September 5, 2019 - ISSUE FOR BID

VOLUME 2

DIVISIONS 3 - 33 Specifications

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SIMON OSWALD ARCHITECTURE

Mechanical, Electrical, Plumbing & Fire Protection Engineers:
MCCLURE ENGINEERING

Structural Engineer:
KH ENGINEERING GROUP

Civil Engineer:
ENGINEERING SURVEYS & SERVICES, INC.
PROJECT MANUAL FOR: General Site - Primary Care Clinic North
Bid Package 2 - Building & Site Paving

PROJECT NUMBER: CP190411

AT:

UNIVERSITY OF MISSOURI - Columbia
Columbia, MISSOURI

FOR:

THE CURATORS OF THE UNIVERSITY OF MISSOURI

PREPARED BY:

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ISSUE FOR: BID

DATE: September 5, 2019
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CERTIFICATION PAGE

Project Title
General Site - Primary Care Clinic North
Bid Package 2 – Building & Site Paving
MU Project #CP190411
Columbia, Missouri

The following drawings and specifications have been prepared by me or under my direct supervision:

Drawings:
General Drawing Sheets G001 through G003
Architectural Drawing Sheets A201 through A901

Specifications:
Division 1 Specifications: all except as noted below
* Note: Divisions 1.B – 1.D by University
* Note: Divisions 1.E.8 and 1.E.9 by University
* Note: Division 1.J Geotech by ES&S
* Note: Divisions 1.E.7 & 01 9100 by CXE Group
* Note: Division 01 9119 by CXE Group/WJE
Division 4 Specifications: 04 2113 & 04 2200
Division 5 Specifications: 05 4523 – 05 5213
Division 6 Specifications: 06 1053 – 06 6200
Division 7 Specifications: 07 2100 – 07 9200
Division 8 Specifications: 08 1113 – 08 9119
Division 9 Specifications: 09 2216 – 09 9123
Division 10 Specifications: 10 1419 – 10 5300
Division 11 Specification: 11 5126
Division 12 Specifications: 12 2413 – 12 9300
Division 13 Specification: 13 4900

Name and license: William H. Oswald - MO #A-5419

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The following drawings and specifications have been prepared by me or under my direct supervision:

**Drawings:**
- S001 GENERAL NOTES
- S002 CONCRETE TYPICAL DETAILS
- S003 STRUCTURAL STEEL TYPICAL DETAILS
- S004 METAL STUDS TYPICAL DETAILS
- S100 FOUNDATION PLAN
- S101 ROOF FRAMING PLAN
- S102 ENTRY CANOPY PLANS & DETAILS
- S103 TRASH ENCLOSURE AND PATIO PLANS & DETAILS
- S300 BRACE FRAME ELEVATIONS
- S301 BRACE FRAME ELEVATIONS
- S500 SECTIONS & DETAILS
- S501 SECTIONS & DETAILS
- S502 SECTIONS & DETAILS

**Specifications:**
- 03 3000 Cast-In-Place Concrete
- 05 1200 Structural Steel Framing
- 05 2100 Steel Joist Framing
- 05 3100 Steel Decking
- 05 4000 Cold-Formed Metal Framing

**Other Documents:**
- Structural Engineering Calculations

Name and license: Kathy J. Hagen - MO PE-2000155328

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Project Title: General Site - Primary Care Clinic North
Bid Package 2 – Building & Site Paving
MU Project #CP190411
Columbia, Missouri

The following drawings and specifications have been prepared by me or under my direct supervision:

**Drawings:**

FP101  FLOOR FIRE PROTECTION

**Specifications:**

Division 20 Specifications: 20 0000 – 20 2530
Division 21 Specifications: 21 0000 – 21 0030

Name and license: Eric Reuther, PE-2011015792

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Drawings:
P100   PLUMBING FOUNDATION PLAN
P101   PLUMBING FLOOR PLAN
P102   ROOF PLUMBING PLAN
P200   PLUMBING WASTE AND VENT RISER
P201   PLUMBING DOMESTIC WATER RISER
P300   PLUMBING SCHEDULES

Specifications:
22 0000  Plumbing Work
22 2000  Plumbing Piping Systems
22 3000  Drains and Cleanouts
22 4000  Plumbing Fixtures
22 6000  Plumbing Equipment
22 8000  Plumbing Specialties

Name and license: Eric Reuther, PE-2011015792
The following drawings and specifications have been prepared by me or under my direct supervision:

**Drawings:**

Mechanical Drawing Sheets M100 through M903

**Specifications:**

Division 23 Specifications: 23 0000 – 23 8200
*Note: Division 23 0800 by CXE Group*
Division 24 Specifications: 24 0000 – 24 4100
Division 25 Specifications: 25 0000

Name and license: Eric Reuther, PE-2011015792

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**Drawings:**

Electrical Drawing Sheets E001 through E702

**Specifications:**

Division 26 Specifications: 26 0000 – 26 5200  
   * Note: Division 26 0800 by CXE Group  
Division 27 Specifications: 27 0000 – 27 5119  
Division 28 Specifications: 28 0000 – 28 3000

Name and license: Austin P. Strieker - MO #PE-2014032649

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The following drawings and specifications have been prepared by me or under my direct supervision:

**Drawings:**
- C0.01 SITE PLAN
- C0.02 GENERAL NOTES
- C1.01 SITE PLAN
- C2.01 - C2.03 GRADING & DRAINAGE PLAN
- C3.01 UTILITY PLAN
- C4.01 EROSION CONTROL PLAN
- C5.01 - C5.03 SITE DETAILS
- C6.01 EROSION CONTROL DETAILS
- L1.01 LANDSCAPE PLAN
- L1.02 LANDSCAPE DETAILS

**Specifications:**
- 31 2000 Earth Moving
- 32 1216 Asphalt Paving
- 32 1313 Concrete Paving
- 32 1316 Decorative Concrete Paving
- 32 1373 Concrete Paving Joint Sealants
- 32 1380 Pavement Markings
- 32 8400 Irrigation
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- 32 9300 Landscape Plants
- 33 0543 Underground Utilities
- 33 4100 Storm Utility Drainage Piping

**APPENDICES**
- 32 9200A Hydraulic Mulch for Hydroseed

**Other Documents:**
- Storm Water Pollution Prevention Plan

Name and license: Zachary Karis Thomas - MO #PE-2004017256

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PART 1 - GENERAL

1.1 SUMMARY
A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

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

B. W/C Ratio: The ratio by weight of water to cementitious materials.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.

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.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, 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 Architect.

1.4 INFORMATIONAL SUBMITTALS
A. 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. Curing compounds.
7. Adhesives.
8. Vapor retarders.

B. Material Test Reports: For the following, from a qualified testing agency:
1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

C. Minutes of preinstallation conference.

1.5 FIELD CONDITIONS

A. 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 deg F for three 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.

B. Hot-Weather Placement: Comply with ACI 301 and as follows:

1. Maintain concrete temperature below 90 deg 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.

PART 2 - PRODUCTS

2.1 CONCRETE, GENERAL

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

1. ACI 301.

2. ACI 117.

2.2 FORM-FACING MATERIALS

A. Smooth-Formed Finished Concrete: Form-facing panels that 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.

   a. Structural 1, B-B or better; mill oiled, and edge sealed.

B. Reinforcing Bars: ASTM A 615/A 615M, Grade 60, deformed.

C. Plain-Steel Wire: ASTM A 1064/A 1064M, as drawn.

D. Deformed-Steel Wire: ASTM A 1064/A 1064M.
E. Plain-Steel Welded-Wire Reinforcement: ASTM A 1064/A 1064M, plain, fabricated from as-drawn steel wire into flat sheets.


2.3 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60, plain-steel bars, cut true to length with ends square and free of burrs.

B. 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.

2.4 CONCRETE MATERIALS

A. 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.

B. Cementitious Materials:

2. Fly Ash: ASTM C 618, Class F or C.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, 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.

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

D. Air-Entraining Admixture: ASTM C 260/C 260M.

E. Chemical Admixtures: Certified by manufacturer to be compatible with other admixtures and that do not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.

F. Water: ASTM C 94/C 94M.
2.5 **VAPOR RETARDERS**

A. Sheet Vapor Retarder: ASTM E 1745, Class C, except with maximum water-vapor permeance of 0.3 perms. Include manufacturer's recommended adhesive or pressure-sensitive joint tape.

2.6 **CURING MATERIALS**

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

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

D. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

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

      a. *<Insert manufacturer's name; product name or designation>*

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, 18 to 25 percent solids, nondissipating, certified by curing compound manufacturer to not interfere with bonding of floor covering.

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

      a. *<Insert manufacturer's name; product name or designation>*

F. Clear, Waterborne, Membrane-Forming Curing and Sealing Compound: ASTM C 1315, Type 1, Class A.

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

      a. *<Insert manufacturer's name; product name or designation>*

2.7 **RELATED MATERIALS**


B. Bonding Agent: ASTM C 1059/C 1059M, Type II, nonredispersible, 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 I and II, nonload bearing, for bonding hardened or freshly mixed concrete to hardened concrete.
2.8 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: 15 percent.
   2. Silica Fume: 10 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.30 percent by weight of cement.

D. Admixtures: Use admixtures according to manufacturer's written instructions.

   1. Use water-reducing, high-range water-reducing, or plasticizing admixture in concrete, as required, for placement and workability.
   2. Use water-reducing and retardating admixture when required by high temperatures, low humidity, or other adverse placement conditions.
   3. Use water-reducing admixture in pumped concrete and concrete with a w/c ratio below 0.50.

2.9 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings and Grade beams: Normal-weight concrete.

   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Maximum W/C Ratio: 0.5.
   3. Slump Limit: 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.

B. Slabs-on-Grade and Elevated Concrete on Metal Deck - Interior: Normal-weight concrete.

   1. Minimum Compressive Strength: 4000 psi at 28 days.
   2. Maximum W/C Ratio: 0.45.
   3. Slump Limit: 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
   4. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

C. Exterior Concrete: Normal-weight concrete.

   1. Minimum Compressive Strength: 4500 psi at 28 days.
   2. Maximum W/C Ratio: 0.45.
   3. Slump Limit: 8 inches for concrete with verified slump of 2 to 4 inches before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch.
   4. Air Content: Insert number percent, plus or minus 1.5 percent at point of delivery for 3/4-inch nominal maximum aggregate size.

2.10 FABRICATING REINFORCEMENT

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."
2.11 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F, reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 - EXECUTION

3.1 FORMWORK INSTALLATION

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:

2. Class C, 1/2 inch for rough-formed finished surfaces.

D. Construct forms tight enough to prevent loss of concrete mortar.

E. Construct 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. Form openings, chases, offsets, sinkages, keyways, reglets, blocking, screeds, and bulkheads required in the Work. Determine sizes and locations from trades providing such items.

I. Clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, and other debris just before placing concrete.

J. Retighten forms and bracing before placing concrete, as required, to prevent mortar leaks and maintain proper alignment.

K. Coat contact surfaces of forms with form-release agent, according to manufacturer’s written instructions, before placing reinforcement.
3.2 EMBEDDED ITEM INSTALLATION

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 303.

3.3 VAPOR-RETARDER INSTALLATION

A. Sheet Vapor Retarders: Place, protect, and repair sheet vapor retarder according to ASTM E 1643 and manufacturer's written instructions.

1. Lap joints 6 inches and seal with manufacturer's recommended tape.
2. Seal all edges of vapor retarder at penetrations

B. Bituminous Vapor Retarders: Place, protect, and repair bituminous vapor retarder according to manufacturer's written instructions.

3.4 STEEL REINFORCEMENT INSTALLATION

A. General: Comply with CRSI's "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

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

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.

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 Architect.

1. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
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 one-fourth 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 does 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. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

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

3.6 CONCRETE PLACEMENT

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections are completed.

B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.

1. Do not add water to concrete after adding high-range water-reducing admixtures to mixture.

C. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. 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 not to 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.
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.

3.7 FINISHING FORMED SURFACES

A. 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, or to be covered with a coating or covering material applied directly to concrete.

B. 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.

3.8 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Scratch Finish: While still plastic, texture concrete surface that has been screeded and bull-floated or darbied. Use stiff brushes, brooms, or rakes to produce a profile amplitude of 1/4 inch in one direction.

1. Apply scratch finish to surfaces, to receive concrete floor toppings, to receive mortar setting beds for bonded cementitious floor finishes, and as indicated.

C. 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 restraightening until surface is left with a uniform, smooth, granular texture.

1. Apply float finish to surfaces, to receive trowel finish, to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo, and as indicated.

D. 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, to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system, and as indicated.

2. Finish surfaces to the following tolerances, according to ASTM E 1155; for a randomly trafficked floor surface:

   a. Specified overall values of flatness, \( F(F) \) 35; and of levelness, \( F(L) \) 25; with minimum local values of flatness, \( F(F) \) 24; and of levelness, \( F(L) \) 17; for slabs-on-grade.
E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces as indicated and where ceramic or quarry tile is to be installed by either thickset or thinset method. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

F. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and 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 Architect before application.

3.9 MISCELLANEOUS CONCRETE ITEM INSTALLATION

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 or unless required for seismic anchor support.
3. Minimum Compressive Strength: 4000 psi at 28 days.
4. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
5. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.10 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 lb/sq. ft. x h 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 remainder of 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 seven 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-inch lap over adjacent absorbive 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.
   a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
   b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
   c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies does not interfere with bonding of floor covering used on Project.

3.11 MOISTURE VAPOR EMISSIONS AND ALKALINITY CONTROL SEALER

A. Sealer is applied on the day of the concrete pour or as soon as harsh weather permits, prior to any other chemical treatments for concrete slabs either on grade, below grade, or above grade receiving resilient flooring, such as sheet vinyl, vinyl composite tile, rubber, carpet, tile, etc.

B. Manufacturer’s representative will be on the site the day of concrete pour to install or train its application and document. He/She shall return on every application thereafter to verify that the proper procedures are followed:
   1. Apply Sealer to concrete slabs as soon as final finishing operations are complete and the concrete has hardened sufficiently to sustain floor traffic without damage.
   2. Spray apply Sealer at the rate of 200 square feet per gallon. Lightly broom product evenly over the substrate and product has completely penetrated the surface.
   3. If within two (2) hours after initial application areas are subjected to heavy rainfall and puddling occurs, reapply sealer product to these areas as soon as possible as weather conditional permits.

3.12 FIELD QUALITY CONTROL

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

B. Inspections:
   1. Steel reinforcement placement.
   2. Headed bolts and studs.
   3. Verification of use of required design mixture.
   4. Concrete placement, including conveying and depositing.
   5. Curing procedures and maintenance of curing temperature.
   6. Verification of concrete strength before removal of shores and forms from beams and slabs.
C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172/C 172M shall be performed according to the following requirements:

1. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. or fraction thereof of each concrete mixture placed each day.
   a. When frequency of testing provides fewer than five compressive-strength tests for each concrete mixture, testing shall be conducted from at least five randomly selected batches or from each batch if fewer than five are used.

2. Slump: ASTM C 143/C 143M; 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/C 231M, 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 C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below or 80 deg F and above, and one test for each composite sample.

5. Compression Test Specimens: ASTM C 31/C 31M.
   a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

6. Compressive-Strength Tests: ASTM C 39/C 39M; test one laboratory-cured specimen at 7 days and two specimens at 28 days and one at 56 days.

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 Architect, 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 Architect 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 Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect.

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 E 1155 within 24 hours of finishing.

END OF SECTION 03 3000
SECTION 04 2113 - BRICK MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Face brick.
2. Mortar and grout.
3. Ties and anchors.
4. Embedded flashing.
5. Miscellaneous masonry accessories.

B. Related Sections:

1. Section 05 5000 "Metal Fabrications" for furnishing steel lintels for brick masonry.

1.3 ACTION SUBMITTALS

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

B. Samples for Initial Selection:

1. Face brick, in the form of straps of five or more bricks.
2. Weep holes/vents.

1.4 INFORMATIONAL SUBMITTALS

A. List of Materials Used in Constructing Mockups: List generic product names together with manufacturers, manufacturers’ product names, model numbers, lot numbers, batch numbers, source of supply, and other information as required to identify materials used. Include mix proportions for mortar and grout and source of aggregates.

1. Submittal is for information only. Neither receipt of list nor approval of mockup constitutes approval of deviations from the Contract Documents unless such deviations are specifically brought to the attention of Architect and approved in writing.

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

1. Masonry units.
   a. Include material test reports substantiating compliance with requirements.
   b. For brick, include size-variation data verifying that actual range of sizes falls within specified tolerances.
   c. For exposed brick, include test report for efflorescence according to ASTM C 67.
d. Provide product technical data and test reports.

2. Cementitious materials. Include brand, type, and name of manufacturer.
3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
4. Grout mixes. Include description of type and proportions of ingredients.
5. Anchors, ties, and metal accessories.

C. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.5 QUALITY ASSURANCE

A. Source Limitations for Masonry Units: Obtain exposed masonry units of a uniform texture and color, or a uniform blend within the ranges accepted for these characteristics, from single source from single manufacturer for each product required.

B. Source Limitations for Mortar Materials: Obtain mortar ingredients of a uniform quality, including color for exposed masonry, from single manufacturer for each cementitious component and from single source or producer for each aggregate.

C. Masonry Standard: Comply with ACI 530.1/ASCE 6/TMS 402/602 unless modified by requirements in the Contract Documents.

D. Sample Panels: Build sample panels to verify selections made under sample submittals and to demonstrate aesthetic effects. Comply with requirements in Section 01 4000 "Quality Requirements" for mockups.

