifications for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).
- E. ASTM D3005 - Standard Specifications for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- G. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy; National Electrical Manufacturers Association; 2009 (ANSI/NEMA WC 70/ICEA S-95-658).
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).
- I. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- K. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- M. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- N. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.

- O. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
3. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. Refer to Article 1105.03 of the Standard Specifications.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- C. Field Quality Control Test Reports.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Project Record Documents: Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.8 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14°F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Engineer and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- D. Comply with NEMA WC 70.
- E. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- F. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- G. Conductors for Grounding and Bonding: Also comply with Section 26 0526.
- H. Conductor Material:
 - 1. Copper Conductors: Soft drawn annealed, 98% conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 - 2. Tinned Copper Conductors: Comply with ASTM B33.
- I. Minimum Conductor Size: No. 12 AWG.
 - 1. Branch Circuits: No. 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet: No. 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet: No. 8 AWG, for voltage drop.
- J. Conductor Color Coding:
 - 1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 - 2. Color Coding Method: Integrally colored insulation.
 - a. Conductors size No. 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 - 3. Color Code:
 - a. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.

- 3) Phase C: Blue.
- 4) Neutral/Grounded: White.
- b. Equipment Ground, All Systems: Green.

2.3 SINGLE CONDUCTOR BUILDING WIRE

- A. Manufacturers:
 - 1. Copper Building Wire:
 - a. General Cable
 - b. The Okonite Company
 - c. Southwire Company: www.southwire.com.
 - d. Superior Essex
 - e. Or Engineer Approved Equal
- B. Description: Single conductor insulated wire.
- C. Conductor Stranding:
 - 1. Feeders and Branch Circuits:
 - a. Size No. 10 AWG and Smaller: Solid.
 - b. Size No. 8 AWG and Larger: Stranded.
- D. Insulation Voltage Rating: 600 V.
- E. Insulation:
 - 1. Copper Building Wire: Type THHN/THWN-2, except as indicated below.
 - a. Size No. 4 AWG and Larger: Type XHHW-2.

2.4 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 0526.
- C. Wiring Connectors for Splices and Taps:
 - 1. Copper Conductors Size No. 8 AWG and Smaller: Use twist-on insulated spring connectors.
 - 2. Copper Conductors Size No. 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.

3. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
 4. Stranded Conductors Size No. 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221°F for standard applications and 302°F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. Ideal Industries, Inc: www.idealindustries.com.
 - c. NSI Industries LLC: www.nsiindustries.com.
 - d. Or Engineer Approved Equal
- H. Mechanical Connectors: Provide bolted type or set-screw type.
1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilSCO.com.
 - c. Thomas & Betts Corporation: www.tnb.com
 - d. Or Engineer Approved Equal
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilSCO.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Or Engineer Approved Equal
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.
1. Manufacturers:
 - a. Burndy: www.burndy.com.
 - b. IlSCO: www.ilSCO.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Or Engineer Approved Equal

2.5 WIRING ACCESSORIES

A. Electrical Tape:

1. Manufacturers:
 - a. 3M: www.3m.com.
 - b. Plymouth Rubber Europa: www.plymouthrubber.com.
 - c. Pro Tapes & Specialties: www.protapes.com
 - d. Or Engineer Approved Equal
 2. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221°F.
 3. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0°F and suitable for continuous temperature environment up to 221°F.
- B. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as shown on the drawings.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

- A. Circuiting Requirements:
 1. Unless dimensioned, circuit routing indicated is diagrammatic.
 2. When circuit destination is indicated and routing is not shown, determine exact routing required.
 3. Arrange circuiting to minimize splices.
 4. Include circuit lengths required to install connected devices within 10 feet of location shown.
 5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.

6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 7. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are shown as separate, combining them together in a single raceway is permitted, under the following conditions:
 - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
 - b. Increase size of conductors as required to account for ampacity derating.
 - c. Size raceways, boxes, etc. to accommodate conductors.
 8. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.
- C. Install conductors and cable in a neat and workmanlike manner in accordance with NECA 1.
- D. Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 2. Pull all conductors and cables together into raceway at same time.
 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
- G. Terminate cables using suitable fittings.
- H. Install conductors with a minimum of 12 inches of slack at each outlet.
- I. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- J. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- K. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.

2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 3. Do not remove conductor strands to facilitate insertion into connector.
 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- L. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
- M. Insulate ends of spare conductors using vinyl insulating electrical tape.
- N. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- P. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 0526
GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.

1.3 REFERENCE STANDARDS

- A. IEEE 81 - Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System; Institute of Electrical and Electronic Engineers; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).
- D. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 - 2. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

- A. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- B. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- C. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- D. Bonding and Equipment Grounding:

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal air ducts.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:

1. Use insulated copper conductors unless otherwise indicated.

C. Connectors for Grounding and Bonding:

1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install grounding and bonding system components in a neat and workmanlike manner in accordance with NECA 1.
- C. Make grounding and bonding connections using specified connectors.
 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.

2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.

END OF SECTION

SECTION 26 0529
HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0534 - Conduit: Additional support and attachment requirements for conduits.
- C. Section 26 0537 - Boxes: Additional support and attachment requirements for boxes.
- D. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

1.3 REFERENCE STANDARDS

- A. ASTM A123 - Standard Specifications for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2013.
- B. ASTM A153 - Standard Specifications for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM B633 - Standard Specifications for Electrodeposited Coatings of Zinc on Iron and Steel; 2013.
- D. MFMA-4 - Metal Framing Standards Publication; Metal Framing Manufacturers Association; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 - 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.

5. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.
- D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of four times the applied force.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 2.5. Include consideration for vibration, equipment operation, and shock loads where applicable.
 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 5. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123 or ASTM A153.
- B. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.

1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
- C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.
- D. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
- E. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
 2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
 3. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 4. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch.
 5. Minimum Channel Dimensions: 1 5/8 inches width by 13/16 inch height.
 6. Manufacturers:
 - a. Cooper B-Line, a division of Eaton Corporation: www.cooperindustries.com.
 - b. Thomas & Betts Corporation: www.tnb.com.
 - c. Unistrut, a brand of Atkore International Inc: www.unistrut.com.
 - d. Or approved equal.
- F. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Busway Supports: 1/2 inch diameter.
 - c. Single Conduit up to 1 inch trade size: 1/4 inch diameter.
 - d. Single Conduit larger than 1 inch trade size: 3/8 inch diameter.
 - e. Trapeze Support for Multiple Conduits: 3/8 inch diameter.
 - f. Outlet Boxes: 1/4 inch diameter.
 - g. Luminaires: 1/4 inch diameter.
- G. Anchors and Fasteners:
1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
 2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
 3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.

4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that mounting surfaces are ready to receive support and attachment components.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install support and attachment components in a neat and workmanlike manner in accordance with NECA 1.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Install support and attachment components for steel conduits in accordance with NECA 101
- F. Unless specifically indicated or approved by Engineer, do not provide support from suspended ceiling support system or ceiling grid.
- G. Unless specifically indicated or approved by Engineer, do not provide support from roof deck
- H. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- I. Equipment Support and Attachment:
 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.