1. Build sample panels for each type of exposed unit masonry construction in sizes approximately 48 inches long by 48 inches high by full thickness.
2. Where masonry is to match existing, erect panels adjacent and parallel to existing surface.
3. Clean exposed faces of panels with masonry cleaner indicated.
4. Protect approved sample panels from the elements with weather-resistant membrane.
5. Approval of sample panels is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; aesthetic qualities of workmanship; and other material and construction qualities specifically approved by Architect in writing.

a. Approval of sample panels does not constitute approval of deviations from the Contract Documents contained in sample panels unless such deviations are specifically approved by Architect in writing.

E. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build in place mock-up on building as directed by owners representative and Architect and as follows:

a. Include a sealant-filled joint at least 16 inches long in mockup.
b. Include lower corner of window opening at upper corner of exterior wall mockup. Make opening approximately 12 inches wide by 16 inches high.
c. Include through-wall flashing installed for a 24-inch length in corner of exterior wall mockup approximately 16 inches down from top of mockup, with a 12-inch length of flashing left exposed to view (omit masonry above half of flashing).
d. Include metal studs, sheathing, air barrier, veneer anchors, flashing, cavity drainage material, and weep holes in mockup.
2. Clean exposed faces of mockups with masonry cleaner as indicated.
3. Protect accepted mockups from the elements with weather-resistant membrane.
4. Approval of mockups is for color, texture, and blending of masonry units; relationship of mortar and sealant colors to masonry unit colors; tooling of joints; and aesthetic qualities of workmanship.
   a. Approval of mockups is also for other material and construction qualities specifically approved by Architect in writing.
   b. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless such deviations are specifically approved by Architect in writing.
5. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

C. Store aggregates where grading and other required characteristics can be maintained, and contamination avoided.

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.

1.7 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day’s work. Cover partially completed masonry when construction is not in progress.
   1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.
   1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
   2. Protect sills, ledges, and projections from mortar droppings.
   3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
   4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.
C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than seven days after completing cleaning.


PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

2.2 BRICK

A. General: Provide shapes indicated and as follows, with exposed surfaces matching finish and color of exposed faces of adjacent units.

1. For ends of sills and caps and for similar applications that would otherwise expose unfinished brick surfaces, provide units without cores or frogs and with exposed surfaces finished.

B. Face Brick: Facing brick complying with ASTM C 216.

1. Products: Subject to compliance with requirements, provide units indicated in Appendix B “Exterior Finish Key” for manufacturer and color/texture.

   a. Grade: SW.
   b. Type: FBX
   c. Initial Rate of Absorption: Less than 30 g/30 sq. in. per minute when tested per ASTM C 67.
   d. Efflorescence: Provide brick that has been tested according to ASTM C 67 and is rated “not effloresced.”
   f. Compressive strength: 13,000 psi minimum
   g. Application: Use where brick is exposed unless otherwise indicated.
   h. Color and Texture: Refer to Appendix B “Exterior Finish Key” for manufacturer, color and texture.
   i. Units shall not have coatings or clear water repellants

2.3 MORTAR MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.
B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Aggregate for Mortar: ASTM C 144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

E. Water: Clean Potable water

F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

2.4 TIES AND ANCHORS

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated:

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

C. Adjustable Masonry-Veneer Anchors:
   1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
      a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
   2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) Heckmann Building Products, Inc; Pos-I-Tie.
         2) Wire-Bond; SureTie.
         3) Rodenhouse
      b. Anchor Section: Corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed, washer head that covers hole in sheathing and Rodenhouse 2" diameter Thermal-Grip Brick Tie washer.
      c. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch- diameter, hot-dip galvanized steel wire.
   3. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except
manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads.

2.5 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing: Use the following unless otherwise indicated:

1. Self-adhering stainless-steel Flashing: 2 mil stainless steel bonded with 8 mil butyl backing. Use only where flashing is fully concealed in masonry.
   a. Products: Subject to compliance with requirements, provide one of the following:
      1) Hohmann & Barnard, Inc.;
      2) Sandell Manufacturing Co., Inc.
      3) York Manufacturing, Inc.; 304, Self-Adhering stainless steel.

b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

2. Metal Drip Edge: Fabricate from stainless steel. Extend at least 5 1/2 inches into wall with ½-inch turn up on face of sheathing and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

B. Application: Unless otherwise indicated, use the following:

1. Where flashing is indicated to receive counter flashing, use metal flashing.
2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing or flexible flashing with a metal drip edge.
4. Where flashing is fully concealed, use flexible flashing.
   a. Provide support at airspace with stainless steel sheet.

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

2.6 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.

B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

C. Weep/Vent Products: Use one of the following unless otherwise indicated:

1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Advanced Building Products Inc; Mortar Break II.
   b. CavClear/Archovations, Inc; Stone Mat.
   c. Dur-O-Wal; a Hohmann & Barnard company; Polytite MortarStop.
   d. Mortar Net Solutions; Mortar Net.

2. Provide one of the following configurations:
   a. Strips, full depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.
   b. Sheets or strips full depth of cavity and installed to full height of cavity.
   c. Sheets or strips not less than 3/4 inch thick and installed to full height of cavity with additional strips 4 inches high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from clogging with mortar.

2.7 MASONRY CLEANERS

A. Mild detergent cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry or adjoining surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Masonry contractor shall clean as the work progresses and use a product that does not contain Hydrochloric acid, Hydrofluoric acid or ammonium bi-fluoride.

2.8 MORTAR MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar.
2. Use portland cement-lime or mortar cement mortar unless otherwise indicated.
3. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide Type N unless another type is indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
1. Examine insulation face for continuity and notify installing contractor for repair prior to installing masonry.

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

3.2 INSTALLATION, GENERAL

A. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

B. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

C. Select and arrange units for exposed unit masonry to produce a uniform blend of colors and textures.

1. Mix units from several pallets or cubes as they are placed.

D. Matching Existing Masonry: Match coursing, bonding, color, and texture of existing masonry.

E. Wetting of Brick: Wet brick before laying if initial rate of absorption exceeds 30 g/30 sq. in. per minute when tested per ASTM C 67. Allow units to absorb water so they are damp but not wet at time of laying.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:

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

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
6. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.
7. For faces of adjacent exposed masonry units, do not vary from flush alignment by more than 1/16 inch except due to warpage of masonry units within tolerances specified for warpage of units.
C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, with a maximum thickness limited to 1/2 inch; do not vary from bed-joint thickness of adjacent courses by more than 1/8 inch.

2. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch, do not vary from adjacent bed-joint and head-joint thicknesses by more than 1/8 inch.

3. For exposed bed joints and head joints of stacked bond, do not vary from a straight line by more than 1/16 inch from one masonry unit to the next.

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar, remove loose masonry units and mortar, and wet brick if required before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay solid masonry units with completely filled bed and head joints; butter ends with sufficient mortar to fill head joints and shove into place. Do not deeply furrow bed joints or slush head joints.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:

1. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.

2. Locate anchor sections to allow maximum vertical differential movement of ties up and down.

   a. Locate anchors in the mid-section of joint with ¾ inches minimum and 1 ¾ inches maximum cover from exterior face of veneer.
3. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.

4. If screw misses steel studs the resulting hole is to be filled with polyurethane spray foam and sealed with liquid armor (same material as weather barrier).

3.7 EXPANSION JOINTS

A. General: Install expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints in brick as follows:

1. Build in compressible joint fillers where indicated.
2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 07 9200 "Joint Sealants."

C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 9200 "Joint Sealants," but not less than 3/8 inch.

D. Provide vertical expansion joints at locations shown on drawings. Horizontal expansion joints to be installed at top of wall.

3.8 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.9 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:

1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
2. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches above top of mortar net, with upper edge tucked under termination bar and sealed tight with sealant and Liquid armor weather barrier.
3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
4. Install stainless steel pan flashing with drip edge and soldered end dams and membrane flashing. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of pan flashing.
5. At spliced joints of stainless-steel pan flashing overlap pans and seal with elastomeric sealant.

C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:

1. Use specified weep/vent products to form weep holes.
2. Space weep holes 24 inches o.c. unless otherwise indicated.

D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in "Miscellaneous Masonry Accessories" Article.

E. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.

1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.10 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to meet specifications requirements shall be done at contractor’s expense.

B. Inspections: Level 1 special inspections according to the International Building Code, 2018.

1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

C. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provide, according tp ASTM C 780.

3.11 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:

1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
2. Test cleaning methods on sample wall panel; leave one-half of panel uncleanned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
5. Clean masonry with a proprietary acidic cleaner applied according to manufacturer's written instructions.
6. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.12 MASONRY WASTE DISPOSAL

A. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 2113
SECTION 04 2200 - CONCRETE UNIT MASONRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Concrete masonry units.
   2. Decorative concrete masonry units.
   3. Mortar and grout.
   4. Steel reinforcing bars.
   5. Masonry joint reinforcement.
   6. Ties and anchors.
   7. Miscellaneous masonry accessories.

1.3 DEFINITIONS

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

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

1.4 PERFORMANCE REQUIREMENTS

A. Provide structural unit masonry that develops indicated net-area compressive strengths at 28 days.

   1. Determine net-area compressive strength of masonry from average net-area compressive strengths of masonry units and mortar types (unit-strength method) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

   2. Determine net-area compressive strength of masonry by testing masonry prisms according to ASTM C 1314.

1.5 ACTION SUBMITTALS

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

B. Shop Drawings: For the following:

   1. Masonry Units: Show sizes, profiles, coursing, and locations of special shapes.

   2. Reinforcing Steel: Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, “Details and Detailing of Concrete Reinforcement.”

C. Samples for Initial Selection:
1. Decorative CMUs, in the form of small-scale units.
2. Weep holes/vents.

D. Samples for Verification: For each type and color of the following:
   1. Decorative CMUs.

1.6 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of the following:
   1. Masonry units.
      a. Include material test reports substantiating compliance with requirements.
   2. Cementitious materials. Include brand, type, and name of manufacturer.
   3. Preblended, dry mortar mixes. Include description of type and proportions of ingredients.
   4. Grout mixes. Include description of type and proportions of ingredients.
   5. Reinforcing bars.
   7. Anchors, ties, and metal accessories.

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

C. Statement of Compressive Strength of Masonry: For each combination of masonry unit type and mortar type, provide statement of average net-area compressive strength of masonry units, mortar type, and resulting net-area compressive strength of masonry determined according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602.

D. Cold-Weather and Hot-Weather Procedures: Detailed description of methods, materials, and equipment to be used to comply with requirements.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store masonry units on elevated platforms in a dry location. If units are not stored in an enclosed location, cover tops and sides of stacks with waterproof sheeting, securely tied. If units become wet, do not install until they are dry.

B. Store cementitious materials on elevated platforms, under cover, and in a dry location. Do not use cementitious materials that have become damp.

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

D. Deliver preblended, dry mortar mix in moisture-resistant containers designed for use with dispensing silos. Store preblended, dry mortar mix in delivery containers on elevated platforms, under cover, and in a dry location or in covered weatherproof dispensing silos.

E. Store masonry accessories, including metal items, to prevent corrosion and accumulation of dirt and oil.
1.8 PROJECT CONDITIONS

A. Protection of Masonry: During construction, cover tops of walls, projections, and sills with waterproof sheeting at end of each day's work. Cover partially completed masonry when construction is not in progress.

1. Extend cover a minimum of 24 inches down both sides of walls and hold cover securely in place.

B. Stain Prevention: Prevent grout, mortar, and soil from staining the face of masonry to be left exposed or painted. Immediately remove grout, mortar, and soil that come in contact with such masonry.

1. Protect base of walls from rain-splashed mud and from mortar splatter by spreading coverings on ground and over wall surface.
2. Protect sills, ledges, and projections from mortar droppings.
3. Protect surfaces of window and door frames, as well as similar products with painted and integral finishes, from mortar droppings.
4. Turn scaffold boards near the wall on edge at the end of each day to prevent rain from splashing mortar and dirt onto completed masonry.

C. Cold-Weather Requirements: Do not use frozen materials or materials mixed or coated with ice or frost. Do not build on frozen substrates. Remove and replace unit masonry damaged by frost or by freezing conditions. Comply with cold-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

1. Cold-Weather Cleaning: Use liquid cleaning methods only when air temperature is 40 deg F and higher and will remain so until masonry has dried, but not less than 7 days after completing cleaning.


PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

A. Defective Units: Referenced masonry unit standards may allow a certain percentage of units to contain chips, cracks, or other defects exceeding limits stated in the standard. Do not use units where such defects will be exposed in the completed Work.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and as follows, with exposed surfaces matching exposed faces of adjacent units unless otherwise indicated.

1. Provide square-edged units for outside corners unless otherwise indicated.

B. Integral Water Repellent: Provide units made with integral water repellent for exposed units.

1. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested according to ASTM E 514 as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive, with test period extended to 24 hours, shall show no visible water or leaks on the back of test specimen.
C. CMUs: ASTM C 90.
   1. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
   2. Density Classification: Normal weight.
   3. Size (Width): Manufactured to dimensions 3/8 inch less than nominal dimensions.

D. Decorative CMUs: ASTM C 90.
   1. **Products:** Subject to compliance with requirements, provide the following:
      a. Refer to Appendix B “Exterior Finish Key” for manufacturer, color and style
   2. Unit Compressive Strength: Provide units with minimum average net-area compressive strength of 2800 psi.
   3. Density Classification: Normal weight.
   4. Size (Width): Manufactured to dimensions specified in “CMUs” Paragraph.
   5. Pattern and Texture:
      a. Standard pattern, ground-face finish. Refer to Appendix B “Exterior Finish Key”.
      b. Standard pattern, split-face finish. Refer to Appendix B “Exterior Finish Key”.
   7. Special Aggregate: Provide units made with aggregate matching aggregate in Architect's sample.

2.3 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II, except Type III may be used for cold-weather construction. Provide natural color or white cement as required to produce mortar color indicated.

B. Hydrated Lime: ASTM C 207, Type S.

C. Portland Cement-Lime Mix: Packaged blend of portland cement and hydrated lime containing no other ingredients.

D. Aggregate for Mortar: ASTM C 144.
   1. For mortar that is exposed to view, use washed aggregate consisting of natural sand or crushed stone.

E. Aggregate for Grout: ASTM C 404.

F. Cold-Weather Admixture: Nonchloride, noncorrosive, accelerating admixture complying with ASTM C 494/C 494M, Type C, and recommended by manufacturer for use in masonry mortar of composition indicated.

G. Water-Repellent Admixture: Liquid water-repellent mortar admixture intended for use with CMUs, containing integral water repellent by same manufacturer.

H. Water: Potable.
2.4 **REINFORCEMENT**

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60.

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.
   1. Exterior Walls: Hotdip galvanized, carbon steel.
   2. Wire Size for Side Rods: 0.187-inch diameter.
   5. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
   6. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

C. Masonry-Joint Reinforcement for Multiwythe Masonry:
   1. Adjustable (two-piece) type, either ladder or truss design, with one side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum horizontal play of 1/16 inch and maximum vertical adjustment of 1-1/4 inches. Size ties to extend at least halfway through facing wythe but with at least 5/8-inch cover on outside face. Ties have hooks or clips to engage a continuous horizontal wire in the facing wythe.

2.5 **TIES AND ANCHORS**

A. Materials: Provide ties and anchors specified in this article that are made from materials that comply with the following unless otherwise indicated.

B. Adjustable Masonry-Veneer Anchors:
   1. General: Provide anchors that allow vertical adjustment but resist tension and compression forces perpendicular to plane of wall, for attachment over sheathing to wood or metal studs, and as follows:
      a. Structural Performance Characteristics: Capable of withstanding a 100-lbf load in both tension and compression without deforming or developing play in excess of 0.05 inch.
   2. Screw-Attached, Masonry-Veneer Anchors: Units consisting of a wire tie and a metal anchor section.
      a. Products: Subject to compliance with requirements, provide one of the following:
         1) Heckmann Building Products, Inc; Pos-I-Tie.
         2) Wire-Bond; SureTie.
         3) Rodenhouse
      b. Anchor Section: Corrosion-resistant, self-drilling, eye-screw designed to receive wire tie. Eye-screw has spacer that seats directly against framing and is same thickness as sheathing and has gasketed, washer head that covers hole in sheathing and Rodenhouse 2" diameter Thermal-Grip Brick Tie washer.
      c. Wire Ties: Triangular-, rectangular-, or T-shaped wire ties fabricated from 0.187-inch-diameter, hot-dip galvanized steel wire.
3. Stainless-Steel Drill Screws for Steel Studs: Proprietary fastener consisting of carbon-steel drill point and 300 Series stainless-steel shank, complying with ASTM C 954 except manufactured with hex washer head and neoprene or EPDM washer, No. 10 diameter by length required to penetrate steel stud flange with not less than three exposed threads.

2.6 EMBEDDED FLASHING MATERIALS

A. Flexible Flashing: Use the following unless otherwise indicated:
   
   1. Self-adhering stainless-steel Flashing: 2 mil stainless steel bonded with 8 mil butyl backing. Use only where flashing is fully concealed in masonry.
      
      a. Products: Subject to compliance with requirements, provide one of the following:
         
         1) Hohmann & Barnard, Inc.;
         2) Sandell Manufacturing Co., Inc.
         3) York Manufacturing, Inc.; 304, Self-Adhering stainless steel.

   b. Accessories: Provide preformed corners, end dams, other special shapes, and seaming materials produced by flashing manufacturer.

2. Metal Drip Edge: Fabricate from stainless steel. Extend at least 3 inches into wall and 1/2 inch out from wall, with outer edge bent down 30 degrees and hemmed.

B. Application: Unless otherwise indicated, use the following:

   1. Where flashing is indicated to receive counterflashing, use metal flashing.
   2. Where flashing is indicated to be turned down at or beyond the wall face, use metal flashing.
   3. Where flashing is partly exposed and is indicated to terminate at the wall face, use metal flashing or flexible flashing with a metal drip edge.
   4. Where flashing is fully concealed, use flexible flashing.

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

2.7 MISCELLANEOUS MASONRY ACCESSORIES

A. Compressible Filler: Premolded filler strips complying with ASTM D 1056, Grade 2A1; compressible up to 35 percent; of width and thickness indicated; formulated from neoprene, urethane, or PVC.

B. Bond-Breaker Strips: Asphalt-saturated, organic roofing felt complying with ASTM D 226, Type I (No. 15 asphalt felt).

C. Weep/Vent Products: Use one of the following unless otherwise indicated:

   1. Cellular Plastic Weep/Vent: One-piece, flexible extrusion made from UV-resistant polypropylene copolymer, full height and width of head joint and depth 1/8 inch less than depth of outer wythe, in color selected from manufacturer's standard.
   2. Mesh Weep/Vent: Free-draining mesh; made from polyethylene strands, full height and width of head joint and depth 1/8 inch less than depth of outer wythe; in color selected from manufacturer's standard.
D. Cavity Drainage Material: Free-draining mesh, made from polymer strands that will not degrade within the wall cavity.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Advanced Building Products Inc; Mortar Break II.
   b. CavClear/Archovations, Inc; Stone Mat.
   c. Dur-O-Wal; a Hohmann & Barnard company; Polytite MortarStop.
   d. Mortar Net Solutions; Mortar Net.

2. Provide one of the following configurations:
   a. Strips, full depth of cavity and 10 inches high, with dovetail shaped notches 7 inches deep that prevent clogging with mortar droppings.
   b. Sheets or strips full depth of cavity and installed to full height of cavity.
   c. Sheets or strips not less than 3/4 inch thick and installed to full height of cavity with additional strips 4 inches high at weep holes and thick enough to fill entire depth of cavity and prevent weep holes from clogging with mortar.

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

2.8 MORTAR AND GROUT MIXES

A. General: Do not use admixtures, including pigments, air-entraining agents, accelerators, retarders, water-repellent agents, antifreeze compounds, or other admixtures unless otherwise indicated.

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime, masonry cement, or mortar cement mortar unless otherwise indicated.
3. For exterior masonry, use portland cement-lime, masonry cement, or mortar cement mortar.
4. For reinforced masonry, use portland cement-lime, masonry cement, or mortar cement mortar.
5. Add cold-weather admixture (if used) at same rate for all mortar that will be exposed to view, regardless of weather conditions, to ensure that mortar color is consistent.

B. Preblended, Dry Mortar Mix: Furnish dry mortar ingredients in form of a preblended mix. Measure quantities by weight to ensure accurate proportions, and thoroughly blend ingredients before delivering to Project site.

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification. Provide the following types of mortar for applications stated unless another type is indicated or needed to provide required compressive strength of masonry.

1. For masonry below grade or in contact with earth, use Type S.
2. For reinforced masonry, use Type N.
3. For exterior, above-grade, load-bearing and non-load-bearing walls and parapet walls; for interior load-bearing walls; for interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

D. Grout for Unit Masonry: Comply with ASTM C 476.
1. Use grout of type indicated or, if not otherwise indicated, of type (fine or coarse) that will comply with Table 1.15.1 in ACI 530.1/ASCE 6/TMS 602 for dimensions of grout spaces and pour height.

2. Proportion grout in accordance with ASTM C 476, Table 1 or paragraph 4.2.2 for specified 28-day compressive strength indicated, but not less than 2000 psi.

3. Provide grout with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

2.9 MASONRY CLEANERS

A. Mild detergent cleaner: Manufacturer's standard-strength cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry without discoloring or damaging masonry or adjoining surfaces. Use product expressly approved for intended use by cleaner manufacturer and manufacturer of masonry units being cleaned.

1. Masonry contractor shall clean as the work progresses and use a product that does not contain Hydrochloric acid, Hydrofluoric acid or ammonium bi-fluoride.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

2. Verify that foundations are within tolerances specified.

3. Verify that reinforcing dowels are properly placed.

4. Examine insulation face for continuity and notify installing contractor for repair prior to installing masonry.

B. Before installation, examine rough-in and built-in construction for piping systems to verify actual locations of piping connections.

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

3.2 INSTALLATION, GENERAL

A. Build chases and recesses to accommodate items specified in this and other Sections.

B. Leave openings for equipment to be installed before completing masonry. After installing equipment, complete masonry to match the construction immediately adjacent to opening.

C. Use full-size units without cutting if possible. If cutting is required to provide a continuous pattern or to fit adjoining construction, cut units with motor-driven saws; provide clean, sharp, unchipped edges. Allow units to dry before laying unless wetting of units is specified. Install cut units with cut surfaces and, where possible, cut edges concealed.

3.3 TOLERANCES

A. Dimensions and Locations of Elements:
1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch or minus 1/4 inch.
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch.
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch in a story height or 1/2-inch total.

B. Lines and Levels:

1. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
2. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
3. For conspicuous vertical lines, such as external corners, door jambs, reveals, and expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet, 1/4 inch in 20 feet, or 1/2 inch maximum.
4. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet, 3/8 inch in 20 feet, or 1/2 inch maximum.
5. For vertical alignment of exposed head joints, do not vary from plumb by more than 1/4 inch in 10 feet, or 1/2 inch maximum.

C. Joints:

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

3.4 LAYING MASONRY WALLS

A. Lay out walls in advance for accurate spacing of surface bond patterns with uniform joint thicknesses and for accurate location of openings, movement-type joints, returns, and offsets. Avoid using less-than-half-size units, particularly at corners, jambs, and, where possible, at other locations.

B. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch horizontal face dimensions at corners or jambs.

C. Stopping and Resuming Work: Stop work by racking back units in each course from those in course below; do not tooth. When resuming work, clean masonry surfaces that are to receive mortar before laying fresh masonry.

D. Built-in Work: As construction progresses, build in items specified in this and other Sections. Fill in solidly with masonry around built-in items.

E. Fill space between steel frames and masonry solidly with mortar unless otherwise indicated.

3.5 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:
1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in all courses of piers, columns, and pilasters.
3. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
4. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

B. Tool exposed joints slightly concave when thumbprint hard, using a jointer larger than joint thickness unless otherwise indicated.

3.6 MASONRY JOINT REINFORCEMENT

A. General: Install entire length of longitudinal side rods in mortar with a minimum cover of 5/8 inch on exterior side of walls, 1/2 inch elsewhere. Lap reinforcement a minimum of 6 inches.

1. Space reinforcement not more than 16 inches o.c.
2. Space reinforcement not more than 8 inches o.c. in foundation walls and parapet walls.

B. Interrupt joint reinforcement at control and expansion joints unless otherwise indicated.

C. Provide continuity at wall intersections by using prefabricated T-shaped units.

D. Provide continuity at corners by using prefabricated L-shaped units.

3.7 REINFORCED UNIT MASONRY INSTALLATION

A. Placing Reinforcement: Comply with requirements in ACI 530.1/ASCE 6/TMS 602.

B. Grouting: Do not place grout until entire height of masonry to be grouted has attained enough strength to resist grout pressure.

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.
2. Limit height of vertical grout pours to not more than 60 inches.

3.8 ANCHORING MASONRY VENEERS

A. Anchor masonry veneers to wall framing with masonry-veneer anchors to comply with the following requirements:

1. Embed tie sections in masonry joints. Provide not less than 2 inches of air space between back of masonry veneer and face of sheathing.
2. Locate anchor sections to allow maximum vertical differential movement of ties up and down.
   a. Locate anchors in the mid-section of joint with ¾ inches minimum and 1 ¾ inches maximum cover from exterior face of veneer.
3. Space anchors as indicated, but not more than 16 inches o.c. vertically and 16 inches o.c. horizontally with not less than 1 anchor for each 2.67 sq. ft. of wall area. Install additional anchors within 12 inches of openings and at intervals, not exceeding 36 inches, around perimeter.
4. If screw misses steel studs the resulting hole is to be filled with polyurethane spray foam and sealed with liquid armor (same material as weather barrier).
3.9 EXPANSION JOINTS

A. General: Install expansion joint materials in unit masonry as masonry progresses. Do not allow materials to span expansion joints without provision to allow for in-plane wall or partition movement.

B. Form expansion joints in brick as follows:
   1. Build in compressible joint fillers where indicated.
   2. Form open joint full depth of brick wythe and of width indicated, but not less than 3/8 inch for installation of sealant and backer rod specified in Section 07 9200 “Joint Sealants.”

C. Provide horizontal, pressure-relieving joints by either leaving an air space or inserting a compressible filler of width required for installing sealant and backer rod specified in Section 07 9200 “Joint Sealants,” but not less than 3/8 inch.

D. Provide vertical expansion joints at locations shown on drawings. Horizontal expansion joints to be installed at top of wall.

3.10 LINTELS

A. Install steel lintels where indicated.

B. Provide minimum bearing of 8 inches at each jamb unless otherwise indicated.

3.11 FLASHING, WEEP HOLES, CAVITY DRAINAGE, AND VENTS

A. General: Install embedded flashing and weep holes in masonry at shelf angles, lintels, ledges, other obstructions to downward flow of water in wall, and where indicated.

B. Install flashing as follows unless otherwise indicated:
   1. Prepare masonry surfaces so they are smooth and free from projections that could puncture flashing. Where flashing is within mortar joint, place through-wall flashing on sloping bed of mortar and cover with mortar. Before covering with mortar, seal penetrations in flashing with adhesive, sealant, or tape as recommended by flashing manufacturer.
   2. At masonry-veneer walls, extend flashing through veneer, across air space behind veneer, and up face of sheathing at least 8 inches above top of mortar net, with upper edge tucked under termination bar and sealed tight with sealant and Liquid armor weather barrier.
   3. At lintels and shelf angles, extend flashing a minimum of 6 inches into masonry at each end. At heads and sills, extend flashing 6 inches at ends and turn up not less than 2 inches to form end dams.
   4. Install stainless steel pan flashing with drip edge and soldered end dams and membrane flashing. Stop flexible flashing 1/2 inch back from outside face of wall and adhere flexible flashing to top of pan flashing.
   5. At spliced joints of stainless-steel pan flashing overlap pans and seal with elastomeric sealant.

C. Install weep holes in head joints in exterior wythes of first course of masonry immediately above embedded flashing and as follows:
   1. Use specified weep/vent products to form weep holes.
   2. Space weep holes 24 inches o.c. unless otherwise indicated.
D. Place cavity drainage material in cavities to comply with configuration requirements for cavity drainage material in “Miscellaneous Masonry Accessories” Article.

E. Install vents in head joints in exterior wythes at spacing indicated. Use specified weep/vent products to form vents.
   1. Close cavities off vertically and horizontally with blocking in manner indicated. Install through-wall flashing and weep holes above horizontal blocking.

3.12 FIELD QUALITY CONTROL

A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas as needed to perform tests and inspections. Retesting of materials that fail to meet specifications requirements shall be done at contractor’s expense.

B. Inspections: Level 1 special inspections according to the International Building Code, 2018.
   1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

C. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provide, according to ASTM C 780.

3.13 REPAIRING, POINTING, AND CLEANING

A. Remove and replace masonry units that are loose, chipped, broken, stained, or otherwise damaged or that do not match adjoining units. Install new units to match adjoining units; install in fresh mortar, pointed to eliminate evidence of replacement.

B. Pointing: During the tooling of joints, enlarge voids and holes, except weep holes, and completely fill with mortar. Point up joints, including corners, openings, and adjacent construction, to provide a neat, uniform appearance. Prepare joints for sealant application, where indicated.

C. In-Progress Cleaning: Clean unit masonry as work progresses by dry brushing to remove mortar fins and smears before tooling joints.

D. Final Cleaning: After mortar is thoroughly set and cured, clean exposed masonry as follows:
   1. Remove large mortar particles by hand with wooden paddles and nonmetallic scrape hoes or chisels.
   2. Test cleaning methods on sample wall panel; leave one-half of panel uncleanned for comparison purposes. Obtain Architect's approval of sample cleaning before proceeding with cleaning of masonry.
   3. Protect adjacent stone and nonmasonry surfaces from contact with cleaner by covering them with liquid strippable masking agent or polyethylene film and waterproof masking tape.
   4. Wet wall surfaces with water before applying cleaners; remove cleaners promptly by rinsing surfaces thoroughly with clear water.
   5. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.
3.14 MASONRY WASTE DISPOSAL

A. Excess Masonry Waste: Remove excess clean masonry waste that cannot be used as fill, as described above, and other masonry waste, and legally dispose of off Owner's property.

END OF SECTION 04 2200
SECTION 05 1200 - STRUCTURAL STEEL FRAMING

PART 1 - GENERAL

1.1 SUMMARY
A. Section Includes:
   1. Structural steel.
   2. Field-installed shear connectors.

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 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 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 structural-steel connections indicated to comply with design loads, include analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS
A. Qualification Data: For fabricator and professional engineer.
B. Welding certificates.
C. Mill test reports for structural steel, including chemical and physical properties.
D. Product Test Reports: For the following:
1. Bolts, nuts, and washers including mechanical properties and chemical analysis.
2. Tension-control, high-strength, bolt-nut-washer assemblies.
3. Shear stud connectors.
4. Shop primers.

1.6 QUALITY ASSURANCE

A. Fabricator Qualifications: A qualified fabricator that participates in the AISC Quality Certification Program and is designated an AISC-Certified Plant, Category STD.

B. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Comply with applicable provisions of the following specifications and documents:

   1. AISC 303.
   2. AISC 360.
   3. RCSC’s “Specification for Structural Joints Using ASTM A 325 or A 490 Bolts.”

1.7 DELIVERY, STORAGE, AND HANDLING

A. Store materials to permit easy access for inspection and identification. Keep steel members off ground and spaced by using pallets, dunnage, or other supports and spacers. Protect steel members and packaged materials from corrosion and deterioration.

   1. Do not store materials on structure in a manner that might cause distortion, damage, or overload to members or supporting structures. Repair or replace damaged materials or structures as directed.

B. Store fasteners in a protected place in sealed containers with manufacturer's labels intact.

   1. Fasteners may be repackaged provided Owner's testing and inspecting agency observes repackaging and seals containers.
   2. Clean and relubricate bolts and nuts that become dry or rusty before use.
   3. Comply with manufacturers' written recommendations for cleaning and lubricating ASTM F 1852 fasteners and for retesting fasteners after lubrication.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Connections: Provide details of simple shear connections required by the Contract Documents to be selected or completed by structural-steel fabricator, including comprehensive engineering analysis by a qualified professional engineer, 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. Construction: Braced frame.
2.2 STRUCTURAL-STEEL MATERIALS

A. W-Shapes: ASTM A 992/A 992M.

B. Channels, Angles, M, S-Shapes: ASTM A 36/A 36M.

C. Plate and Bar: ASTM A 36/A 36M.

D. Steel Pipe: ASTM A 53/A 53M, Type E or Type S, Grade B.
   1. Weight Class: Standard.
   2. Finish: Black except where indicated to be galvanized.

E. Welding Electrodes: Comply with AWS requirements.

2.3 BOLTS, CONNECTORS, AND ANCHORS

A. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade C, heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers; all with plain finish.

B. Zinc-Coated High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy-hex steel structural bolts; ASTM A 563, Grade DH heavy-hex carbon-steel nuts; and ASTM F 436, Type 1, hardened carbon-steel washers.
   1. Finish: Hot-dip or mechanically deposited zinc coating.

C. 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.

D. Shear Connectors: ASTM A 108, Grades 1015 through 1020, headed-stud type, cold-finished carbon steel; AWS D1.1/D1.1M, Type B.

E. Unheaded Anchor Rods: ASTM F 1554, Grade 36.
   4. Washers: ASTM F 436, Type 1, hardened carbon steel.
   5. Finish: Mechanically deposited zinc coating, ASTM B 695, Class 50.

F. Headed Anchor Rods: ASTM F 1554, Grade 36, straight.
   3. Washers: ASTM F 436, Type 1, hardened carbon steel.

   2. Washers: ASTM F 436, Type 1, hardened carbon steel.
   3. Finish: Plain.
2.4 **GROUT**

A. Nonmetallic, Shrinkage-Resistant Grout: ASTM C 1107/C 1107M, 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**


1. Camber structural-steel members where indicated.
2. Fabricate beams with rolling camber up.
3. Identify high-strength structural steel according to ASTM A 6/A 6M and maintain markings until structural steel has been erected.
4. Mark and match-mark materials for field assembly.