- J. Conduit Support and Attachment: Also comply with Section 26 0534.
- K. Box Support and Attachment: Also comply with Section 26 0537.
- L. Interior Luminaire Support and Attachment: Also comply with Section 26 5100.
- M. Secure fasteners according to manufacturer's recommended torque settings.
- N. Remove temporary supports.
- O. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.
- P. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:
 - 1. To Wood: Fasten with lag screws or through bolts.
 - 2. To New Concrete: Bolt to concrete inserts.
 - 3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
 - 4. To Existing Concrete: Expansion anchor fasteners.
 - 5. To Steel: Beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69.
 - 6. To Light Steel: Sheet metal screws.
 - 7. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet anchorage requirements.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

**SECTION 26 0534
CONDUIT**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Intermediate metal conduit (IMC).
- C. Flexible metal conduit (FMC).
- D. Liquidtight flexible metal conduit (LFMC).
- E. Electrical metallic tubing (EMT).
- F. Conduit fittings.
- G. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 07 8400 - Firestopping.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0537 - Boxes.

1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit (EIMC); 2005.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); National Electrical Contractors Association; 2013.
- F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); National Electrical Contractors Association; 2003.
- G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2012 (ANSI/NEMA FB 1).
- H. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- J. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.

- K. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- L. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- M. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- N. UL 1242 - Electrical Intermediate Metal Conduit-Steel; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
5. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.5 SUBMITTALS

- A. Refer to Article 1105.03 of the Standard Specifications.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Concealed within Masonry Walls: Use electrical metallic tubing (EMT).

- D. Concealed within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- E. Concealed Above Accessible Ceilings: Use electrical metallic tubing (EMT).
- F. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
- G. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- H. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
 - 1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed below 8 feet, except within electrical and communication rooms or closets.
- I. Exposed, Exterior: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- J. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
 - 1. Maximum Length: 6 feet.
- K. Connections to Vibrating Equipment:
 - 1. Dry Locations: Use flexible metal conduit.
 - 2. Damp, Wet, or Corrosive Locations: Use liquid tight flexible metal conduit.
 - 3. Maximum Length: 6 feet unless otherwise indicated.
 - 4. Vibrating equipment includes, but is not limited to:
 - a. Motors.
 - b. HVAC Equipment.

2.2 CONDUIT REQUIREMENTS

- A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.
- B. Fittings for Grounding and Bonding: Also comply with Section 26 0526.
- C. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Minimum Conduit Size, Unless Otherwise Indicated:
 - 1. Branch Circuits: 3/4 inch trade size.
 - 2. Branch Circuit Homeruns: 3/4 inch trade size.
 - 3. Flexible Connections to Luminaires: 1/2 inch trade size.
- F. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

A. Manufacturers:

1. Allied Tube & Conduit: www.alliedeg.com.
2. Republic Conduit: www.republic-conduit.com.
3. Wheatland Tube Company: www.wheatland.com.
4. Or Engineer Approved Equal

B. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.

C. Fittings:

1. Manufacturers:

- a. Bridgeport Fittings Inc: www.bptfittings.com.
- b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
- c. Thomas & Betts Corporation: www.tnb.com.
- d. Or approved equal.

2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Material: Use steel or malleable iron.

4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.4 INTERMEDIATE METAL CONDUIT (IMC)

A. Manufacturers:

1. Allied Tube & Conduit: www.alliedeg.com.
2. Republic Conduit: www.republic-conduit.com.
3. Wheatland Tube Company: www.wheatland.com.
4. Or Engineer Approved Equal

B. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.

C. Fittings:

1. Manufacturers:

- a. Bridgeport Fittings Inc: www.bptfittings.com.
- b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
- c. Thomas & Betts Corporation: www.tnb.com.
- d. Or Engineer Approved Equal

2. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material: Use steel or malleable iron.
4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.5 FLEXIBLE METAL CONDUIT (FMC)

A. Manufacturers:

1. AFC Cable Systems, Inc; www.afcweb.com.
2. Electri-Flex Company; www.electriflex.com.
3. International Metal Hose; www.metalhose.com.
4. Or Engineer Approved Equal

B. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.

C. Fittings:

1. Manufacturers:

- a. Bridgeport Fittings Inc: www.bptfittings.com.
- b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
- c. Thomas & Betts Corporation: www.tnb.com.
- d. Or Engineer Approved Equal

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Material: Use steel or malleable iron.

2.6 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

A. Manufacturers:

1. AFC Cable Systems, Inc; www.afcweb.com.
2. Electri-Flex Company; www.electriflex.com.
3. International Metal Hose; www.metalhose.com.
4. Or Engineer Approved Equal

B. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.

C. Fittings:

1. Manufacturers:

- a. Bridgeport Fittings Inc: www.bptfittings.com.
 - b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
 - c. Thomas & Betts Corporation: www.tnb.com.
 - d. Or Engineer Approved Equal
2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material: Use steel or malleable iron.

2.7 ELECTRICAL METALLIC TUBING (EMT)

A. Manufacturers:

1. Allied Tube & Conduit: www.alliedeg.com.
2. Republic Conduit: www.republic-conduit.com.
3. Wheatland Tube Company: www.wheatland.com.
4. Or Engineer Approved Equal

B. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.

C. Fittings:

1. Manufacturers:

- a. Bridgeport Fittings Inc: www.bptfittings.com.
- b. O-Z/Gedney, a brand of Emerson Industrial Automation: www.emersonindustrial.com.
- c. Thomas & Betts Corporation: www.tnb.com.
- d. Or Engineer Approved Equal

2. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Material: Use steel or malleable iron.

4. Connectors and Couplings: Use compression (gland) type.

- a. Do not use indenter type connectors and couplings.
- b. Do not use set-screw type connectors and couplings.

5. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.

2.8 ACCESSORIES

A. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.

B. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.

- C. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.
- D. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
- E. Modular Seals for Conduit Penetrations: Rated for minimum of 40 pounds per square inch, gage; Suitable for the conduits to be installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that mounting surfaces are ready to receive conduits.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install conduit in a neat and workmanlike manner in accordance with NECA 1.
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- E. Conduit Routing:
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated and routing is not shown, determine exact routing required.
 - 3. Conceal all conduits unless specifically indicated to be exposed.
 - 4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
 - 5. Unless otherwise approved, do not route conduits exposed:
 - a. Across floors.
 - b. Across roofs exposed to sunlight.
 - c. Across building exterior surfaces.
 - 6. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 7. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
 - 8. Arrange conduit to provide no more than 150 feet between pull points.
 - 9. Route conduits above water and drain piping where possible.
 - 10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
 - 11. Maintain minimum clearance of 6 inches between conduits and piping for other systems.

12. Group parallel conduits in the same area together on a common rack.

F. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
5. Use conduit clamp to support single conduit from beam clamp or threaded rod.
6. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
7. Use of wire for support of conduits is not permitted.
8. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

G. Connections and Terminations:

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.
4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

H. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.

4. Conceal bends for conduit risers emerging above ground.
 5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
 6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
 7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
 8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
 9. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- I. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where conduits are subject to earth movement by settlement or frost.
- J. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- K. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- L. Provide grounding and bonding in accordance with Section 26 0526.

3.3 FIELD QUALITY CONTROL

- A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- B. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.5 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 26 0537
BOXES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.

1.2 RELATED REQUIREMENTS

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.
- B. Section 26 2726 - Wiring Devices:
 - 1. Wall plates.
 - 2. Additional requirements for locating boxes for wiring devices.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; National Electrical Contractors Association; 2010.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; National Electrical Manufacturers Association; 2012 (ANSI/NEMA FB 1).
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; National Electrical Manufacturers Association; 2013 (ANSI/NEMA OS 1).
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2014.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- I. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- J. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
6. Coordinate the work with other trades to preserve insulation integrity.
7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 BOXES

- A. General Requirements:
 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes:
 1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.