B. Thermal Cutting: Perform thermal cutting by machine to greatest extent possible.

1. Plane thermally cut edges to be welded to comply with requirements in AWS D1.1/D1.1M.

C. Bolt Holes: Cut, drill, mechanically thermal cut, or punch standard bolt holes perpendicular to metal surfaces.

D. Finishing: Accurately finish ends of columns and other members transmitting bearing loads.

E. Cleaning: Clean and prepare steel surfaces that are to remain unpainted according to SSPC-SP 1, "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/D1.1M 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 ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

B. Weld Connections: Comply with AWS D1.1/D1.1M for tolerances, appearances, welding procedure specifications, weld quality, and methods used in correcting welding work.
2.7  **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 to receive sprayed fire-resistive materials (applied fireproofing).

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 A 123/A 123M.

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.

2.9  **SOURCE QUALITY CONTROL**

A. Testing Agency: 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.

B. Bolted Connections: Inspect and test shop-bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

C. Welded Connections: Visually inspect shop-welded connections according to AWS D1.1/D1.1M 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.
4. Radiographic Inspection: ASTM E 94.

D. In addition to visual inspection, test and inspect shop-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

E. Prepare test and inspection reports.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify, with certified steel erector present, elevations of concrete- and masonry-bearing surfaces and locations of anchor rods, bearing plates, and other embedments for compliance with requirements.

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 and AISC 360.


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.

E. Splice members only where indicated.

F. Do not use thermal cutting during erection unless approved by Architect. Finish thermally cut sections within smoothness limits in AWS D1.1/D1.1M.

G. Do not enlarge unfair holes in members by burning or using drift pins. Ream holes that must be enlarged to admit bolts.

H. 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/D1.1M and manufacturer's written instructions.
3.4 FIELD CONNECTIONS

A. High-Strength Bolts: Install high-strength bolts according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts" for type of bolt and type of joint specified.

1. Joint Type: Snug tightened.

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

1. Comply with AISC 303 and AISC 360 for bearing, alignment, adequacy of temporary connections, and removal of paint on surfaces adjacent to field welds.

3.5 FIELD QUALITY CONTROL

A. Special Inspections: Owner will engage a qualified special inspector to perform the following special inspections:

1. Verify structural-steel materials and inspect steel frame joint details.
2. Verify weld materials and inspect welds.
3. Verify connection materials and inspect high-strength bolted connections.

B. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

C. Bolted Connections: Inspect bolted connections according to RCSC's "Specification for Structural Joints Using ASTM A 325 or A 490 Bolts."

D. Welded Connections: Visually inspect field welds according to AWS D1.1/D1.1M.

   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.

E. In addition to visual inspection, test and inspect field-welded shear connectors according to requirements in AWS D1.1/D1.1M for stud welding and as follows:

1. Perform bend tests if visual inspections reveal either a less-than-continuous 360-degree flash or welding repairs to any shear connector.
2. Conduct tests according to requirements in AWS D1.1/D1.1M on additional shear connectors if weld fracture occurs on shear connectors already tested.

3.6 REPAIRS AND PROTECTION

A. Galvanized Surfaces: Clean areas where galvanizing is damaged or missing and repair galvanizing to comply with ASTM A 780/A 780M.

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.
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   2. KCS-type K-series steel joists.

1.2 DEFINITIONS

A. SJI's "Specifications": Steel Joist Institute's "Standard Specifications, Load Tables and Weight Tables for Steel Joists and Joist Girders."

B. Special Joists: Steel joists or joist girders requiring modification by manufacturer to support nonuniform, unequal, or special loading conditions that invalidate load tables in SJI's "Specifications."

1.3 ACTION SUBMITTALS

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

B. Shop Drawings:
   1. Include layout, designation, number, type, location, and spacing of joists.
   2. Include joining and anchorage details, bracing, bridging, and joist accessories; splice and connection locations and details; and attachments to other construction.
   3. Indicate locations and details of bearing plates to be embedded in other construction.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For professional engineer.

B. Welding certificates.

C. Manufacturer certificates.

D. Mill Certificates: For each type of bolt.

1.5 QUALITY ASSURANCE

1. Manufacturer's responsibilities include providing professional engineering services for designing special joists to comply with performance requirements.

B. Welding Qualifications: Qualify field-welding procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, and handle joists as recommended in SJI's "Specifications."

B. Protect joists from corrosion, deformation, and other damage during delivery, storage, and handling.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide special joists and connections capable of withstanding design loads indicated.

1. Use ASD; data are given at service-load level.
2. Design special joists to withstand design loads with live-load deflections no greater than the following:


2.2 K-SERIES STEEL JOISTS


B. Steel Joist Substitutes: Manufacture according to "Standard Specifications for Open Web Steel Joists, K-Series" in SJI's "Specifications," with steel-angle or -channel members.

C. Provide holes in chord members for connecting and securing other construction to joists.

D. Extended Ends: Extend bearing ends of joists with SJI's Type R extended ends where indicated, complying with SJI's "Specifications."

E. Do not camber joists.

F. Equip bearing ends of joists with manufacturer's standard beveled ends or sloped shoes if joist slope exceeds 1/4 inch per 12 inches.

2.3 PRIMERS

A. Primer: Provide shop primer that complies with Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting."
2.4  JOIST ACCESSORIES


B. Carbon-Steel Bolts and Threaded Fasteners: ASTM A 307, Grade A, carbon-steel, hex-head bolts and threaded fasteners; carbon-steel nuts; and flat, unhardened steel washers.

C. High-Strength Bolts, Nuts, and Washers: ASTM A 325, Type 1, heavy hex steel structural bolts; ASTM A 563 heavy hex carbon-steel nuts; and ASTM F 436 hardened carbon-steel washers.


D. Welding Electrodes: Comply with AWS standards.

E. Galvanizing Repair Paint: ASTM A 780.

F. Furnish miscellaneous accessories including splice plates and bolts required by joist manufacturer to complete joist assembly.

2.5  CLEANING AND SHOP PAINTING

A. Clean and remove loose scale, heavy rust, and other foreign materials from fabricated joists and accessories by hand-tool cleaning, SSPC-SP 2 or power-tool cleaning, SSPC-SP 3.

B. Apply one coat of shop primer to joists and joist accessories to be primed to provide a continuous, dry paint film not less than 1 mil thick.

PART 3 - EXECUTION

3.1  EXAMINATION

A. Examine supporting substrates, embedded bearing plates, and abutting structural framing 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

A. Do not install joists until supporting construction is in place and secured.

B. Install joists and accessories plumb, square, and true to line; securely fasten to supporting construction according to SJI's "Specifications" and "Standard Specifications for Composite Steel Joists, CJ-Series" in "Standard Specifications for Composite Steel Joists, Weight Tables and Bridging Tables, Code of Standard Practice," joist manufacturer's written recommendations, and requirements in this Section.

   1. Before installation, splice joists delivered to Project site in more than one piece.
   2. Space, adjust, and align joists accurately in location before permanently fastening.
3. Install temporary bracing and erection bridging, connections, and anchors to ensure that joists are stabilized during construction.
4. Delay rigidly connecting bottom-chord extensions to columns or supports until dead loads are applied.

C. Field weld joists to supporting steel bearing plates and framework. Coordinate welding sequence and procedure with placement of joists. Comply with AWS requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.

D. Bolt joists to supporting steel framework using carbon-steel bolts.


F. Install and connect bridging concurrently with joist erection, before construction loads are applied. Anchor ends of bridging lines at top and bottom chords if terminating at walls or beams.

3.3 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified independent testing and inspecting agency to inspect field welds and bolted connections and to perform field tests and inspections and prepare test and inspection reports.

B. Visually inspect field welds according to AWS D1.1/D1.1M.

1. In addition to visual inspection, test field welds according to AWS D1.1/D1.1M and the following procedures, as applicable:
   a. Liquid Penetrant Inspection: ASTM E 165.
   b. Magnetic Particle Inspection: ASTM E 709.

C. Visually inspect bolted connections.

D. Correct deficiencies in Work that test and inspection reports have indicated are not in compliance with specified requirements.

E. Perform additional testing to determine compliance of corrected Work with specified requirements.

3.4 PROTECTION

A. Touchup Painting: After installation, promptly clean, prepare, and prime or reprime field connections, rust spots, and abraded surfaces of prime-painted joists abutting structural steel, and accessories.

1. Clean and prepare surfaces by hand-tool cleaning according to SSPC-SP 2, or power-tool cleaning according to SSPC-SP 3.
2. Apply a compatible primer of same type as primer used on adjacent surfaces.
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Roof deck.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings:
   1. Include layout and types of deck panels, anchorage details, reinforcing channels, pans, cut deck openings, special jointing, accessories, and attachments to other construction.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

B. Product Certificates: For each type of steel deck.

C. 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.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to AWS D1.3, "Structural Welding Code - Sheet Steel."


1.5 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 PERFORMANCE REQUIREMENTS

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

2.2 ROOF DECK

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

1. Canam Steel Corporation; Canam Group, Inc.
2. Epic Metals Corporation.
3. Nucor Corp.

B. 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:

2. Profile Depth: 1-1/2 inches.
3. Design Uncoated-Steel Thickness: 0.0295 inch.
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 profilere commended 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.

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:

2. Weld Spacing: Weld edge and interior ribs of deck units with a minimum of two welds per deck unit at each support. Space welds 12 inches apart in the field of roof and 6 inches apart in roof corners and perimeter, based on roof-area definitions in FMG Loss Prevention Data Sheet 1-28 or as indicated on plan selecting whichever is maximum.

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 18 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 mechanically fasten flanges to top of deck. Space mechanical fasteners not more than 12 inches apart with at least one fastener at each corner.

1. Install reinforcing channels or zees in ribs to span between supports and 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. 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:

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.

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.

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: Owner 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 Architect.

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.

END OF SECTION 05 3100
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SECTION 05 4000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Exterior non-load-bearing wall framing.

1.2 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.

1.3 INFORMATIONAL SUBMITTALS

A. Welding certificates.

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

   1. Steel sheet.
   2. Expansion 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.

1.4 QUALITY ASSURANCE

A. Product Tests: Mill certificates or data from a qualified independent testing agency indicating steel sheet complies with requirements, including base-metal thickness, yield strength, tensile strength, total elongation, chemical requirements, and metallic-coating thickness.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
1.5 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 MANUFACTURERS

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

1. ClarkDietrich
2. MarinoWARE
3. SCAFCO Steel Stud Company

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 “Quality Requirements,” 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.
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.
   b. Ceiling Joist Framing: Vertical deflection of 1/360 of the span for live loads and 1/240 for total loads of the span.

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 deg 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:


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.
D. **AISI Specifications and Standards**: Unless more stringent requirements are indicated, comply with AISI S100 and AISI S200.

### 2.3 COLD-FORMED STEEL FRAMING, GENERAL

**A. Steel Sheet**: ASTM A 1003/A 1003M, Structural Grade, Type H, metallic coated, of grade and coating weight as follows:

1. **Grade**: Per Structural General Notes and as required by design.
2. **Coating**: G60, A60, AZ50, or GF30.

**B. Steel Sheet for Vertical Deflection Clips**: ASTM A 653/A 653M, structural steel, zinc coated, of grade and coating as follows:

1. **Grade**: As required by structural performance.
2. **Coating**: G60.

### 2.4 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**: 0.0329 inch.
2. **Flange Width**: 1-5/8 inches.

**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**: 1-1/4 inches.

**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.

**E. Double Deflection Tracks**: Manufacturer's double, deep-leg, U-shaped steel tracks, consisting of nested inner and outer tracks; unpunched, with unstiffened flanges.

1. **Outer Track**: Of web depth to allow free vertical movement of inner track, with flanges designed to support horizontal loads and transfer them to the primary structure, and as follows:
   
   a. **Minimum Base-Metal Thickness**: 0.0329 inch.
   b. **Flange Width**: 1 inch plus the design gap for one-story structures.

2. **Inner Track**: Of web depth indicated, and as follows:
a. Minimum Base-Metal Thickness: 0.0428 inch.
b. Flange Width: Insert dimension equal to sum of outer deflection track flange width plus 1 inch.

2.5 FRAMING ACCESSORIES

A. Fabricate steel-framing accessories from steel sheet, ASTM A 1003/A 1003M, 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.
7. Joist hangers and end closures.
8. Hole reinforcing plates.

2.6 ANCHORS, CLIPS, AND FASTENERS

A. Steel Shapes and Clips: ASTM A 36/A 36M, zinc coated by hot-dip process according to ASTM A 123/A 123M.

B. Anchor Bolts: ASTM F 1554, Grade 36, threaded carbon-steel hex-headed bolts and carbon-steel nuts; and flat, hardened-steel washers; zinc coated by mechanically deposition according to ASTM B 695, Class 50.

C. 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.

D. 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.

E. 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.

F. Welding Electrodes: Comply with AWS standards.

2.7 MISCELLANEOUS MATERIALS

A. Galvanizing Repair Paint: SSPC-Paint 20 or MIL-P-21035B.

B. Cement Grout: Portland cement, ASTM C 150, Type I; and clean, natural sand, ASTM C 404. Mix at ratio of 1 part cement to 2-1/2 parts sand, by volume, with minimum water required for placement and hydration.
C. 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 C 1107/C 1107M, with fluid consistency and 30-minute working time.

D. 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.

E. 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.

2.8 FABRICATION

A. Fabricate cold-formed steel framing and accessories plumb, square, and true to line, and with connections securely fastened, according to referenced AISI's specifications and standards, manufacturer's written instructions, and requirements in this Section.

1. Fabricate framing assemblies using jigs or templates.
2. Cut framing members by sawing or shearing; do not torch cut.
3. Fasten cold-formed steel framing members by welding, screw fastening, clinch fastening, pneumatic pin fastening, or riveting as standard with fabricator. Wire tying of framing members is not permitted.
   a. Comply with AWS D1.3/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
   b. Locate mechanical fasteners and install according to Shop Drawings, with 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 plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.
2. Squareness: Fabricate each cold-formed steel framing assembly to a maximum out-of-square tolerance of 1/8 inch.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine 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 **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/D1.3M requirements and procedures for welding, appearance and quality of welds, and methods used in correcting welding work.
      b. Locate mechanical fasteners and install according to Shop Drawings, 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. Install insulation, specified in Section 07 2100 "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.

H. Fasten hole reinforcing plate over web penetrations that exceed size of manufacturer's approved or standard punched openings.

I. 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 plus or minus 1/8 inch from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.3 **EXTERIOR NON-LOAD-BEARING WALL INSTALLATION**

*If this article is required, retain with "Installation, General" Article.*

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:


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. Install double deep-leg deflection tracks and anchor outer track to building structure.
3. Connect vertical deflection clips to bypassing 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 and a minimum of 96 inches.
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.

3.4 FIELD QUALITY CONTROL

A. Testing: Owner will engage a qualified independent testing and inspecting agency to perform field tests and inspections and prepare test reports.

B. Field and shop welds will be subject to testing and inspecting.

C. Testing agency will report test results promptly and in writing to Contractor and Architect.

D. 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.
3.5 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 05 4000
SECTION 05 4523 - MEDICAL EQUIPMENT SUPPORT SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Summary:
   1. Performance specifications for engineered design-build support systems using cold-formed adjustable metal framing and hot-rolled steel section supports.

B. Scope:
   1. All ceiling mounted equipment including
      a. Radiographic Equipment Ceiling Channel Grid.
      b. Radiographic Equipment Direct Mounting Ceiling Channel System.
      c. Monitor Equipment Ceiling Channel Grid.
      d. MRI Scan Equipment Ceiling Channel Grid to support RF Shielding panels.
      e. CT Overhead counterpoise system (OCS) ceiling plate.
   2. Provide and install equipment support systems as located on the reflected ceiling plans as indicated.
   3. Ceiling Channel Grids shall be a universal grid or per manufacturer’s drawing -type consisting of 12 Gage 1-5/8” cold-formed channel rails flush with the finished ceiling and extending wall to wall unless otherwise noted on the reflected ceiling plans and shall be perpendicular to the path of travel of the equipment.
   4. Ceiling Direct Mounting Channel Systems shall be single channels consisting of 12 Gage 1-5/8” cold-formed channel rails flush with the finished ceiling and extending wall to wall unless otherwise noted on the reflected ceiling plans and shall be parallel to the path of travel of the equipment. Take-Up rails finish painted white with trolleys shall be provided and installed with these systems.

1.2 RELATED SECTIONS

A. Section 05 1200 “Structural Steel”

B. Section 05 4000 “Cold-Formed Metal Framing”

C. Section 05 5000 “Metal Fabrications”

1.3 REFERENCES

A. All design shall be in accordance with:
   1. The governing local and state building code including IBC 2009.

B. Material Standards:
1. ASTM A36 – Carbon Structural Steel.
2. ASTM A53 – Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
3. ASTM A325 – Structural Bolts, Steel, Heat Treated 120/105 ksi Minimum Tensile Strength.
4. ASTM A500 – Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in rounds and Shapes.
5. ASTM A501 – Hot-rolled Welded and Seamless Carbon Steel Structural Tubing.
6. ASTM A572 – High-Strength Low-Allow Columbium-Vanadium Structural Steel.
8. ASTM A653 – Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by Hot-Dip Process.
9. ASTM A992 – Steel for Structural Shapes
10. A1011/A1011M-03a Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low-Alloy with Improved Formability.

C. Connection Standards:
   1. RCSC (Research Council on Structural Connections) – Specification for Structural Joints Using ASTM A325 or A490 Bolts.
   2. AWS D1.1 Structural Welding Code

1.4 DEFINITIONS

A. Qualified Person: Someone "... who, by possession of a recognized degree, certificate, or professional standing, or who by extensive knowledge, training, and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, work, or the project" (defined by OSHA 29 CFR 1926.32 (m)).

B. Design-Build: Method where design and construction are a single source of responsibility for one entity.

C. Turnkey: Fast-track supply and installation in a condition ready for immediate use, occupation, or operation.

1.5 SUBMITTALS

A. Shop Drawings: Successful Design-Build Medical Equipment Support Contractor shall submit shop drawings showing the complete system including plans, sections, and details of the system. Center point / Iso-centers of all equipment shall be located off of finished wall lines. Plans shall show all manufactured parts by catalog numbers, all fabricated parts, and all fasteners and hardware.

B. Calculations: Structural calculations for all member and connections shall be submitted. The Medical support system shall lend itself to a rational structural analysis with section properties of framing members demonstrated by calculations. Structural calculations and drawings shall be furnished with a stamp by a licensed engineer in the state where the installation is to occur complying with all applicable codes and regulatory requirements. Calculations must include design for deflection and rotational requirements, as applicable, and not just stress.

1.6 QUALITY ASSURANCE

A. Design-Build Medical Equipment Support Contractor Quality Assurance:
   1. Material and installation shall be provided by qualified and competent persons from a
Design-Build Medical Equipment Support Contractor with at least ten (10) years experienced in the professional engineering, design, manufacture and installation of adjustable metal framing supports. The Design-Build Medical Equipment Support Contractor shall demonstrate (10) years experience of turnkey projects of similar scope and size and shall maintain a continuing quality assurance program for both its material and installation crews.

2. Design-Build Medical Equipment Support Contractor shall provide the single source responsibility and liability for all engineering, design, materials and workmanship, and shall provide as single limited warranty for all aspects of the project: engineering, fabrication, material quality, and installation. Installing contractor must be a trained representative of the cold formed metal framing system manufacturer.

3. Design-Build Medical Equipment Support Contractor shall be responsible for complete coordination with the equipment suppliers to verify all loading and installation requirements and shall be responsible for directly contacting these companies for the latest design requirements.

4. Design-Build Medical Equipment Support Contractor shall employ a qualified and competent structural engineer to directly supervise all design and construction phases.

5. Acceptable Design-Build Medical Equipment Support Contractors:
   a. Unistrut Service Company of Ohio.

6. Design-Build Medical Equipment Support Contractor shall meet the following compliance requirements by having the following in place:
   b. Established Industrial Safety and Fall Protection Program.
   c. Minimum 10 hour Occupational Safety & Health Administration (OSHA) Training Certification.
   d. Worker’s Compensation Insurance.
   e. “Installer Training” for any hybrid or adhesive anchoring systems, if applicable (Hilti)

B. Component Quality Assurance:
   1. Manufacturers Brochure: Brochure shall show materials, strengths, finishes and sizes. Sufficient engineering information shall be provided to permit stress calculations. Materials listed should conform to the appropriate specifications from ASTM, AISI, AISC, and / or AWS.
   2. Material Quality Assurance: Submit certification that products comply with specified requirements and are suitable for intended application.

C. Installation Quality Assurance:
   1. Submit list of a minimum of 5 completed projects of similar size and complexity to this Work. Include for each project:
      a. Project name and location.
      b. Name of owner.
      c. Name of contractor.
      d. Name of architect.
      e. Name of manufacturer.
      f. Number and type of supports.
      g. Date of completion.

   2. Pre-Installation Meeting: Convene a pre-installation meeting a minimum of 2 (two) weeks before start of installation of support systems. Require attendance of parties directly affecting work of this section, including General Contractor or Owner representative,
Mechanical, Plumbing and Electrical Contractor, Equipment representative and support system Design-Build Medical Equipment Support Contractor. Review the following:

a. Shop Drawings.
b. Sequencing.
c. Existing Interferences.
d. Mechanical, Plumbing, and Electrical installation coordination.
e. Time restrictions.
f. Access to areas.
g. Finished Ceiling Elevations.
h. Reflected Ceiling Plan light fixture locations.
i. Final equipment center-point / iso-center locations.

1.7 LIABILITY AND WARRANTY

A. Warranty: A one (1) year limited warranty on all engineering, design, materials, installation, and system performance shall be provided in writing to the Owner from the date of Owner sign-off at project completion.

1.8 DESIGN CRITERIA

A. Any designs indicated in the contract documents are for concept only and should not be taken as final designs nor shall be used for material take-off nor used for estimating purposes in any way.

B. Final designs including all final designs, materials and all installation labor shall be the exclusive and sole responsibility of the Design-Build Medical Equipment Support Contractor and all costs shall be included in their proposal at bid time.

C. The building structural members, elevations, and room layout shall be fully coordinated for the design of all supports. Equipment loads must be adequately supported from the building structural members and distributed accordingly. Floor to floor distances, finished ceiling elevations, room locations, and building support structure elevations must all be coordinated for appropriate design of support systems for proper understanding of required hanger lengths, bracing requirements, attachment design, etc.

D. Loads to be used shall be per each equipment manufacturer's specification.

E. An overall system minimum factor of safety of three (3) shall be used for strength design.

F. Minimum rotational requirements, unless otherwise stated in the equipment manufacturer's specifications, shall be as follows:

1. For all light and gas/service column/booms: Maximum rotation on the equipment mounting plate shall be no greater than 0.20 degrees per 12”.
2. For all Unistrut Ceiling Channel Grids and Ceiling Channel Systems: Maximum deflection on the system shall be no greater than 0.0625” for any one location of worst case loading on the system.

G. All systems shall be adequately braced in all four directions for lateral loading. If no lateral loading is specified by the equipment manufacturer's specifications, 1/10th of the static downward loading shall be applied in the horizontal axis. Movement shall not exceed the total for that allowed on the system at the worst case loading condition.

H. For ceiling channel, rails shall be designed for no more than 1/720th of the span maximum deflection in either plane when maximum loading conditions are applied due to equipment
operation.

I. Ceiling channel shall be installed horizontal in plane and parallel to each other within 1/32\textsuperscript{nd} of an inch.

J. Anchorage to the existing structure shall be as designed by the structural engineer of the system.

1. Mechanical anchors into concrete shall be designed with a minimum factor of safety of 6 and shall be either expansion bolts, epoxy anchors, or through bolts with backing plate.
2. Anchorages into existing concrete shall not penetrate existing reinforcing bars.
3. Anchorages into new post-tension concrete shall require concrete inserts designed, located, and supplied by the Design-Build Medical Equipment Support Contractor (installed by Concrete Contractor).
4. Connections to structural steel shall be clamp-on fittings or field welding.
5. Drilling through truss bottom chords shall not be allowed.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Coordinate deliveries and storage of all materials with General Contractor or Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. All cold-formed channel and fittings shall be a manufactured by:

1. Unistrut Corporation or approved equal. No alternatives are approved unless written authorization from Owner is obtained.
2. Hilti MI/MQ Support and Installation Systems are an approved equal

2.2 MATERIALS

A. Channel: All cold-formed channel members shall be fabricated from structural grade steel conforming to one of the following ASTM specifications: A1011 SS GR 33 or A653 GR 33. Channel shall be 1-5/8" framing system 12 Gage. Minimum yield strength shall be 33 ksi.

B. Fittings: All cold-formed fittings shall be fabricated from steel conforming to one of the following ASTM specifications: A575, A576, A36, or A653. Minimum fitting thickness shall be ¼" with physical requirements per A1011. Minimum yield strength shall be 33 ksi.

C. Channel Nuts: All channel nuts shall be fabricated from steel conforming to ASTM specification A1011 SS GR 33.

D. Bolts and Fasteners: All bolts and fasteners used in connections shall be minimum SAE Grade 5, EG finish. Threaded Rod Grade B7.

E. Hot Rolled Structural Steel: ASTM A36 minimum.

2.3 FINISHES

A. All cold-formed channel and/or fitting members shall be finished in accordance with one of the
following standards:

1. Perma-Green II (GR): Rust inhibitive acrylic enamel paint finish applied by electrodeposition, after cleaning and phosphating, and thoroughly baked. Color per Federal Standard 595a color number 14109 (dark limit V-). Finish paint shall withstand minimum 400 hours salt spray (scribed), and 600 hours salt spray (unscribed), when tested in accordance with ASTM B117. Or approved equal paint finish.


3. Pre-Galvanized (PG): Zinc coated by hot-dipped process prior to roll forming. The zinc weight shall be G90 conforming to ASTM A653.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine building drawings and areas and conditions in which systems are to be installed. Notify Architect of areas or conditions not acceptable for support of system. Do not begin installation until unacceptable areas or conditions have been corrected.

B. Design all supports to work around mechanical ductwork, electrical lighting fixtures, and plumbing where possible. All efforts shall be fully coordinated prior to final design.

3.2 INSTALLATION

A. For ceiling channel, rails shall be on centers at 2'-2" center to center as required by equipment manufacturer and allow continuous attachment along any point on the rail. System shall be true, plumb, and level to the tolerances specified.

B. Framing shall be adjusted as required in the field to avoid interferences.

C. Hammer drilling times shall be coordinated in existing facilities with the Owner.

D. All bolted connections into cold-formed channel members with channel nuts shall be tightened to a minimum:

   1. 50 ft-lbs for ½" bolts.
   2. 100 ft-lbs for 5/8" bolts.
   3. 125 ft-lbs for ¾" bolts.

E. All bolted connections for structural steel joints shall be per ASIC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.

F. Gas/Service Column/Boom mounting plates supplied by the equipment supplier as noted in the equipment specifications shall be installed by the system support Design-Build Medical Equipment Support Contractor unless otherwise specified.

G. Supply and install all required threaded rod, hex nuts, flat washers, lock washers for exam and surgical lights and gas/service column/booms unless otherwise specified.

H. Install wall mold on Ceiling Channel Grids and Ceiling Direct Mounting Channel Systems in rooms to receive lay-in ceiling tile where applicable.

I. Shear off tek screws on the inside of the ceiling channel for equipment mounting block installation.
J. Supply and install white snap-in closure strips into the open ceiling channel as required after the equipment has been installed unless installation labor is agreed to otherwise at the time of contract agreement.

3.3 CLEANUP

A. Upon completion of this section of work, remove all protective wraps and debris. Repair any damage due to installation of this section of work.

3.4 PROTECTION

A. During installation, it shall be the responsibility of the Design-Build Medical Equipment Support Contractor to protect this work from damage.

B. Upon completion of this scope of work, it shall become the responsibility of the general contractor or Owner to protect this work from damage during the remainder of construction on the project and until substantial completion.

C. Any modifications to the installed system shall be performed only and exclusively by the Design-Build Medical Equipment Support Contractor responsible for the system. Modifications made by any other party transfers liability and integrity of the system to that party making the modifications.

END OF SECTION 05 4523
PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Steel framing and supports for operable partitions.
   2. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   3. Shelf angles.
   4. Metal bollards.

B. Products furnished, but not installed, under this Section include the following:
   1. Loose steel lintels.

C. Related Requirements:
   1. Section 03 3000 "Cast-in-Place Concrete" for installing anchor bolts, steel pipe sleeves, slotted-channel inserts, wedge-type inserts, and other items cast into concrete.
   2. Section 04 2000 "Unit Masonry" for installing loose lintels, anchor bolts, and other items built into unit masonry.
   3. Section 05 1200 "Structural Steel Framing."

1.2 COORDINATION

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

B. Coordinate installation of metal fabrications that are anchored to or that receive other work. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

1.3 ACTION SUBMITTALS

A. Shop Drawings: Show fabrication and installation details. Include plans, elevations, sections, and details of metal fabrications and their connections. Show anchorage and accessory items. Provide Shop Drawings for the following:
   1. Steel framing and supports for applications where framing and supports are not specified in other Sections.
   2. Shelf angles.
   3. Metal bollards.
   4. Loose steel lintels.
1.4 INFORMATIONAL SUBMITTALS

A. Welding certificates.

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

1.5 QUALITY ASSURANCE

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

B. Welding Qualifications: Qualify procedures and personnel according to the following:

   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

1.6 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes acting on exterior metal fabrications by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects.

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

2.2 METALS

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For metal fabrications exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

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

C. Steel Tubing: ASTM A 500/A 500M, cold-formed steel tubing.

D. Steel Pipe: ASTM A 53/A 53M, Standard Weight (Schedule 40) unless otherwise indicated.

E. Slotted Channel Framing: Cold-formed metal box channels (struts) complying with MFMA-4.

   2. Material: Cold-rolled steel, ASTM A 1008/A 1008M, commercial steel, Type B; 0.0966-inch minimum thickness; coated with rust-inhibitive, baked-on, acrylic enamel.
2.3 MISCELLANEOUS MATERIALS

A. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

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

B. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.

C. Galvanizing Repair Paint: High-zinc-dust-content paint complying with SSPC-Paint 20 and compatible with paints specified to be used over it.

D. Concrete: Comply with requirements in Section 03 3000 "Cast-in-Place Concrete" for normal-weight, air-entrained, concrete with a minimum 28-day compressive strength of 3000 psi.

2.4 FABRICATION, GENERAL

A. Shop Assembly: Preassemble items in the shop to greatest extent possible. Disassemble units only as necessary for shipping and handling limitations. Use connections that maintain structural value of joined pieces. Clearly mark units for reassembly and coordinated installation.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld corners and seams continuously to comply with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners or welds where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) fasteners unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate seams and other connections that are exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.

H. Cut, reinforce, drill, and tap metal fabrications as indicated to receive finish hardware, screws, and similar items.

I. Provide for anchorage of type indicated; coordinate with supporting structure. Space anchoring devices to secure metal fabrications rigidly in place and to support indicated loads.

J. Where units are indicated to be cast into concrete or built into masonry, equip with integrally welded steel strap anchors, 1/8 by 1-1/2 inches, with a minimum 6-inch embedment and 2-inch
hook, not less than 8 inches from ends and corners of units and 24 inches o.c., unless otherwise indicated.

2.5 MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Provide steel framing and supports not specified in other Sections as needed to complete the Work.

B. Fabricate units from steel shapes, plates, and bars of welded construction unless otherwise indicated. Fabricate to sizes, shapes, and profiles indicated and as necessary to receive adjacent construction.
   1. Fabricate units from slotted channel framing where indicated.
   2. Furnish inserts for units installed after concrete is placed.

C. Fabricate supports for operable partitions from continuous steel beams of sizes indicated with attached bearing plates, anchors, and braces as indicated. Drill or punch bottom flanges of beams to receive partition track hanger rods; locate holes where indicated on operable partition Shop Drawings.

D. Galvanize miscellaneous framing and supports where indicated.

E. Prime miscellaneous framing and supports with zinc-rich primer where indicated.

2.6 SHELF ANGLES

A. Fabricate shelf angles from steel angles of sizes indicated and for attachment to concrete framing. Provide horizontally slotted holes to receive 3/4-inch bolts, spaced not more than 6 inches from ends and 24 inches o.c., unless otherwise indicated.
   1. Provide mitered and welded units at corners.
   2. Provide open joints in shelf angles at expansion and control joints. Make open joint approximately 2 inches larger than expansion or control joint.

B. For cavity walls, provide vertical channel brackets to support angles from backup masonry and concrete.

C. Galvanize and prime shelf angles located in exterior walls.

2.7 METAL BOLLARDS

A. Fabricate metal bollards from Schedule 40 steel pipe.

B. Prime bollards with zinc-rich primer.

2.8 LOOSE BEARING AND LEVELING PLATES

A. Provide loose bearing and leveling plates for steel items bearing on masonry or concrete construction. Drill plates to receive anchor bolts and for grouting.

B. Galvanize plates.

C. Prime plates with zinc-rich primer.
2.9 LOOSE STEEL LINTELS

A. Fabricate loose steel lintels from steel angles and shapes of size indicated for openings and recesses in masonry walls and partitions at locations indicated. Fabricate in single lengths for each opening unless otherwise indicated. Weld adjoining members together to form a single unit where indicated.

B. Size loose lintels to provide bearing length at each side of openings equal to 1/12 of clear span, but not less than 8 inches unless otherwise indicated.

C. Galvanize and prime loose steel lintels located in exterior walls.

2.10 FINISHES, GENERAL

A. Finish metal fabrications after assembly.

B. Finish exposed surfaces to remove tool and die marks and stretch lines, and to blend into surrounding surface.

2.11 STEEL AND IRON FINISHES

A. Galvanizing: Hot-dip galvanize items as indicated to comply with ASTM A 153/A 153M for steel and iron hardware and with ASTM A 123/A 123M for other steel and iron products.

1. Do not quench or apply post galvanizing treatments that might interfere with paint adhesion.

B. Preparation for Shop Priming Galvanized Items: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with metallic phosphate process.

C. Shop prime iron and steel items unless they are to be embedded in concrete, or masonry, or unless otherwise indicated.

D. Shop Priming: Apply shop primer to comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

B. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

C. Field Welding: Comply with the following requirements:
1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. At exposed connections, finish exposed welds and surfaces smooth and blended so no roughness shows after finishing and contour of welded surface matches that of adjacent surface.

D. Fastening to In-Place Construction: Provide anchorage devices and fasteners where metal fabrications are required to be fastened to in-place construction. Provide threaded fasteners for use with concrete and masonry inserts, toggle bolts, through bolts, lag screws, wood screws, and other connectors.

E. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

3.2 INSTALLING MISCELLANEOUS FRAMING AND SUPPORTS

A. General: Install framing and supports to comply with requirements of items being supported, including manufacturers' written instructions and requirements indicated on Shop Drawings.