4. Use suitable concrete type boxes where flush-mounted in concrete.
 5. Use suitable masonry type boxes where flush-mounted in masonry walls.
 6. Use raised covers suitable for the type of wall construction and device configuration where required.
 7. Use shallow boxes where required by the type of wall construction.
 8. Do not use "through-wall" boxes designed for access from both sides of wall.
 9. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
 10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 11. Boxes for Supporting Luminaires and Ceiling Fans: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 12. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
 13. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices (Other Than Communications Systems Outlets): 4 inches square by 1 1/2 inches deep trade size.
 - b. Communications Systems Outlets: 4 inches square by 2 1/8 inches deep trade size.
 - c. Ceiling Outlets: 4 inches octagonal or square by 2 1/8 inches deep trade size.
 14. Wall Plates: Comply with Section 26 2726.
- C. Cabinets and Enclosures, including junction and pull boxes larger than 100 cubic inches:
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA 250 Environment Type, unless otherwise indicated:
 - a. Indoor Clean, Dry Locations: Type 12, painted steel.
 - b. Outdoor Locations: Type 3R, painted steel.
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that mounting surfaces are ready to receive boxes.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.

- B. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Box Locations:
 - 1. Locate boxes to be accessible. Provide access panels in accordance with Section 08 3100 as required where approved by the Architect.
 - 2. Unless dimensioned, box locations indicated are approximate.
 - 3. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
 - 4. Locate boxes so that wall plates do not span different building finishes.
 - 5. Locate boxes so that wall plates do not cross masonry joints.
 - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
 - 8. Acoustic-Rated Walls: Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches horizontal separation.
 - 9. Fire Resistance Rated Walls: Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - 10. Locate junction and pull boxes in the following areas, unless otherwise indicated or approved by the Architect:
 - a. Concealed above accessible suspended ceilings.
 - b. Within joists in areas with no ceiling.
 - c. Electrical rooms.
 - d. Mechanical equipment rooms.
- H. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.

3. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
- I. Install boxes plumb and level.
- J. Flush-Mounted Boxes:
 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- K. Install boxes as required to preserve insulation integrity.
- L. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- M. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified in Section 07 8400.
- N. Close unused box openings.
- O. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- P. Provide grounding and bonding in accordance with Section 26 0526.

3.3 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

**SECTION 26 0923
LIGHTING CONTROL DEVICES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Occupancy sensors.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0537 - Boxes.
- C. Section 26 2726 - Wiring Devices: Devices for manual control of lighting, including wall switches.
- D. Section 26 5100 - Interior Lighting.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- B. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of lighting control devices with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Notify Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work
- B. Sequencing:
 - 1. Do not install lighting control devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. Refer to Article 1105.03 of the Standard Specifications.
- B. Product Data: Include ratings, configurations, standard wiring diagrams, dimensions, colors, service condition requirements, and installed features.
 - 1. Occupancy Sensors: Include detailed motion detection coverage range diagrams.
- C. Shop Drawings:
 - 1. Occupancy Sensors: Provide lighting plan indicating location, model number, and orientation of each occupancy sensor and associated system component.
- D. Field Quality Control Reports.
- E. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

- F. Operation and Maintenance Data: Include detailed information on device programming and setup.
- G. Project Record Documents: Record actual installed locations and settings for lighting control devices.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum 3 years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Store products in a clean, dry space in original manufacturer's packaging in accordance with manufacturer's written instructions until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturers required service conditions during and after installation.

1.9 WARRANTY

- A. Provide 5 year manufacturer warranty for all occupancy sensors.

PART 2 PRODUCTS

2.1 LIGHTING CONTROL DEVICES - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide all required conduit, wiring, connectors, hardware, components, accessories, etc. as required for a complete operating system.
- C. Products for Switching of Electronic Fluorescent Ballasts: Tested and rated to be suitable for peak inrush currents specified in NEMA 410.

2.2 OCCUPANCY SENSORS

- A. Manufacturers:
 - 1. Hubbell Building Automation, Inc: www.hubbellautomation.com
 - 2. Sensor Switch Inc: www.sensorswitch.com.
 - 3. WattStopper: www.wattstopper.com.
 - 4. Or Engineer Approved Equal
- B. All Occupancy Sensors:
 - 1. Description: Factory-assembled commercial specification grade devices for indoor use capable of sensing both major motion, such as walking, and minor motion, such as small

desktop level movements, according to published coverage areas, for automatic control of load indicated.

2. Sensor Technology:
 - a. Passive Infrared/Ultrasonic Dual Technology Occupancy Sensors: Designed to detect occupancy using a combination of both passive infrared and ultrasonic technologies.
 3. Provide LED to visually indicate motion detection with separate color LEDs for each sensor type in dual technology units.
 4. Operation: Unless otherwise indicated, occupancy sensor to turn load on when occupant presence is detected and to turn load off when no occupant presence is detected during an adjustable turn-off delay time interval.
 5. Dual Technology Occupancy Sensors: Field configurable turn-on and hold-on activation with settings for activation by either or both sensing technologies.
 6. Passive Infrared Lens Field of View: Field customizable by addition of factory masking material, adjustment of integral blinders, or similar means to block motion detection in selected areas.
 7. Turn-Off Delay: Field adjustable, with time delay settings up to 30 minutes.
 8. Sensitivity: Field adjustable.
 9. Compatibility (Non-Dimming Sensors): Suitable for controlling incandescent lighting, low-voltage lighting with electronic and magnetic transformers, fluorescent lighting with electronic and magnetic ballasts, LED lighting, and fractional motor loads, with no minimum load requirements.
 10. Load Rating for Line Voltage Occupancy Sensors: As required to control the load indicated on the drawings.
- C. Ceiling Mounted Occupancy Sensors:
1. All Ceiling Mounted Occupancy Sensors:
 - a. Description: Low profile occupancy sensors designed for ceiling installation.
 - b. Unless otherwise indicated or required to control the load indicated on the drawings, provide low voltage units, for use with separate compatible accessory power packs.
 - c. Provide field selectable setting for disabling LED motion detector visual indicator.
 - d. Occupancy sensor to be field selectable as either manual-on/automatic-off or automatic on/off.
 2. Passive Infrared/Ultrasonic Dual Technology Ceiling Mounted Occupancy Sensors:
 - a. Extended Range Sensors: Capable of detecting motion within an area of 1,200 square feet at a mounting height of 9 feet, with a field of view of 360 degrees.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.

- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that openings for outlet boxes are neatly cut and will be completely covered by devices or wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to lighting control devices.
- F. Verify that the service voltage and ratings of lighting control devices are appropriate for the service voltage and load requirements at the location to be installed.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of lighting control devices provided under this section.
- C. Install lighting control devices in accordance with manufacturer's instructions.
- D. Unless otherwise indicated, connect lighting control device grounding terminal or conductor to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- E. Install lighting control devices plumb and level, and held securely in place.
- F. Where required and not furnished with lighting control device, provide wall plate in accordance with Section 26 2726.
- G. Where applicable, install lighting control devices and associated wall plates to fit completely flush to mounting surface with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- H. Occupancy Sensor Locations:
 - 1. Location Adjustments: Do not make adjustments to locations without obtaining approval from the Architect/Engineer.
 - 2. Locate ultrasonic and dual technology passive infrared/ultrasonic occupancy sensors a minimum of 6 feet from air supply ducts or other sources of heavy air flow and as per manufacturer's recommendations, in order to minimize false triggers.