B. Anchor supports for operable partitions securely to, and rigidly brace from, building structure.

C. Support steel girders on solid grouted masonry, concrete, or steel pipe columns. Secure girders with anchor bolts embedded in grouted masonry or concrete or with bolts through top plates of pipe columns.

1. Where grout space under bearing plates is indicated for girders supported on concrete or masonry, install as specified in "Installing Bearing and Leveling Plates" Article.

D. Install pipe columns on concrete footings with grouted baseplates. Position and grout column baseplates as specified in "Installing Bearing and Leveling Plates" Article.

1. Grout baseplates of columns supporting steel girders after girders are installed and leveled.

3.3 INSTALLING METAL BOLLARDS

A. Fill metal-capped bollards solidly with concrete and allow concrete to cure seven days before installing.

B. Anchor bollards in concrete as detailed.

C. Fill bollards solidly with concrete, mounding top surface to shed water.

3.4 INSTALLING BEARING AND LEVELING PLATES


B. Set bearing and leveling plates on wedges, shims, or leveling nuts. After bearing members have been positioned and plumbed, tighten anchor bolts. Do not remove wedges or shims but, if protruding, cut off flush with edge of bearing plate before packing with nonshrink grout. Pack grout solidly between bearing surfaces and plates to ensure that no voids remain.
3.5 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas. Paint uncoated and abraded areas with the same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

B. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas and repair galvanizing to comply with ASTM A 780/A 780M.

END OF SECTION 05 5000
SECTION 05 5100 - METAL STAIRS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Industrial-type stairs with steel grating treads.
   2. Steel tube railings attached to metal stairs.
   3. Steel tube handrails attached to walls adjacent to metal stairs.

B. Related Sections:
   1. Section 03 3000 "Cast-in-Place Concrete" for concrete fill for stair treads and platforms.
   2. Section 05 5000 "Metal Fabrications" for metal treads and nosings installed at locations other than in metal stairs.
   3. Section 06 1053 "Miscellaneous Rough Carpentry" for wood blocking for anchoring railings.
   4. Section 09 2216 "Non-Structural Metal Framing" for metal backing for anchoring railings.

1.3 PERFORMANCE REQUIREMENTS
A. Delegated Design: Design metal stairs, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance of Stairs: Metal stairs shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated.
   1. Uniform Load: 100 lbf/sq. ft.
   2. Concentrated Load: 300 lbf applied on an area of 4 sq. in.
   3. Uniform and concentrated loads need not be assumed to act concurrently.
   4. Stair Framing: Capable of withstanding stresses resulting from railing loads in addition to loads specified above.
   5. Limit deflection of treads, platforms, and framing members to L/240 or 1/4 inch, whichever is less.

C. Seismic Performance: Metal stairs shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.
   1. Component Importance Factor is 1.5.

1.4 ACTION SUBMITTALS
A. Product Data: For metal stairs and the following:
1. Nonslip aggregates and nonslip-aggregate finishes.

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

C. Samples for Initial Selection: For products involving selection of color, texture, or design.

D. Delegated-Design Submittal: For installed products indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified professional engineer.

B. Welding certificates.

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

D. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for stairs and railings.

   1. Test railings according ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

A. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM AMP 510, "Metal Stairs Manual," for class of stair designated, unless more stringent requirements are indicated.

B. Welding Qualifications: Qualify procedures and personnel according to the following:

   1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."
   2. AWS D1.3, "Structural Welding Code - Sheet Steel."

1.7 COORDINATION

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

B. Coordinate installation of anchorages for metal stairs. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

C. Coordinate locations of hanger rods and struts with other work so that they will not encroach on required stair width and will be within the fire-resistance-rated stair enclosure.
PART 2 - PRODUCTS

2.1 METALS, GENERAL

A. Metal Surfaces, General: Provide materials with smooth, flat surfaces unless otherwise indicated. For components exposed to view in the completed Work, provide materials without seam marks, roller marks, rolled trade names, or blemishes.

2.2 FERROUS METALS

A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
B. Steel Tubing: ASTM A 500 (cold formed) or ASTM A 513.
C. Steel Bars for Grating Treads: ASTM A 36/A 36M or steel strip, ASTM A 1011/A 1011M or ASTM A 1018/A 1018M.
D. Wire Rod for Grating Crossbars: ASTM A 510.
E. Cast Iron: Either gray iron, ASTM A 48/A 48M, or malleable iron, ASTM A 47/A 47M, unless otherwise indicated.
F. Uncoated, Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, either commercial steel, Type B, or structural steel, Grade 25, unless another grade is required by design loads; exposed.
G. Uncoated, Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, either commercial steel, Type B, or structural steel, Grade 30, unless another grade is required by design loads.

2.3 FASTENERS

A. General: Provide zinc-plated fasteners with coating complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 12 for exterior use, and Class Fe/Zn 5 where built into exterior walls. Select fasteners for type, grade, and class required.
B. Bolts and Nuts: Regular hexagon-head bolts, ASTM A 307, Grade A; with hex nuts, ASTM A 563; and, where indicated, flat washers.
C. Anchor Bolts: ASTM F 1554, Grade 36, of dimensions indicated; with nuts, ASTM A 563; and, where indicated, flat washers.
D. Machine Screws: ASME B18.6.3.
E. Lag Screws: ASME B18.2.1.

2.4 MISCELLANEOUS MATERIALS

A. Welding Rods and Bare Electrodes: Select according to AWS specifications for metal alloy welded.
B. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.

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

C. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.


E. Concrete Materials and Properties: Comply with requirements in Section 03 3000 "Cast-in-Place Concrete" for normal-weight, air-entrained, ready-mix concrete with a minimum 28-day compressive strength of 3000 psi unless otherwise indicated.

F. Nonslip-Aggregate Concrete Finish: Factory-packaged abrasive aggregate made from fused, aluminum-oxide grits or crushed emery; rustproof and nonglazing; unaffected by freezing, moisture, or cleaning materials.

G. Welded Wire Fabric: ASTM A 185/A 185M, 6 by 6 inches, W1.4 by W1.4, unless otherwise indicated.

2.5 FABRICATION, GENERAL

A. Provide complete stair assemblies, including metal framing, hangers, struts, railings, clips, brackets, bearing plates, and other components necessary to support and anchor stairs and platforms on supporting structure.

   1. Join components by welding unless otherwise indicated.
   2. Use connections that maintain structural value of joined pieces.
   3. Fabricate treads and platforms of exterior stairs so finished walking surfaces slope to drain.

B. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

C. Form bent-metal corners to smallest radius possible without causing grain separation or otherwise impairing work.

D. Form exposed work with accurate angles and surfaces and straight edges.

E. Weld connections to comply with the following:

   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove welding flux immediately.
   4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Type 3 welds: partially dressed weld with spatter removed.

F. Form exposed connections with hairline joints, flush and smooth, using concealed fasteners where possible. Where exposed fasteners are required, use Phillips flat-head (countersunk) screws or bolts unless otherwise indicated. Locate joints where least conspicuous.

G. Fabricate joints that will be exposed to weather in a manner to exclude water. Provide weep holes where water may accumulate.
2.6 STEEL-FRAMED STAIRS

A. Stair Framing:
   1. Fabricate stringers of steel channels.
      a. Provide closures for exposed ends of channel stringers.
   2. Construct platforms of steel channel headers and miscellaneous framing members as needed to comply with performance requirements.
   3. Weld or bolt stringers to headers; weld or bolt framing members to stringers and headers. If using bolts, fabricate and join so bolts are not exposed on finished surfaces.

B. Metal Bar-Grating Stairs: Form treads and platforms to configurations shown from metal bar grating; fabricate to comply with NAAMM MBG 531, "Metal Bar Grating Manual."
   1. Fabricate treads and platforms from welded or pressure-locked steel grating with openings in gratings no more than 1/2 inch in least dimension.
   2. Surface: Serrated.
   4. Fabricate grating platforms with nosing matching that on grating treads. Provide toeplates at open-sided edges of grating platforms. Weld grating to platform framing.

2.7 STAIR RAILINGS

A. Comply with applicable requirements in Section 05 5213 "Pipe and Tube Railings."
   1. Rails may be bent at corners, rail returns, and wall returns, instead of using prefabricated fittings.
   2. Connect posts to stair framing by direct welding unless otherwise indicated.

2.8 FINISHES

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

B. Finish metal stairs after assembly.

C. Apply shop primer to uncoated surfaces of metal stair components, except those with galvanized finishes and those to be embedded in concrete or masonry unless otherwise indicated. Comply with SSPC-PA 1, "Paint Application Specification No. 1: Shop, Field, and Maintenance Painting of Steel," for shop painting.
   1. Stripe paint corners, crevices, bolts, welds, and sharp edges.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Fastening to In-Place Construction: Provide anchorage devices and fasteners where necessary for securing metal stairs to in-place construction. Include threaded fasteners for concrete and masonry inserts, through-bolts, lag bolts, and other connectors.
B. Cutting, Fitting, and Placement: Perform cutting, drilling, and fitting required for installing metal stairs. Set units accurately in location, alignment, and elevation, measured from established lines and levels and free of rack.

C. Provide temporary bracing or anchors in formwork for items that are to be built into concrete, masonry, or similar construction.

D. Fit exposed connections accurately together to form hairline joints. Weld connections that are not to be left as exposed joints but cannot be shop welded because of shipping size limitations. Do not weld, cut, or abrade surfaces of exterior units that have been hot-dip galvanized after fabrication and are for bolted or screwed field connections.

E. Field Welding: Comply with requirements for welding in “Fabrication, General” Article.

3.2 ADJUSTING AND CLEANING

A. Touchup Painting: Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with same material as used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

1. Apply by brush or spray to provide a minimum 2.0-mil dry film thickness.

END OF SECTION 05 5100
SECTION 05 5213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Steel pipe railings.
   B. Related Requirements:
      1. Section 05 5112 "Metal Pan Stairs" for steel tube railings associated with metal pan stairs.

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 anchorages for railings. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.
   C. Schedule installation so wall attachments are made only to completed walls. Do not support railings temporarily by any means that do not satisfy structural performance requirements.

1.4 ACTION SUBMITTALS
   A. Product Data: For the following:
      1. Manufacturer's product lines of mechanically connected railings.
      2. Railing brackets.
   B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.
   C. Delegated-Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.5 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For testing agency.
B. Welding certificates.

C. Mill Certificates: Signed by manufacturers of stainless-steel products certifying that products furnished comply with requirements.

D. Product Test Reports: For pipe and tube railings, for tests performed by a qualified testing agency, according to ASTM E 894 and ASTM E 935.

1.6 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel according to the following:


1.7 DELIVERY, STORAGE, AND HANDLING

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

1.8 FIELD CONDITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain each type of railing from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design railings, including attachment to building construction.

B. Structural Performance: Railings, including attachment to building construction, shall withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:

1. Handrails and Top Rails of Guards:
   a. Uniform load of 50 lbf/ ft. applied in any direction.
   b. Concentrated load of 200 lbf applied in any direction.
   c. Uniform and concentrated loads need not be assumed to act concurrently.

2. Infill of Guards:
   a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
   b. Infill load and other loads need not be assumed to act concurrently.
C. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F.

2.3 METALS, GENERAL

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

B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.

2.4 STEEL AND IRON

A. Pipe: ASTM A 53/A 53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
   1. Provide galvanized finish for exterior installations and where indicated.

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

2.5 FASTENERS

A. General: Provide the following:
   1. Ungalvanized-Steel Railings: Plated steel fasteners complying with ASTM B 633 or ASTM F 1941, Class Fe/Zn 5 for zinc coating.

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

C. Fasteners for Interconnecting Railing Components:
   1. Provide concealed fasteners for interconnecting railing components and for attaching them to other work, unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

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

B. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout complying with ASTM C 1107/C 1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.

C. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
2.7 FABRICATION

A. General: Fabricate railings to comply with requirements indicated for design, dimensions, member sizes and spacing, details, finish, and anchorage, but not less than that required to support structural loads.

B. Shop assemble railings to greatest extent possible to minimize field splicing and assembly. Disassemble units only as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation. Use connections that maintain structural value of joined pieces.

C. Cut, drill, and punch metals cleanly and accurately. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated. Remove sharp or rough areas on exposed surfaces.

D. Form work true to line and level with accurate angles and surfaces.

E. Fabricate connections that are exposed to weather in a manner that excludes water. Provide weep holes where water may accumulate.

F. Cut, reinforce, drill, and tap as indicated to receive finish hardware, screws, and similar items.

G. Connections: Fabricate railings with either welded or nonwelded connections unless otherwise indicated.

H. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.

   1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
   2. Obtain fusion without undercut or overlap.
   3. Remove flux immediately.
   4. At exposed connections, finish exposed surfaces smooth and blended so no roughness shows after finishing and welded surface matches contours of adjoining surfaces.

I. Form Changes in Direction as Follows:

   1. By bending or by inserting prefabricated elbow fittings.

J. For changes in direction made by bending, use jigs to produce uniform curvature for each repetitive configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.

K. Close exposed ends of railing members with prefabricated end fittings.

L. Provide wall returns at ends of wall-mounted handrails unless otherwise indicated. Close ends of returns unless clearance between end of rail and wall is 1/4 inch or less.

M. Brackets, Flanges, Fittings, and Anchors: Provide wall brackets, flanges, miscellaneous fittings, and anchors to interconnect railing members to other work unless otherwise indicated.

   1. At brackets and fittings fastened to plaster or gypsum board partitions, provide crush-resistant fillers or other means to transfer loads through wall finishes to structural supports and prevent bracket or fitting rotation and crushing of substrate.

N. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work. Fabricate anchorage devices capable of withstanding loads imposed by railings. Coordinate anchorage devices with supporting structure.
O. For railing posts set in concrete, provide steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.

P. For removable railing posts, fabricate slip-fit sockets from steel tube or pipe whose ID is sized for a close fit with posts; limit movement of post without lateral load, measured at top, to not more than one-fortieth of post height. Provide socket covers designed and fabricated to resist being dislodged.

1. Provide chain with eye, snap hook, and staple across gaps formed by removable railing sections at locations indicated. Fabricate from same metal as railings.

2.8 STEEL AND IRON FINISHES

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine plaster and gypsum board assemblies, where reinforced to receive anchors, to verify that locations of concealed reinforcements are clearly marked for Installer. Locate reinforcements and mark locations if not already done.

3.2 INSTALLATION, GENERAL

A. Fit exposed connections together to form tight, hairline joints.

B. Perform cutting, drilling, and fitting required for installing railings. Set railings accurately in location, alignment, and elevation; measured from established lines and levels and free of rack.

1. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.

2. Set posts plumb within a tolerance of 1/16 inch in 3 feet.

3. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.

C. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

1. Coat, with a heavy coat of bituminous paint, concealed surfaces of aluminum that are in contact with grout, concrete, masonry, wood, or dissimilar metals.

D. Adjust railings before anchoring to ensure matching alignment at abutting joints.

E. Fastening to In-Place Construction: Use anchorage devices and fasteners where necessary for securing railings and for properly transferring loads to in-place construction.
3.3 **RAILING CONNECTIONS**

A. Welded Connections: Use fully welded joints for permanently connecting railing components. Comply with requirements for welded connections in "Fabrication" Article whether welding is performed in the shop or in the field.

B. Expansion Joints: Install expansion joints at locations indicated but not farther apart than required to accommodate thermal movement. Provide slip-joint internal sleeve extending 2 inches beyond joint on either side, fasten internal sleeve securely to one side, and locate joint within 6 inches of post.

3.4 **ANCHORING POSTS**

A. Use metal sleeves preset and anchored into concrete for installing posts. After posts are inserted into sleeves, fill annular space between post and sleeve with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

B. Form or core-drill holes not less than 5 inches deep and 3/4 inch larger than OD of post for installing posts in concrete. Clean holes of loose material, insert posts, and fill annular space between post and concrete with nonshrink, nonmetallic grout or anchoring cement, mixed and placed to comply with anchoring material manufacturer's written instructions.

C. Anchor posts to metal surfaces with oval flanges, angle type, or floor type as required by conditions, connected to posts and to metal supporting members as follows:

1. For steel pipe railings, weld flanges to post and bolt to metal supporting surfaces.

D. Install removable railing sections, where indicated, in slip-fit metal sockets cast in concrete.

3.5 **ATTACHING RAILINGS**

A. Anchor railing ends at walls with round flanges anchored to wall construction and welded to railing ends or connected to railing ends using nonwelded connections.

B. Anchor railing ends to metal surfaces with flanges bolted to metal surfaces and welded to railing ends or connected to railing ends using nonwelded connections.

C. Attach railings to wall with wall brackets, except where end flanges are used. Locate brackets as indicated or, if not indicated, at spacing required to support structural loads.

D. Secure wall brackets and railing end flanges to building construction as follows:

1. For steel-framed partitions, use hanger or lag bolts set into wood backing between studs. Coordinate with stud installation to locate backing members.

3.6 **PROTECTION**

A. Protect finishes of railings from damage during construction period with temporary protective coverings approved by railing manufacturer. Remove protective coverings at time of Substantial Completion.

**END OF SECTION 05 5213**
PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Wood blocking and nailers.
   2. Utility shelving.
   3. Plywood backing panels.
B. Related Requirements:
   1. Section 06 1600 "Sheathing" for sheathing, subflooring, and underlayment.

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

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

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

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL
A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, provide lumber that complies with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Provide lumber graded by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Dress lumber, S4S, unless otherwise indicated.

B. Maximum Moisture Content of Lumber: 19 percent for 2-inch nominal thickness or less; no limit for more than 2-inch nominal thickness unless otherwise indicated.

2.2 MISCELLANEOUS LUMBER

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

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

B. Utility Shelving: Lumber with 15 percent maximum moisture content of any of the following species and grades:

1. Mixed southern pine or southern pine No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.

C. Concealed Boards: 19 percent maximum moisture content of any of the following species and grades:

1. Mixed southern pine or southern pine, No. 2 grade; SPIB.
2. Hem-fir or hem-fir (north), Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
3. Spruce-pine-fir (south) or spruce-pine-fir, Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.

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

E. For blocking and nailers used for attachment of other construction, select and cut lumber to eliminate knots and other defects that will interfere with attachment of other work.

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

2.3 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1, Exterior, A-C, in thickness indicated or, if not indicated, not less than 3/4-inch nominal thickness.

1. Plywood shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."
2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.

1. Where carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M.

B. Screws for Fastening to Metal Framing: ASTM C 1002, length as recommended by screw manufacturer for material being fastened.

C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308 as appropriate for the substrate.

   2. Material: Stainless steel with bolts and nuts complying with ASTM F 593 and ASTM F 594, Alloy Group 1 or 2.

2.5 METAL FRAMING ANCHORS


   1. Use for interior locations unless otherwise indicated.

2.6 MISCELLANEOUS MATERIALS

A. Adhesives for Gluing Furring to Concrete or Masonry: Formulation complying with ASTM D 3498 that is approved for use indicated by adhesive manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.

B. Set carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit carpentry accurately to other construction. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels.

C. Install metal framing anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.

D. Do not splice structural members between supports unless otherwise indicated.
E. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than 16 inches o.c.

F. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

G. Securely attach carpentry work to substrate by anchoring and fastening as indicated, complying with the following:


3.2 WOOD BLOCKING AND NAILER INSTALLATION

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

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

3.3 WOOD FURRING INSTALLATION

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

3.4 PROTECTION

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

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

END OF SECTION 06 1053
SECTION 06 1600 - SHEATHING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Wall sheathing.
   2. Parapet sheathing.

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

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

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS
A. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.
   B. Factory mark panels to indicate compliance with applicable standard.

2.2 WALL SHEATHING
   3. Basis-of-Design Product: Subject to compliance with requirements, provide Georgia-Pacific Gypsum LLC; Dens-Glass Gold or comparable product by one of the following:
      a. CertainTeed Corporation.
      b. CertainTeed Gypsum.
      c. National Gypsum Company.
      d. USG Corporation.
4. Type and Thickness: Type X, 5/8 inch thick.
5. Size: 48 by 96 inches for vertical installation.

2.3 PARAPET SHEATHING

A. Plywood Sheathing: Exterior, Structural I sheathing.
6. Span Rating: Not less than 16/0.
7. Nominal Thickness: Not less than 1/2 inch.

2.4 FASTENERS

A. General: Provide fasteners of size and type indicated that comply with requirements specified in this article for material and manufacture.
8. For parapet and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A153/A153M.

B. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.

C. Screws for Fastening Gypsum Sheathing to Cold-Formed Metal Framing: Steel drill screws, in length recommended by sheathing manufacturer for thickness of sheathing to be attached.
9. For steel framing less than 0.0329 inch thick, use screws that comply with ASTM C1002.
10. For steel framing from 0.033 to 0.112 inch thick, use screws that comply with ASTM C954.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Do not use materials with defects that impair quality of sheathing or pieces that are too small to use with minimum number of joints or optimum joint arrangement. Arrange joints so that pieces do not span between fewer than three support members.

B. Cut panels at penetrations, edges, and other obstructions of work; fit tightly against abutting construction unless otherwise indicated.

C. Securely attach to substrate by fastening as indicated, complying with the following:

D. Coordinate wall parapet sheathing installation with flashing and joint-sealant installation so these materials are installed in sequence and manner that prevent exterior moisture from passing through completed assembly.

E. Do not bridge building expansion joints; cut and space edges of panels to match spacing of structural support elements.

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


B. Fastening Methods: Fasten panels as indicated below:

13. Parapet Wall Sheathing:
   a. Screw to cold-formed metal framing.
   b. Space panels 1/8 inch apart at edges and ends.

3.3 GYPSUM SHEATHING INSTALLATION

A. Comply with GA-253 and with manufacturer's written instructions.

   14. Fasten gypsum sheathing to cold-formed metal framing with screws.
   15. Install panels with a 3/8-inch gap where non-load-bearing construction abuts structural elements.
   16. Install panels with a 1/4-inch gap where they abut masonry or similar materials that might retain moisture, to prevent wicking.

B. Apply fasteners so heads bear tightly against face of sheathing, but do not cut into facing.

C. Horizontal Installation: Install sheathing with V-grooved edge down and tongue edge up. Interlock tongue with groove to bring long edges in contact with edges of adjacent panels without forcing. Abut ends over centers of studs, and stagger end joints of adjacent panels not less than one stud spacing. Attach at perimeter and within field of panel to each stud.

   17. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

D. Vertical Installation: Install vertical edges centered over studs. Abut ends and edges with those of adjacent panels. Attach at perimeter and within field of panel to each stud.

   18. Space fasteners approximately 8 inches o.c. and set back a minimum of 3/8 inch from edges and ends of panels.

E. Seal sheathing joints according to sheathing manufacturer's written instructions.

END OF SECTION 06 1600
SECTION 06 4116 - PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Plastic-laminate-faced architectural cabinets.
   2. Wood furring, blocking, shims, and hanging strips for installing plastic-laminate-faced architectural cabinets unless concealed within other construction before cabinet installation.

B. Related Requirements:
   1. Section 12 3623.13 "Plastic-Laminate-Clad Countertops."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product, including, panel products, high-pressure decorative laminate, and cabinet hardware and accessories.

B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show details full size.
   2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   3. Show locations and sizes of cutouts and holes for installed in architectural plastic-laminate cabinets.

C. Samples for Initial Selection:
   1. Plastic laminates.
   2. PVC edge material.

D. Samples for Verification:
   1. Plastic laminates, 12 by 12 inches, for each type, color, pattern, and surface finish and specified edge material applied to one edge.
   2. Wood-grain plastic laminates, 24 by 24 inches, for each pattern and surface finish and specified edge material applied to one edge.
   3. Exposed cabinet hardware and accessories, one unit for each type and finish.
1.4 DELIVERY, STORAGE, AND HANDLING

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

1.5 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install cabinets until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where cabinets are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support cabinets by field measurements before being enclosed, and indicate measurements on Shop Drawings.

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

1.6 COORDINATION

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

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 08 7111 "Door Hardware (Descriptive Specification)" to fabricator of architectural woodwork; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE-FACED ARCHITECTURAL CABINETS

A. Quality Standard: Unless otherwise indicated, comply with the “Architectural Woodwork Standards” for grades of architectural plastic-laminate cabinets indicated for construction, finishes, installation, and other requirements.

1. The Contract Documents contain selections chosen from options in the quality standard and additional requirements beyond those of the quality standard. Comply with those selections and requirements in addition to the quality standard.

B. Grade: Premium.

C. Type of Construction: Frameless.

D. Cabinet, Door, and Drawer Front Interface Style: Flush overlay.
E. High-Pressure Decorative Laminate: NEMA LD 3, grades as indicated or if not indicated, as required by woodwork quality standard.

1. Manufacturers subject to compliance with requirements, provide products by the following:
   
a. Refer to Appendix A "Interior Finish Key" for color, texture and manufacturer.

F. Laminate Cladding for Exposed Surfaces:

1. Horizontal Surfaces: Grade HGS.
2. Postformed Surfaces: Grade HGP.
3. Vertical Surfaces: Grade HGS.
4. Edges: PVC edge banding, 0.12-inch-thick, matching laminate in color, pattern, and finish.
5. Pattern Direction: As indicated.

G. Materials for Semiexposed Surfaces:

1. Surfaces Other Than Drawer Bodies: Thermoset decorative panels.
   
a. Edges of Thermoset Decorative Panel Shelves: PVC or polyester edge banding.
   b. For semiexposed backs of panels with exposed plastic-laminate surfaces, provide surface of high-pressure decorative laminate, NEMA LD 3, Grade VGS.

2. Drawer Sides and Backs: Thermoset decorative panels with PVC or polyester edge banding.
3. Drawer Bottoms: Thermoset decorative panels.

H. Concealed Backs of Panels with Exposed Plastic-Laminate Surfaces: High-pressure decorative laminate, NEMA LD 3, Grade BKL.

I. Drawer Construction: Fabricate with exposed fronts fastened to subfront with mounting screws from interior of body.

1. Join subfronts, backs, and sides with glued rabbeted joints supplemented by mechanical fasteners or glued dovetail joints.

J. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:

1. As indicated by laminate manufacturer's designations.

2.2 WOOD MATERIALS

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

1. Wood Moisture Content: 5 to 10 percent.

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

2.3 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 08 7111 "Door Hardware (Descriptive Specification)."

B. Butt Hinges: 2-3/4-inch, five-knuckle steel hinges made from 0.095-inch-thick metal, and as follows:

C. Back-Mounted Pulls: BHMA A156.9, B02011.

D. Wire Pulls: Back mounted, solid metal, 5 inches long, 2-1/2 inches deep, and 5/16 inch in diameter.

E. Adjustable Shelf Standards and Supports (use in soiled and clean rooms): BHMA A156.9, B04071; with shelf rests, B04081 BHMA A156.9, B04102; with shelf brackets, B04112.

   1. Basis-of-Design for all adjustable shelves: Heavy Duty Knape & Vogt 85/185 series steel double-slot wall standards (1 ¼” x ½” x length indicated on drawings) with 24” double-flange adjustable brackets. Finish to be ANO.


F. Drawer Slides: BHMA A156.9.

   1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated steel with polymer rollers.

   2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.

   3. For drawers not more than 3 inches high and not more than 24 inches wide, provide Grade 2.

   4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1.

   5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-100.

G. Door Locks: BHMA A156.11, E07121.

H. Drawer Locks: BHMA A156.11, E07041.

I. Door and Drawer Silencers: BHMA A156.16, L03011.

J. False Front Connectors: Hafele Keku Push-In Fittings # 262.50.313.

   1. For removal of aprons at sink and lavatories.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

   1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

L. For concealed hardware, provide manufacturer’s standard finish that complies with product class requirements in BHMA A156.9.

M. Countertop Support Angles: Equal to Rakks #EH1824FM or EH1818FM. Contractor to verify which bracket is required for countertop depth.
N. Aluminum Slides for Sliding & Fixed Glass Doors at Reception Counters:
   1. Hardware equal to Knape and Vogt Roll Ezy Ball Bearing Track System with the following components 993 Upper Channel, 995 Shoe for each pane of glass, 997 Ball Bearing Carrier, and 999 Lower Track

O. Shoes for glass panels:
   1. Basis-of-Design Product: Provide The Wagner Companies; Series GR2850 base shoe with stainless steel cladding covering all exposed surfaces of the shoe or a comparable product by one of the following:
      b. CR Laurence Company – Series B6S base shoe with stainless steel cladding
      c. Julius Blum and Company – Series 1142 base shoe with stainless steel cladding

2.4 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

2.5 FABRICATION

A. Fabricate cabinets to dimensions, profiles, and details indicated.

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

   1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.6 CLOSET AND UTILITY SHELVING

A. Shelf Material: 3/4-inch thermoset decorative panel with PVC or polyester edge banding.

B. Cleats: 3/4-inch thermoset decorative panel.
PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

B. Before installing cabinets, examine shop-fabricated work for completion and complete work as required.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Assemble cabinets and complete fabrication at Project site to the extent that it was not completed in the shop.

C. Install cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

D. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

E. Anchor cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails or finishing screws for exposed fastening, countersunk and filled flush with woodwork.
   1. Use filler matching finish of items being installed.

F. Cabinets: Install without distortion so doors and drawers’ fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete installation of hardware and accessory items as indicated.
   1. Install cabinets with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
   2. Fasten wall cabinets through back, near top and bottom, and at ends not more than 16 inches o.c. with No. 10 wafer-head screws sized for not less than 1-1/2-inch penetration into wood framing, blocking, or hanging strips No. 10 wafer-head sheet metal screws through metal backing or metal framing behind wall finish

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective cabinets, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean, lubricate, and adjust hardware.

C. Clean cabinets on exposed and semiexposed surfaces.

END OF SECTION 06 4116
SECTION 06 6200 – RESIN PANEL SYSTEMS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Resin panels.
   2. Resin panel hardware.

B. Related Requirements:
   1. Section 06 4116 "Plastic Laminate-Faced Architectural Cabinets" for coordination of casework scheduled to receive the pony wall system.
   2. Section 06 1053 "Miscellaneous Rough Carpentry" for wood blocking required for installing pony wall system.

1.3 PREINSTALLATION MEETINGS
A. Preinstallation Conference: Conduct conference at Project site.

1.4 SUBMITTALS
A. Product Data: For each type of product and hardware.
B. Shop Drawings: Show location of panels, large-scale details, attachment and hardware devices, and other components. Include dimensioned details, plans and elevations.
   1. Show locations and sizes of blocking, including concealed blocking specified in other Sections.
   2. Show fastenings and other pertinent information for hardware and systems.
   3. Show mounting locations for door and pony wall hardware.
C. Samples for verification for resin panels, 12 inch x 12 inch, for each type, color, pattern, and surface finish.

1.5 QUALITY ASSURANCE
A. Fabricator Qualifications: Shop that is acceptable to resin panel manufacture and employs skilled workers who custom-fabricate products similar to those required for this Project and whose products have a record of successful in-service performance.

1.6 DELIVERY, STORAGE AND HANDLING
A. Do not deliver resin panels until painting and similar operations that could damage panels have been completed in installation areas.

1.7 FIELD CONDITIONS

A. Field Measurements: Where resin panels are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed and indicate measurements on Shop Drawings.

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

1.8 COORDINATION

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

PART 2 - PRODUCTS

2.1 RESIN PANELS (RP-1, RP-2, RP-3): Refer to Appendix A “Interior Finish Key”

A. Basis-of-Design: Subject to compliance with requirements, provide products by the following: As listed in Appendix A – Interior Finish Key or comparable product by one of the following:

1. 3 Form
2. Lumicor

B. Patterns:

1. Fabrication: Fabricate panels with pattern running vertically.
2. Installation: Install panels so patterns run vertically on all resin panel elements and in all applications.

C. Panel thickness, Pattern & Finish: Refer to Appendix A “Interior Finish Key” for Resin Panel colors and textures.

1. RP-1: 1/2”, Whisper, Sandstone Finish
   a. Project locations: Partition panels at Pharmacy Counter and dividing wall South of Vending/in front of Pharmacy

2. RP-2: 1/2”, Whisper, Sandstone Finish
   a. Project locations: Sliding Doors

3. RP-3: ½", Queue Castaway, Sandstone Finish
a. Project locations: Children’s Waiting

D. Exposed Panel Edges: polished and eased

2.2 **RESIN PANEL SYSTEMS – HARDWARE: (H-1, H-2, H-3) Refer to Appendix A “Interior Finish Key”**

A. Hardware: (H-1, H-4)

1. Pony Wall hardware:
2. Equal to **3-Form Versa Slim System Pony Wall**

a. Vertical end supports: equal Slim One

1) Top cap: Slim One Cap
2) Brackets: (2) Side brackets and MB T-Nut per Slim One post

a) Sized for panel thickness of ½”

b. Bottom Plate: three inch plate for Slim One supports
c. Plate Covers: Slim One covers
d. Slot Covers: at all open slots

3. Pony Wall Locations: as indicated on interior elevations and details for Pharmacy Project locations: Diagonal divider at Reception Counter

B. Hardware: (H-2)

1. Frameless wall-mount sliding door with floor guide: **3-Form Slide 01 100.01 Simple Spec Customized**

a. Project locations: Sliding Doors

C. Hardware: (H-3) NOT USED

1. Single point connector: **3-Form 1” Cap threaded Rod**

a. Project locations: Accent panels at reception front

D. Hardware: (H-5)

1. Suspension hardware: **3-Form Frameless Suspended Partition, Hardware finish Stainless, SimpleSpec 200.08**

a. Project location: Dividing wall South of Vending/in front of Pharmacy

2.3 **INSTALLATION MATERIALS**

A. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage.

2.4 **FABRICATION**

A. Complete fabrication, including assembly, to maximum extent possible at product manufacturing site, before shipment to Project site. Disassemble components only as necessary for shipment
and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Shop cut openings, to maximum extent possible, to receive hardware and similar items.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installing panels, examine shop-fabricated work for completion and complete work as required, including removal of packing.

3.2 INSTALLATION

A. Install panels level, plumb, true, and straight with no distortions. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.

B. Anchor panels with panel system hardware per manufacturer’s instructions.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective resin panels and hardware, where possible, to eliminate defects; where not possible to repair, replace panels or hardware. Adjust for uniform appearance.

B. Remove and replace panels that are broken, chipped, cracked, scratched, stained, or abraded or that are damaged during construction period.

C. Clean resin panels on exposed surfaces.

END OF SECTION 06 6200
SECTION 07 1113 - BITUMINOUS DAMPPROOFING

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Cold-applied, emulsified-asphalt dampproofing.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.