3.4 FIELD QUALITY CONTROL

- A. Inspect each lighting control device for damage and defects.

- B. Test occupancy sensors to verify proper operation, including time delays and ambient light thresholds where applicable. Verify optimal coverage for entire room or area. Record test results in written report to be included with submittals.
- C. Correct wiring deficiencies and replace damaged or defective lighting control devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust occupancy sensor settings to minimize undesired activations while optimizing energy savings, and to achieve desired function as indicated or as directed by Engineer.
- C. Where indicated or as directed by Architect, install factory masking material or adjust integral blinders on dual technology occupancy sensor lenses to block undesired motion detection.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.7 COMMISSIONING

- A. Document and verify operation of all lighting control and time out settings by third party separate from the design and construction teams.

3.8 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of lighting control devices to Engineer, and correct deficiencies or make adjustments as directed.
- B. Training: Train Contracting Authority's personnel on operation, adjustment, programming, and maintenance of lighting control devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of 2 hours of training.
 - 3. Instructor: Qualified contractor familiar with the project and with sufficient knowledge of the installed lighting control devices.
 - 4. Location: At project site.

END OF SECTION

SECTION 26 2416
PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Lighting and appliance panelboards.
- B. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; National Electrical Contractors Association; 2009.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- E. NEMA PB 1 - Panelboards; National Electrical Manufacturers Association; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; National Electrical Manufacturers Association; 2013 (ANSI/NEMA PB 1.1).
- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).
- H. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 67 - Panelboards; Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work

1.5 SUBMITTALS

- A. Refer to Article 1105.03 of the Standard Specifications.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
- D. Source Quality Control Test Reports: Include reports for tests designated in NEMA PB 1 as routine tests.
- E. Field Quality Control Test Reports.
- F. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- G. Project Record Documents: Record actual installed locations of panelboards and actual installed circuiting arrangements.
- H. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- I. Maintenance Materials: Furnish the following.
 1. Panelboard Keys: 2 of each different key.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
 - 1. Panelboards Containing Circuit Breakers: Between 23°F and 104°F.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation: www.eaton.com.
- B. General Electric Company: www.geindustrial.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. Siemens Industry, Inc: www.usa.siemens.com.
- E. Or Engineer Approved Equal
- F. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23°F and 104°F.
- C. Short Circuit Current Rating:
 - 1. Provide panelboards with listed short circuit current rating not less than the available short circuit rating of the existing panel board.
- D. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- E. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices.
- F. Bussing: Sized in accordance with UL 67 temperature rise requirements.

1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.
- H. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 12.
 2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
 4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- I. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- J. Load centers are not acceptable.

2.3 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated.
- B. Conductor Terminations:
1. Main and Neutral Lug Material: Copper, suitable for terminating copper conductors only.
 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 2. Phase and Neutral Bus Material: Copper.
 3. Ground Bus Material: Copper.
- D. Circuit Breakers: Thermal magnetic bolt-on type.
- E. Enclosures:
1. Provide surface-mounted enclosures.

2. Fronts: Provide lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.

2.4 OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers:

1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
5. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
6. Provide listed switching duty rated circuit breakers with SWD marking for all branch circuits serving fluorescent lighting.
7. Provide listed high intensity discharge lighting rated circuit breakers with HID marking for all branch circuits serving HID lighting.
8. Do not use tandem circuit breakers.
9. Do not use handle ties in lieu of multi-pole circuit breakers.

2.5 SOURCE QUALITY CONTROL

- A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.

- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install panelboards securely, in a neat and workmanlike manner in accordance with NECA 1 (general workmanship), NECA 407 (panelboards), and NEMA PB 1.1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 0529.
- E. Install panelboards plumb.
- F. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- H. Provide grounding and bonding in accordance with Section 26 0526.
- I. Install all field-installed branch devices, components, and accessories.
- J. Provide filler plates to cover unused spaces in panelboards.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 125 amperes. Tests listed as optional are not required.
- D. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 10% and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

**SECTION 26 2717
EQUIPMENT WIRING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical connections to equipment.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 0534 - Conduit.
- C. Section 26 0537 - Boxes.
- D. Section 26 2726 - Wiring Devices.
- E. Section 26 2818 - Enclosed Switches.

1.3 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2010).
- B. NEMA WD 6 - Wiring Devices - Dimensional Requirements; National Electrical Manufacturers Association; 2012.
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Conform to NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.

END OF SECTION

**SECTION 26 2726
WIRING DEVICES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates.

1.2 RELATED REQUIREMENTS

- A. Section 26 0537 - Boxes.

1.3 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Federal Specification; Revision G, 2001.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Federal Specification; Revision F, 1999.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- D. NEMA WD 1 - General Color Requirements for Wiring Devices; National Electrical Manufacturers Association; 1999 (R 2010).
- E. NEMA WD 6 - Wiring Device -- Dimensional Specifications; National Electrical Manufacturers Association; 2012.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- H. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- I. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- J. UL 943 - Ground-Fault Circuit-Interruption; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.

4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 5. Notify Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.
- B. Sequencing:
1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. Refer to Article 1105.03 of the Standard Specifications.
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Field Quality Control Test Reports.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Operation and Maintenance Data:
 1. GFI Receptacles: Include information on status indicators and testing procedures and intervals.
- F. Project Record Documents: Record actual installed locations of wiring devices.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Hubbell Incorporated: www.hubbell-wiring.com.
- B. Leviton Manufacturing Company, Inc: www.leviton.com.
- C. Cooper Wiring Devices
- D. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us

- E. Or Engineer Approved Equal
- F. Source Limitations: Where possible, provide products for each type of wiring device produced by a single manufacturer and obtained from a single supplier.

2.2 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. Provide weather resistant GFI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- C. Provide GFI protection for receptacles installed within 6 feet of sinks.
- D. Unless noted otherwise, do not use combination switch/receptacle devices.

2.3 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices, Unless Otherwise Indicated: Gray with gray nylon wall plate.
- C. Wiring Devices Installed in Unfinished Spaces: Gray with galvanized steel wall plate.
- D. Wiring Devices Installed in Wet or Damp Locations: Gray with specified weatherproof cover.

2.4 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell-wiring.com.
 - 2. Cooper Wiring Devices
 - 3. Leviton Manufacturing Company, Inc: www.leviton.com.
 - 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
 - 5. Or Engineer Approved Equal
- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.5 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell-wiring.com.
 - 2. Cooper Wiring Devices.
 - 3. Leviton Manufacturing Company, Inc: www.leviton.com.
 - 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us

5. Or Engineer Approved Equal
- B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.
 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 2. NEMA configurations specified are according to NEMA WD 6.
- C. Convenience Receptacles:
 1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 2. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
- D. GFI Receptacles:
 1. GFI Receptacles: Provide with feed-through protection, light to indicate ground fault tripped condition and loss of protection, and list as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
 2. Weather Resistant GFI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.6 WALL PLATES

- A. Manufacturers:
 1. Hubbell Incorporated: www.hubbell-wiring.com.
 2. Leviton Manufacturing Company, Inc: www.leviton.com.
 3. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us
 4. Or Engineer Approved Equal
 5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer in locations indicated.
- B. Wall Plates: Comply with UL 514D.
 1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 2. Size: Standard.
 3. Screws: Metal with slotted heads finished to match wall plate finish.
- C. Nylon Wall Plates: Smooth finish, high-impact thermoplastic.
- D. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

- E. Premarked Wall Plates: Factory labeled as indicated; hot stamped for nylon wall plates and engraved for metal wall plates.
- F. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that final surface finishes are complete, including painting.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Perform work in a neat and workmanlike manner in accordance with NECA 1 and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of wiring devices provided under this section.
 - 1. Mounting Heights: Unless otherwise indicated, as follows:
 - a. Wall Switches: 48 inches above finished floor.
 - b. Receptacles: 18 inches above finished floor or 6 inches above counter.
 - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 4. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Engineer to obtain direction prior to proceeding with work.
 - 5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.

- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFI receptacles with integral GFI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Install vertically mounted receptacles with grounding pole on bottom and horizontally mounted receptacles with grounding pole on right.
- L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.

3.4 FIELD QUALITY CONTROL

- A. Inspect each wiring device for damage and defects.
- B. Operate each wall switch with circuit energized to verify proper operation.
- C. Test each receptacle to verify operation and proper polarity.
- D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

**SECTION 26 2818
ENCLOSED SWITCHES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); National Electrical Manufacturers Association; 2014.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); National Electrical Manufacturers Association; 2013.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; International Electrical Testing Association; 2013 (ANSI/NETA ATS).
- E. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 4. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work

1.5 SUBMITTALS

- A. Refer to Article 1105.03 of the Standard Specifications.

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of enclosed switches and adjacent equipment with all required clearances indicated.
 - 2. Include wiring diagrams showing all factory and field connections.
- D. Field Quality Control Test Reports.
- E. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- F. Project Record Documents: Record actual locations of enclosed switches.
- G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperature between -22°F and 104°F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Eaton Corporation: www.eaton.com.
- B. General Electric Company: www.geindustrial.com.
- C. Schneider Electric; Square D Products: www.schneider-electric.us.
- D. Or Engineer Approved Equal
- E. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6600 feet.
 - 2. Ambient Temperature: Between -22°F and 104°F.
- D. Horsepower Rating: Suitable for connected load.
- E. Voltage Rating: Suitable for circuit voltage.
- F. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- G. Provide with switch blade contact position that is visible when the cover is open.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- J. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 12.
 - b. Outdoor Locations: Type 3R.
- L. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.

- M. Heavy Duty Switches:
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
 - a. Provide means for locking handle in the ON position.
- N. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Hubs: As required for environment type; sized to accept conduits to be installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install enclosed switches in accordance with manufacturer's instructions.
- B. Install enclosed switches securely, in a neat and workmanlike manner in accordance with NECA 1.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 26 0529.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.

3.3 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- C. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 26 5100
INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Drivers.
- E. Emergency power supply units.

1.2 RELATED REQUIREMENTS

- A. Section 26 0537 - Boxes.
- B. Section 26 0923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors.
- C. Section 26 2726 - Wiring Devices: Manual wall switches.

1.3 REFERENCE STANDARDS

- A. ANSI C82.11 - American National Standard for Lamp Ballasts - High Frequency Fluorescent Lamp Ballasts - Supplements; 2011.
- B. IEEE C62.41.2 - Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits; Institute of Electrical and Electronic Engineers; 2002 (Cor 1, 2012).
- C. IES LM-80 - Approved Method: Measuring Lumen Maintenance of LED Light Sources; Illuminating Engineering Society; 2008.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- E. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; National Electrical Contractors Association; 2006.
- F. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; National Electrical Contractors Association; 2006.
- G. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; National Electrical Manufacturers Association; 2012.
- H. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 101 - Life Safety Code; National Fire Protection Association; 2012.
- J. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- K. UL 935 - Fluorescent-Lamp Ballasts; Current Edition, Including All Revisions.
- L. UL 1598 - Luminaires; Current Edition, Including All Revisions.

- M. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Architect/Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. Refer to Article 1105.03 of the Standard Specifications.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 2. Driver: Include wiring diagrams and list of compatible lamp configurations.
 3. Emergency Power Supply Unit: Include list of compatible lamp configurations and associated lumen output.
- C. Certificates for Dimming Ballasts: Manufacturer's documentation of compatibility with dimming controls to be installed.
- D. Field Quality Control Reports.
- E. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- F. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturers required service conditions during and after installation.

1.9 WARRANTY

- A. Provide 5 year manufacturer warranty for all LED luminaires, including drivers.
- B. Provide 10 year pro-rata warranty for batteries for self-powered exit signs.
- C. Provide 5 year full warranty for emergency power supply units.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
- H. LED Luminaire Components: UL 8750 recognized or listed as applicable.
 - 1. Lumen Maintenance per Lumens-80-08 as determined by TM-21.
 - 2. Minimum 50,000 hours L70.
 - 3. Photometry per LM-79.

4. RoHS compliant.
5. Correlated Color Temperature (CCT): 4100 K unless otherwise indicated.
6. Color Rendering Index (CRI): Not less than 80.
7. Minimum luminaire warranty 5 years.
8. Luminous efficacy of at least 70.

2.3 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20% voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery:
 1. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.

2.4 EXIT SIGNS

- A. Description: Exit signs and similar signs for special purpose applications such as area of refuge/rescue assistance.
- B. All Exit Signs: Internally illuminated with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
 1. Number of Faces: Single or double as indicated or as required for the installed location.
 2. Directional Arrows: As indicated or as required for the installed location.
- C. Self-Powered Exit Signs:
 1. Operation: Upon interruption of normal power source or brownout condition exceeding 20% voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
 2. Battery: Sealed maintenance-free nickel cadmium unless otherwise indicated.
 3. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
 4. Provide low-voltage disconnect to prevent battery damage from deep discharge.
 5. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101; provide indicator light(s) to report test and diagnostic status.

2.5 DRIVERS

- A. LED Drivers: RoHS compliant, 120-277V input voltage, 0-10V dimming,
 - 1. LED Driver is certified by UL Class 2 for use in dry or damp location.
 - 2. LED Driver has a Class A sound rating.
 - 3. LED Driver has a minimum operating ambient temperature of -40°C.
 - 4. LED Driver has a life expectancy of 50,000 hours at Tcase of $\leq 70^{\circ}\text{C}$.
 - 5. LED Driver tolerates sustained open circuit and short circuit output conditions without damage.
 - 6. LED Driver complies with FCC rules and regulations, as per Title 47 CFR Part 15 Non-Consumer (Class A).

2.6 EMERGENCY POWER SUPPLY UNITS

- A. Description: Self-contained fluorescent emergency power supply units suitable for use with indicated luminaires, complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Compatibility:
 - 1. Ballasts: Compatible with electronic, standard magnetic, energy saving, and dimming AC ballasts, including those with end of lamp life shutdown circuits.
 - 2. Lamps: Compatible with low-mercury lamps.
- C. Operation: Upon interruption of normal power source, solid-state control automatically switches connected lamp(s) to the fluorescent emergency power supply for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- D. Battery: Sealed maintenance-free high-temperature nickel cadmium unless otherwise indicated.
- E. Emergency Illumination Output:
- F. Diagnostics: Provide accessible and visible multi-chromatic combination test switch/indicator light to display charge, test, and diagnostic status and to manually activate emergency operation.
- G. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101; provide indicator light(s) to report test and diagnostic status and field selectable audible alert.
- H. Accessories:
 - 1. Provide compatible accessory remote combination test switch/indicator light.

2.7 ACCESSORIES

- A. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.

- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.
- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA 500 (commercial lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to building structure.
 - 4. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 5. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
 - 6. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- F. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Luminaires Recessed in Fire-Rated Ceilings: Install using accessories and firestopping materials to meet regulatory requirements for fire rating.
- G. Suspended Luminaires:
 - 1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 - 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.

- 3. Provide minimum of two supports for each luminaire, with no more than 4 feet between supports.
- H. Wall-Mounted luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- I. Install accessories furnished with each luminaire.
- J. Bond products and metal accessories to branch circuit equipment grounding conductor.
- K. Fluorescent luminaires controlled by dual-level switching: Connect such that each switch controls the same corresponding lamps in each luminaire.
- L. Emergency lighting units:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- M. Exit signs:
 - 1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- N. Emergency power supply units:
 - 1. For field-installed units, install inside luminaire unless otherwise indicated. Where installation inside luminaire is not possible, install on top of luminaire.
 - 2. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal ballast(s) in luminaire. Bypass local switches, contactors, or other lighting controls.

3.4 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Test self-powered exit signs, emergency lighting units, and emergency power supply units to verify proper operation upon loss of normal power supply.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Engineer.

3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Engineer or authority having jurisdiction.
- C. Exit signs with field-selectable directional arrows: Set as indicated or as required to properly designate egress path as directed by Engineer or authority having jurisdiction.

3.6 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. Just prior to Substantial Completion, replace all lamps that have failed.

3.8 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

**SECTION 26 5600
EXTERIOR LIGHTING**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Exterior luminaires.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0537 - Boxes.

1.3 REFERENCE STANDARDS

- A. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals; American Association of State Highway and Transportation Officials; 6th Edition, with 2015 Interim Revisions
- B. ANSI C82.4 - American National Standard for Ballasts for High-Intensity-Discharge and Low Pressure Sodium Lamps (Multiple-Supply Type); 2002.
- C. IEEE C2 - National Electrical Safety Code; Institute of Electrical and Electronic Engineers; 2012.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; National Electrical Contractors Association; 2010.
- E. NECA/IESNA 501 - Recommended Practice for Installing Exterior Lighting Systems; National Electrical Contractors Association; 2006.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 1029 - High-Intensity-Discharge Lamp Ballasts; Current Edition, Including All Revisions.
- H. UL 1598 - Luminaires; Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate placement of poles and associated foundations with utilities, curbs, sidewalks, trees, walls, fences, striping, etc. installed under other sections or by others. Coordinate elevation to obtain specified foundation height.
 - 2. Notify Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work

1.5 SUBMITTALS

- A. Refer to Article 1105.03 of the Standard Specifications.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.

1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
2. Driver: Include wiring diagrams and list of compatible lamp configurations.
- C. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- D. Project Record Documents: Record actual connections and locations of luminaires and any associated remote components.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturers required service conditions during and after installation.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:

1. Ceiling Compatibility: Comply with NEMA LE 4.
- H. LED Luminaire Components: UL 8750 recognized or listed as applicable.
1. Lumen Maintenance per Lumens-80-08 as determined by TM-21.
 2. Minimum 50,000 hours L70.
 3. Photometry per LM-79.
 4. RoHS compliant.
 5. Correlated Color Temperature (CCT): 4100 K unless otherwise indicated.
 6. Color Rendering Index (CRI): Not less than 80.
 7. Minimum luminaire warranty 5 years.
 8. Luminous efficacy of at least 70.

2.3 DRIVERS

- A. LED Drivers: RoHS compliant, 120-277V input voltage, 0-10V dimming,
1. LED Driver is certified by UL Class 2 for use in dry or damp location.
 2. LED Driver has a Class A sound rating.
 3. LED Driver has a minimum operating ambient temperature of -40°C .
 4. LED Driver has a life expectancy of 50,000 hours at T_{case} of $\leq 70^{\circ}\text{C}$.
 5. LED Driver tolerates sustained open circuit and short circuit output conditions without damage.
 6. LED Driver complies with FCC rules and regulations, as per Title 47 CFR Part 15 Non-Consumer (Class A).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- B. Verify that suitable support frames are installed where required.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0537 as required for installation of luminaires provided under this section.

- B. Install products according to manufacturer's instructions.
- C. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 1 (general workmanship) and NECA/IESNA 501 (exterior lighting).
- D. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- E. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- F. Install accessories furnished with each luminaire.
- G. Bond products and metal accessories to branch circuit equipment grounding conductor.

3.4 FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Engineer.

3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer. Secure locking fittings in place.
- B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Engineer.

3.6 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. Demonstration: Demonstrate proper operation of luminaires to Engineer, and correct deficiencies or make adjustments as directed.

3.8 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 27 0528
PATHWAYS FOR COMMUNICATIONS SYSTEMS

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Metal conduits and fittings.

PART 2 PRODUCTS

2.1 METAL CONDUITS AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Allied Tube & Conduit; a Tyco International Ltd. Co.
 2. Republic Conduit.
 3. Wheatland Tube Company; a division of John Maneely Company.
 4. Or approved equal.
- B. General Requirements for Metal Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. EMT: Comply with ANSI C80.3 and UL 797.
- E. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:
 - a. Material: die cast.
 - b. Type: compression.
 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL-467, rated for environmental conditions where installed, and including flexible external bonding jumper.
- F. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
1. Hubbell Incorporated; Killark Division.
 2. O-Z/Gedney; a brand of EGS Electrical Group.
 3. RACO; a Hubbell company.
 4. Thomas & Betts Corporation.
 5. Or approved equal.

- B. General Requirements for Boxes, Enclosures, and Cabinets:
 - 1. Comply with TIA-569-B.
 - 2. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- E. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- F. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- G. Device Box Dimensions: 4 inches square by 2 1/8 inches deep.
- H. Gangable boxes are prohibited.

PART 3 EXECUTION

3.1 PATHWAY APPLICATION

- A. Indoors: Apply pathway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
 - a. Corridors.
 - 4. Boxes and Enclosures: NEMA 250 Type 1, except use NEMA 250 Type 4 stainless steel in damp or wet locations.
- B. Minimum Pathway Size: 1 inch trade size. Minimum size for optical-fiber cables is 1 inch.
- C. Pathway Fittings: Compatible with pathways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. EMT: Use compression, steel fittings. Comply with NEMA FB 2.10.

3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of two 90 degree bends in any pathway run. Support within 12 inches of changes in direction. Utilize long radius ells for all optical-fiber cables.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- J. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.
- K. Cut conduit perpendicular to the length. For conduits of 2 inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- L. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200 pound tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground pathways designated as spare above grade alongside pathways in use.
- M. Mount boxes at heights 18 inches, unless indicated otherwise on drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

3.3 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078400 "Firestopping."

3.4 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage or deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION

SECTION 28 0528
PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
1. Metal conduits, tubing, and fittings.
 2. Boxes, enclosures, and cabinets.

1.2 DEFINITIONS

- A. GRC: Galvanized rigid steel conduit.
- B. IMC: Intermediate metal conduit.

PART 2 PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
1. Allied Tube & Conduit; a Tyco International Ltd. Co.
 2. Republic Conduit.
 3. Wheatland Tube Company; a division of John Maneely Company.
 4. Or approved equal.
- B. General Requirements for Metal Conduits and Fittings:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. GRC: Comply with ANSI C80.1 and UL 6.
- D. IMC: Comply with ANSI C80.6 and UL 1242.
- E. EMT: Comply with ANSI C80.3 and UL 797.
- F. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.
- G. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.
1. Fittings for EMT:
 - a. Material: Steel or die cast.
 - b. Type: Setscrew or compression.
 2. Expansion Fittings: PVC or steel to match conduit type, complying with UL 467, rated for environmental conditions where installed, and including flexible external bonding jumper.
- H. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 BOXES, ENCLOSURES, AND CABINETS

- A. Manufacturers: Subject to compliance with requirements, provide products by the following:
 - 1. Hubbell Incorporated; Killark Division.
 - 2. RACO; a Hubbell Company.
 - 3. Thomas & Betts Corporation.
 - 4. Or approved equal.
- B. General Requirements for Boxes, Enclosures, and Cabinets:
 - 1. Boxes, enclosures and cabinets installed in wet locations shall be listed for use in wet locations.
- C. Sheet-Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.
- D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.
- E. Box extensions used to accommodate new building finishes shall be of same material as recessed box.
- F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.
- G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.
- H. Device Box Dimensions: 4 inches square by 2 1/8 inches deep.
- I. Gangable boxes are prohibited.

PART 3 EXECUTION

3.1 PATHWAY APPLICATION

- A. Indoors: Apply pathway products as specified below unless otherwise indicated:
 - 1. Exposed, Not Subject to Physical Damage: EMT.
 - 2. Exposed, Not Subject to Severe Physical Damage: EMT.
 - 3. Exposed and Subject to Severe Physical Damage: GRC. Pathway locations include the following:
 - a. Corridors.
 - 4. Concealed in Ceilings and Interior Walls and Partitions: EMT.
 - 5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric-Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
 - 6. Damp or Wet Locations: GRC.
 - 7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.
- B. Minimum Pathway Size Indoor: 3/4 inch trade size. Minimum size for optical-fiber cables is 1 inch.

- C. Pathway Fittings: Compatible with pathways and suitable for use and location.
 - 1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
 - 2. EMT: Use setscrew or compression, cast-metal fittings. Comply with NEMA FB 2.10.
 - 3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.2 INSTALLATION

- A. Comply with NECA 1, NECA 101, and TIA-569-B for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum pathways. Comply with NFPA 70 limitations for types of pathways allowed in specific occupancies and number of floors.
- B. Keep pathways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal pathway runs above water and steam piping.
- C. Complete pathway installation before starting conductor installation.
- D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.
- E. Arrange stub-ups so curved portions of bends are not visible above finished slab.
- F. Install no more than the equivalent of three 90-degree bends in any conduit run except for communications wiring conduits for which only two 90-degree bends are allowed. Support within 12 inches of changes in direction.
- G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
- H. Support conduit within 12 inches of enclosures to which attached.
- I. Stub-ups to Above Recessed Ceilings:
 - 1. Use EMT, IMC, or RMC for pathways.
 - 2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.
- J. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of pathway and fittings before making up joints. Follow compound manufacturer's written instructions.
- K. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install insulated bushings on conduits terminated with locknuts.
- L. Install pathways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
- M. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to conduit assembly to assure a continuous ground path.
- N. Cut conduit perpendicular to the length. For conduits of 2 inch trade size and larger, use roll cutter or a guide to ensure cut is straight and perpendicular to the length.
- O. Install pull wires in empty pathways. Use polypropylene or monofilament plastic line with not less than 200 pound tensile strength. Leave at least 12 inches of slack at each end of pull

wire. Cap underground pathways designated as spare above grade alongside pathways in use.

- P. Install pathway sealing fittings at accessible locations according to NFPA 70 and fill them with listed sealing compound. For concealed pathways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install pathway sealing fittings according to NFPA 70.
- Q. Install devices to seal pathway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all pathways at the following points:
 - 1. Where an underground service pathway enters a building or structure.
 - 2. Where otherwise required by NFPA 70.
- R. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.
- S. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surface to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.
- T. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.
- U. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
- V. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

3.3 FIRESTOPPING

- A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078400 "Firestopping."

3.4 PROTECTION

- A. Protect coatings, finishes, and cabinets from damage and deterioration.
 - 1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION

SECTION 28 3111
DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Nonsystem smoke detectors.
 - 2. Magnetic door holders.

1.2 DEFINITIONS

- A. LED: Light-emitting diode.
- B. NICET: National Institute for Certification in Engineering Technologies.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For qualified Installer.
- B. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- D. NFPA Certification: Obtain certification according to NFPA 72 by an NRTL.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Bosch Security Systems.
 - 2. GE Infrastructure; a unit of General Electric Company.
 - 3. NOTIFIER; a Honeywell company.
 - 4. Siemens Building Technologies, Inc.; Fire Safety Division.
 - 5. SimplexGrinnell LP; a Tyco International company.
 - 6. Or Engineer Approved Equal

2.2 NONSYSTEM SMOKE DETECTORS

A. Single-Station Smoke Detectors:

1. Comply with UL 217; suitable for NFPA 101, residential occupancies; operating at 120-V ac.
2. Auxiliary Relays: One Form C rated at 0.5 A.
3. Audible Notification Appliance: Piezoelectric sounder rated at 90 dBA at 10 feet according to UL 464.
4. Test Switch: Push to test; simulates smoke at rated obscuration.
5. Plug-in Arrangement: Detector and associated electronic components shall be mounted in a plug-in module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
6. Self-Restoring: Detectors shall not require resetting or readjustment after actuation to restore them to normal operation.
7. Integral Visual-Indicating Light: LED type indicating detector has operated.

B. Single-Station Duct Smoke Detectors:

1. Comply with UL 268A; operating at 120-V ac.
2. Sensor: LED or infrared light source with matching silicon-cell receiver.
3. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. The fixed base shall be designed for mounting directly to air duct. Provide terminals in the fixed base for connection to building wiring.
4. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
5. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.3 MAGNETIC DOOR HOLDERS

A. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.

1. Electromagnet: Requires no more than 3 W to develop 25 pound holding force.
2. Wall-Mounted Units: Flush mounted unless otherwise indicated.
3. Rating: 120-V ac.

B. Material and Finish: Match door hardware.

2.4 DEVICE GUARDS

A. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.

1. Factory fabricated and furnished by manufacturer of device.
2. Finish: Paint of color to match the protected device.

PART 3 EXECUTION

3.1 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72 for installation of fire-alarm equipment.
- B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches above the finished floor.
- C. Smoke- or Heat-Detector Spacing:
 - 1. Comply with NFPA 72, "Smoke-Sensing Fire Detectors" Section in the "Initiating Devices" Chapter, for smoke-detector spacing.
 - 2. HVAC: Locate detectors not closer than 3 feet from air-supply diffuser or return-air opening.
 - 3. Lighting Fixtures: Locate detectors not closer than 12 inches from any part of a lighting fixture.
- D. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

3.2 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware."
 - 1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

3.3 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.4 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by authorities having jurisdiction.
- B. Tests and Inspections:
 - 1. Visual Inspection: Conduct visual inspection prior to testing.
 - a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
 - 2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
 - 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 - 4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 - 5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems"

Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

- C. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
- D. Fire-alarm system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.

END OF SECTION

**SECTION 31 6615
MICRO PILES**

PART 2 PRODUCTS

1.1 MICRO PILES

- A. Piers shall be hot-dipped galvanized per ASTM A153.
- B. Pier lead sections shall have shaft sections of hot-rolled round-cornered-square solid steel bars meeting the requirements of ASTM A29 or structural steel tube or pipe, seamless or straight seam welded meeting the requirements of ASTM A53, A252, A500, A513 or A618.
 - 1. Torque strength rating = as required by design.
 - 2. Minimum yield strength = as required by design
- C. Pier helix sections shall be hot-rolled low alloy steel sheet, strip or plate meeting the requirements of ASTM A572, A656, or A1018 Grade 50. Minimum plate thickness is 3/8 inch but shall meet design requirements.
- D. All coupling bolts shall conform to ASTM A320 Grade L7 or ASTM A325.
- E. Shaft, helix, and bolt sizes shall be as required by the approved design.

PART 3 EXECUTION

2.1 GENERAL

- A. Locate all below grade utilities, existing foundations, and pipes before starting pier installation.

2.2 INSTALLATION EQUIPMENT

- A. Shall be rotary type, hydraulic power driven torque motor with clockwise and counter-clockwise rotation capabilities. The torque motor shall be capable of continuous adjustment to revolutions per minute (RPM's) during installation. Percussion drilling equipment shall not be permitted. The torque motor shall have torque capacity 15% greater than the torsional strength rating of the central steel shaft to be installed.
- B. Equipment shall be capable of applying adequate down pressure (crowd) and torque simultaneously to suit project soil conditions and load requirements. The equipment shall be capable of continuous position adjustment to maintain proper Helical Pile alignment.

2.3 INSTALLATION TOOLING

- A. A torque indicator shall be used during Helical Pile installation. The torque indicator can be an integral part of the installation equipment or externally mounted in-line with the installation tooling.
 - 1. Shall be capable of providing continuous measurement of applied torque throughout the installation.
 - 2. Shall be capable of torque measurements in increments of at least 500 foot-pounds.
 - 3. Shall be calibrated prior to pre-production testing or start of work. Torque indicators which are an integral part of the installation equipment, shall be calibrated on-site. Torque indicators which are mounted in-line with the installation tooling, shall be calibrated either on-site or at an appropriately equipped test facility. Indicators that measure torque as a function of hydraulic pressure shall be calibrated at normal operating temperatures.

4. Shall be re-calibrated, if in the opinion of the Engineer and/or Contractor reasonable doubt exists as to the accuracy of the torque measurements.

2.4 INSTALLATION

- A. The Contractor is responsible for providing site access, stockpile areas, and removal of all obstructions, utilities, and the like prior to the micro pile Subcontractor's mobilization.
- B. Drilling shall be performed in such a manner as to prevent loss of ground beyond the specified diameter.
- C. Each pier shall be drilled to the approved embedment length in the bearing strata as dictated by the required pier capacity and the measured torque readings during installation.

2.5 TOLERANCES

- A. Drilled piers shall be installed as close as practicable to the plan locations shown on the Drawings. The maximum lateral deviation from the correct location at cut off elevation will be 1/2 inches. The maximum deviation from design cut off elevation will be 1 inch.
- B. Install all piers to no greater than 3% deviation from vertical.
- C. The Contractor shall make corrective measures as directed by the Design Professional, including installing additional piers and other modifications as required to correct for piers out of location or plumb, at no additional cost to the Contracting Authority.

2.6 TERMINATION CRITERIA

- A. The torque as measured during the installation shall not exceed the torsional strength rating of the central steel shaft.
- B. The minimum installation torque and minimum overall length criteria as shown on the working drawings shall be satisfied prior to terminating the Helical Pile installation.
- C. If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to achieving the minimum overall length required, the Contractor shall have the following options:
 1. Terminate the installation at the depth obtained subject to the review and acceptance of the Engineer, or:
 2. Remove the existing Helical Pile and install a new one with fewer and/or smaller diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Engineer. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least 3 feet beyond the terminating depth of the original Helical Pile.
- D. If the minimum installation torque as shown on the working drawings is not achieved at the minimum overall length, and there is no maximum length constraint, the Contractor shall have the following options:
 1. Install the Helical Pile deeper using additional extension sections, or:
 2. Remove the existing Helical Pile and install a new one with additional and/or larger diameter helix plates. The new helix configuration shall be subject to review and acceptance of the Engineer. If re-installing in the same location, the top-most helix of the new Helical Pile shall be terminated at least 3 feet beyond the terminating depth of the original Helical Pile.

3. De-rate the load capacity of the Helical Pile and install additional Helical Pile(s). The de-rated capacity and additional Helical Pile location shall be subject to the review and acceptance of the Engineer.
 - a. If the Helical Pile is refused or deflected by a subsurface obstruction, the installation shall be terminated and the pile removed. The obstruction shall be removed, if feasible, and the Helical Pile re-installed. If the obstruction can't be removed, the Helical Pile shall be installed at an adjacent location, subject to review and acceptance of the Engineer.
 - b. If the torsional strength rating of the central steel shaft and/or installation equipment has been reached prior to proper positioning of the last plain extension section relative to the final elevation, the Contractor may remove the last plain extension and replace it with a shorter length extension. If it is not feasible to remove the last plain extension, the Contractor may cut said extension shaft to the correct elevation. The Contractor shall not reverse (back-out) the Helical Pile to facilitate extension removal.
 - c. The average torque for the last three feet of penetration shall be used as the basis of comparison with the minimum installation torque as shown on the working drawings. The average torque shall be defined as the average of the last three readings recorded at 1 foot intervals.

2.7 QUALITY CONTROL INSPECTIONS

- A. Where torque measurements indicate capacities less than that required by design, the piers shall be installed deeper into the bearing strata or additional piers shall be installed at no additional cost to the Contracting Authority.

2.8 CLEANUP

- A. Remove from the site and dispose of all drilling washwater, cuttings, slurry, and waste material resulting from pier installation.

2.9 OBSTRUCTIONS

- A. If obstructions below 15 feet are encountered which cannot be drilled through, the Contractor shall notify the Design Professional and the pier will be relocated and the design revised as needed.

END OF SECTION

**SECTION 32 3113
CHAIN LINK FENCES AND GATES**

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fence framework, fabric, and accessories.

1.2 REFERENCE STANDARDS

- A. ASTM A392 - Standard Specifications for Zinc-Coated Steel Chain-Link Fence Fabric; 2011a.
- B. ASTM F567 - Standard Practice for Installation of Chain-Link Fence; 2011.
- C. ASTM F1083 - Standard Specifications for Pipe, Steel, Hot-Dipped Zinc-Coated (Galvanized) Welded, for Fence Structures; 2013.

1.3 SUBMITTALS

- A. Product Data: Provide data on fabric, posts, accessories, fittings and hardware.
- B. Manufacturer's Installation Instructions: Indicate installation requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Chain Link Fences and Gates:
 - 1. Master-Halco, Inc.: www.masterhalco.com.
 - 2. Merchants Metals: www.merchantsmetals.com.
 - 3. Ameristar: www.ameristarfence.com.
 - 4. Or approved equal.

2.2 MATERIALS

- A. Posts, Rails, and Frames: ASTM F1083 Schedule 40 hot-dipped galvanized steel pipe, welded construction, minimum yield strength of 30 ksi.
- B. Wire Fabric: ASTM A392 zinc coated steel chain link fabric.

2.3 COMPONENTS

- A. Line Posts: 1.9 inches diameter.
- B. Corner and Terminal Posts: 2.38 inches.
- C. Top and Brace Rail: 1.66 inches diameter, plain end, sleeve coupled.
- D. Fabric: 2 inches diamond mesh interwoven wire, 6 gage, 0.1620 inch thick, top selvage knuckle end closed, bottom selvage twisted tight.

2.4 ACCESSORIES

- A. Fittings: Sleeves, bands, clips, rail ends, tension bars, fasteners and fittings; steel.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install framework, fabric, accessories in accordance with ASTM F567.

3.2 TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch.

END OF SECTION