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

PART 2 - PRODUCTS

2.1 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING
   A. Basis-of-Design Product: Subject to compliance with requirements, provide W.R. Meadows, Inc; Sealmastic Type II or comparable product by one of the following:
      2. BASF Corporation.
      3. ChemMasters, Inc.
      4. Euclid Chemical Company (The); an RPM company.
      5. Henry Company.
   B. Fibered Brush and Spray Coats: ASTM D 1227, Type II, Class 1.

2.2 AUXILIARY MATERIALS
   A. Furnish auxiliary materials recommended in writing by dampproofing manufacturer for intended use and compatible with bituminous dampproofing.
   B. Cut-Back-Asphalt Primer: ASTM D 41/D 41M.
C. Emulsified-Asphalt Primer: ASTM D 1227, Type III, Class 1, except diluted with water as recommended in writing by manufacturer.

D. Asphalt-Coated Glass Fabric: ASTM D 1668/D 1668M, Type I.

E. Patching Compound: Epoxy or latex-modified repair mortar Asbestos-free fibered mastic of type recommended in writing by dampproofing manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for surface smoothness, maximum surface moisture content, and other conditions affecting performance of the Work.

B. Proceed with application only after substrate construction and penetrating work have been completed and unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean, prepare, and treat substrates according to manufacturer's written instructions. Provide clean, dust-free, and dry substrates for dampproofing application.

B. Mask or otherwise protect adjoining exposed surfaces from being stained, spotted, or coated with dampproofing. Prevent dampproofing materials from entering and clogging weep holes and drains.

C. Clean substrates of projections and substances detrimental to dampproofing work; fill voids, seal joints, and remove bond breakers if any.

D. Apply patching compound to patch and fill tie holes, honeycombs, reveals, and other imperfections; cover with asphalt-coated glass fabric.

3.3 APPLICATION, GENERAL

A. Comply with manufacturer's written instructions for dampproofing application, cure time between coats, and drying time before backfilling unless otherwise indicated.

6. Apply dampproofing to provide continuous plane of protection.

7. Apply additional coats if recommended in writing by manufacturer or to achieve a smooth surface and uninterrupted coverage.

B. Concrete Foundations: Apply two brush or spray coats at not less than 1.25 gal./100 sq. ft. for first coat and 1 gal./100 sq. ft. for second coat or one trowel coat at not less than 4 gal./100 sq. ft.

3.4 COLD-APPLIED, EMULSIFIED-ASPHALT DAMPPROOFING

A. Concrete Backup for Brick Veneer Assemblies or Decorative Concrete Masonry Units Cladding: Apply one brush or spray coat at not less than 1 gal./100 sq. ft.
3.5 PROTECTION

A. Protect installed insulation drainage panels from damage due to UV light, harmful weather exposures, physical abuse, and other causes. Provide temporary coverings where panels are subject to abuse and cannot be concealed and protected by permanent construction immediately after installation.

B. Correct dampproofing that does not comply with requirements; repair substrates and reapply dampproofing.

END OF SECTION 07 1113
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PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Extruded polystyrene foam-plastic board.
      2. Molded polystyrene foam-plastic board.
   B. Related Requirements:
      1. Section 07 4265 "Thermal and Air Barrier Wall System" for insulation behind the exterior
         envelope. (Brick, Stone and metal composite panels).
      2. Section 07 5552 "Modified Bituminous Protected Membrane Roofing" for insulation
         specified as part of roofing construction.
      3. Section 09 2900 "Gypsum Board" for sound attenuation blanket used as acoustic
         insulation.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.

1.4 INFORMATIONAL SUBMITTALS
   A. Product Test Reports: For each product, for tests performed by a qualified testing agency.
   B. Evaluation Reports: For foam-plastic insulation, from ICC-ES.

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

2.1 EXTRUDED POLYSTYRENE FOAM-PLASTIC BOARD

A. Extruded polystyrene boards in this article are also called "XPS boards." Roman numeral designators in ASTM C 578 are assigned in a fixed random sequence, and their numeric order does not reflect increasing strength or other characteristics.

B. Extruded Polystyrene Board, Type X: ASTM C 578, Type X, 15-psir minimum compressive strength; unfaced; maximum flame-spread and smoke-developed indexes of 25 and 450, respectively, per ASTM E 84.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. DiversiFoam Products.
   b. Dow Chemical Company (The); STYROFOAM Brand CAVITYMATE SC Insulation.
   c. MBCI; HPCI BarrierTM.
   d. Owens Corning.


PART 3 - EXECUTION

3.1 PREPARATION

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

3.2 INSTALLATION, GENERAL

A. Comply with insulation manufacturer's written instructions applicable to products and applications.

   1. Butt Joints Tightly.

B. Install insulation that is undamaged, dry, and unsoiled and that has not been left exposed to ice, rain, or snow at any time.

C. Extend insulation to envelop entire area to be insulated. Fit tightly around obstructions and fill voids with insulation. Remove projections that interfere with placement.

D. Provide sizes to fit applications and selected from manufacturer's standard thicknesses, widths, and lengths. Apply single layer of insulation units unless multiple layers are otherwise shown or required to make up total thickness or to achieve R-value.

3.3 INSTALLATION OF SLAB INSULATION

A. On vertical slab edge and foundation surfaces, set insulation units using manufacturer's recommended adhesive according to manufacturer's written instructions.
1. If not otherwise indicated, extend insulation a minimum of 36 inches below exterior grade line.

B. On horizontal surfaces, loosely lay insulation units according to manufacturer's written instructions. Stagger end joints and tightly abut insulation units.

1. If not otherwise indicated, extend insulation a minimum of 36 inches in from exterior walls.

3.4 PROTECTION

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

END OF SECTION 07 2100
SECTION 07 2419 - WATER-DRAINAGE EXTERIOR INSULATION AND FINISH SYSTEM (EIFS)

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. EIFS-clad drainage-wall assemblies that are field applied over substrate.
   2. Water-resistive coatings.
   3. Air Barrier

B. Related Requirements:
   1. Section 07 9200 "Joint Sealants" for sealing joints in EIFS with elastomeric joint sealants and for perimeter joints between system and other materials.
   2. Section 06 1600 “Sheathing” for EIFS sub-straight.

1.3 DEFINITIONS

A. Definitions in ASTM E 2110 apply to Work of this Section.

B. EIFS: Exterior insulation and finish system(s).


1.4 SUBMITTALS

A. Product Data: For each EIFS component, trim, and accessory, including water-resistive coatings.

B. Samples for Initial Selection: For each type of finish-coat color and texture indicated.
   1. Include similar Samples of exposed accessories involving color selection.

C. Samples for Verification: 24-inch- square panels for each type of finish-coat color and texture indicated, prepared using same tools and techniques intended for actual work including custom trim, each profile, and an aesthetic reveal.
   1. Include exposed trim and accessory Samples to verify color selected.
   2. Include a typical control joint filled with sealant of color selected, as specified in Section 07 9200 "Joint Sealants."

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

E. Maintenance Data: For EIFS to include in maintenance manuals.
1.5 QUALITY ASSURANCE

A. Installer Qualifications: An installer who is certified in writing by EIFS manufacturer as qualified to install manufacturer’s system using trained workers.

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

1. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original, unopened packages with manufacturers’ labels intact and clearly identifying products.

B. Store materials inside and under cover; keep them dry and protected from weather, direct sunlight, surface contamination, aging, corrosion, damaging temperatures, construction traffic, and other causes.

1. Stack insulation board flat and off the ground.
2. Protect plastic insulation against ignition at all times. Do not deliver plastic insulating materials to Project site before installation time.
3. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

1.7 FIELD CONDITIONS

A. Weather Limitations: Maintain ambient temperatures above 40 deg F for a minimum of 24 hours before, during, and after adhesives or coatings are applied. Do not apply EIFS adhesives or coatings during rainfall. Proceed with installation only when existing and forecasted weather conditions and ambient outdoor air, humidity, and substrate temperatures permit EIFS to be applied, dried, and cured according to manufacturers' written instructions and warranty requirements.

1.8 WARRANTY

A. Manufacturer’s Special Warranty: Manufacturer agrees to repair or replace components of EIFS-clad drainage-wall assemblies that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Bond integrity and weathertightness.
b. Deterioration of EIFS finishes and other EIFS materials beyond normal weathering.

2. Warranty coverage includes the following components of EIFS-clad drainage-wall assemblies:

a. EIFS finish, including base coats, finish coats, and reinforcing mesh.
b. Insulation installed as part of EIFS.
c. Insulation adhesive and mechanical fasteners.
d. EIFS accessories, including trim components and flashing.
e. Water-resistive coatings.
f. EIFS drainage components.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Provide Reflectit smooth on Outsulation Plus MD System by Dryvit Systems, Inc or a comparable product by one of the following:

1. BASF Wall Systems.
2. Sto Corp.
3. Total Wall, Inc.

B. Source Limitations: Obtain EIFS from single source from single EIFS manufacturer and from sources approved by EIFS manufacturer as compatible with EIFS components.

2.2 PERFORMANCE REQUIREMENTS

A. EIFS Performance: Comply with ASTM E 2568 and ICC-ES AC219 and with the following:

1. Weather tightness: Resistant to uncontrolled water penetration from exterior, with a means to drain water entering EIFS to the exterior.
2. Structural Performance: EIFS assembly and components shall comply with ICC-ES AC219 when tested according to ASTM E 2568.
   a. Wind Loads: Uniform pressure as indicated on Drawings.
4. Bond Integrity: Free from bond failure within EIFS components or between EIFS and substrates, resulting from exposure to fire, wind loads, weather, or other in-service conditions.
5. Mildew Resistance of Finish Coat: Sample applied to 2-by-2-inch clean glass substrate; cured for 28 days and shows no growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274.

2.3 EIFS MATERIALS

A. Water-Resistive Coatings: EIFS manufacturer's standard formulation and accessories for use as water-resistive barriers; compatible with substrate and complying with physical and performance criteria of ASTM E 2570.

B. Flexible-Membrane Flashing: Cold-applied, self-adhering, self-healing, rubberized-asphalt and polyethylene-film composite sheet or tape and primer; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer.

C. Drainage Mat: Three-dimensional, nonwoven, entangled filament, nylon or plastic mat designed to drain incidental moisture by gravity; EIFS manufacturer's standard or product recommended in writing by EIFS manufacturer with manufacturer's standard corrosion-resistant mechanical fasteners suitable for intended substrate.
D. Molded, Rigid Cellular Polystyrene Board Insulation: Comply with ASTM C 578, Type I; and EIFS manufacturer's requirements for most stringent requirements for material performance and qualities of insulation, including dimensions and permissible variations, and the following:

1. Aging: Before cutting and shipping, age insulation in block form by air drying for not less than six weeks.
2. Flame-Spread and Smoke-Developed Indexes: 25 and 450 or less, respectively, according to ASTM E 84.
3. Dimensions: Provide insulation boards of not more than 24 inches by 48 inches with minimum thickness of 1-1/2" but not less than allowed by ASTM C 1397.
4. Channeled Board Insulation: EIFS manufacturer's standard factory-fabricated profile with linear, vertical-drainage channels, slots, or waves on the back side of board.

E. Reinforcing Mesh: Balanced, alkali-resistant, open-weave, glass-fiber mesh treated for compatibility with other EIFS materials, made from continuous multiend strands with retained mesh tensile strength of not less than 120 lbf/in. according to ASTM E 2098 and the following:

1. Reinforcing Mesh for EIFS, General: Not less than weight required to meet impact-performance level specified in "Performance Requirements" Article.
2. Strip Reinforcing Mesh: Not less than As recommended by EIFS manufacturer.
3. Detail Reinforcing Mesh: Not less than As recommended by EIFS manufacturer.
4. Corner Reinforcing Mesh: Not less than As recommended by EIFS manufacturer.

F. Mechanical Fasteners: EIFS manufacturer's standard corrosion-resistant fasteners consisting of thermal cap, standard washer and shaft attachments, and fastener indicated below; designed to resist Project's design loads; capable of pulling fastener head below surface of insulation board; and complying with the following:

1. For attachment to steel studs from 0.033 to 0.112 inch in thickness, provide steel drill screws complying with ASTM C 954.

G. Primer: EIFS manufacturer's standard factory-mixed, elastomeric-polymer primer for preparing base-coat surface for application of finish coat.

H. Finish-Coat Materials: EIFS manufacturer's standard acrylic-based coating with enhanced mildew resistance complying with the following:

1. Factory-mixed formulation of polymer-emulsion binder, colorfast mineral pigments, sound stone particles, and fillers.
2. Colors: Refer to Appendix B "Exterior Finish Key" for color.
3. Textures: Smooth.

I. Sealer: Manufacturer's waterproof, clear acrylic-based sealer for protecting finish coat.

J. Water: Potable.

K. Trim Accessories: Type as designated or required to suit conditions indicated and to comply with EIFS manufacturer's written instructions; manufactured from UV-stabilized PVC; and complying with ASTM D 1784, manufacturer's standard cell class for use intended, and ASTM C 1063.

1. Casing Bead: Prefabricated, one-piece type for attachment behind insulation, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
2. Drip Screed/Track: Prefabricated, one-piece type for attachment behind insulation with face leg extended to form a drip, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg.
3. Weep Screed/Track: Prefabricated, one-piece type for attachment behind insulation with perforated face leg extended to form a drip and weep holes in track bottom, of depth required to suit thickness of coating and insulation, with face leg perforated for bonding to coating and back leg; designed to drain incidental moisture that gets into wall construction to the exterior at terminations of EIFS with drainage.

2.4 MIXING

A. Comply with EIFS manufacturer's requirements for combining and mixing materials. Do not introduce admixtures, water, or other materials except as recommended by EIFS manufacturer. Mix materials in clean containers. Use materials within time period specified by EIFS manufacturer or discard.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roof edges, wall framing, flashings, openings, substrates, and junctures at other construction for suitable conditions where EIFS will be installed.

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

1. Begin coating application only after surfaces are dry.
2. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Protect contiguous work from moisture deterioration and soiling caused by application of EIFS. Provide temporary covering and other protection needed to prevent spattering of exterior finish coats on other work.

B. Protect EIFS, substrates, and wall construction behind them from inclement weather during installation. Prevent penetration of moisture behind drainage plane of EIFS and deterioration of substrates.

C. Prepare and clean substrates to comply with EIFS manufacturer's written instructions to obtain optimum bond between substrate and adhesive for insulation.

3.3 EIFS INSTALLATION, GENERAL

A. Comply with ASTM C 1397, ASTM E 2511, and EIFS manufacturer's written instructions for installation of EIFS as applicable to each type of substrate indicated.

3.4 SUBSTRATE PROTECTION APPLICATION

A. Flexible-Membrane Flashing: Install over weather-resistant barrier, applied and lapped to shed water; seal at openings, penetrations, terminations, and where required by EIFS manufacturer.
Prime substrates if required and install flashing to comply with EIFS manufacturer's written instructions and details.

3.5 TRIM INSTALLATION

A. Trim: Apply trim accessories at perimeter of EIFS, at expansion joints, and elsewhere as indicated. Coordinate with installation of insulation.

1. Weep Screed/Track: Use at bottom termination edges, at window and door heads of water-drainage EIFS unless otherwise indicated.
2. Casing Bead: Use at other locations.
3. Soffit Vents: as indicated on drawings.

3.6 DRAINAGE MAT INSTALLATION

A. Drainage Mat: Apply wrinkle free, continuously, with edges butted and mechanically secured with fasteners over water-resistive barrier.

3.7 INSULATION INSTALLATION

A. Board Insulation: Adhesively and mechanically attach insulation to substrate in compliance with ASTM C 1397 and the following:

1. Press and slide insulation into place. Apply pressure over the entire surface of insulation to accomplish uniform contact, high initial grab, and overall level surface.
2. Mechanically attach insulation to substrate. Install top surface of fastener heads flush with plane of insulation. Install fasteners into or through substrates with the following minimum penetration:
   a. Steel Framing: 5/16 inch.
3. Apply insulation over substrates in courses with long edges of boards oriented horizontally.
4. Begin first course of insulation from screed/track and work upward. Work from perimeter casing beads toward interior of panels if possible.
5. Stagger vertical joints of insulation boards in successive courses to produce running bond pattern. Locate joints so no piece of insulation is less than 12 inches wide or 6 inches high. Offset joints not less than 6 inches from corners of window and door openings and not less than 4 inches from aesthetic reveals.
   a. Adhesive Attachment: Offset joints of insulation not less than 6 inches from horizontal and 4 inches from vertical joints in sheathing.
   b. Mechanical Attachment: Offset joints of insulation from horizontal joints in sheathing.
6. Apply channeled insulation with drainage channels aligned vertically.
7. Interlock ends at internal and external corners.
8. Abut insulation tightly at joints within and between each course to produce flush, continuously even surfaces without gaps or raised edges between boards. If gaps greater than 1/16 inch occur, fill with insulation cut to fit gaps exactly; insert insulation without using adhesive or other material.
9. Cut insulation to fit openings, corners, and projections precisely and to produce edges and shapes complying with details indicated.
10. Rasp or sand flush entire surface of insulation to remove irregularities projecting more than 1/32 inch from surface of insulation and to remove yellowed areas due to sun
exposure; do not create depressions deeper than 1/16 inch. Prevent airborne dispersal and immediately collect insulation raspings or sandings.

11. Cut aesthetic reveals in outside face of insulation with high-speed router and bit configured to produce grooves, rabbets, and other features that comply with profiles and locations indicated. Do not reduce insulation thickness at aesthetic reveals to less than 3/4 inch.

12. Install soffit vents to be level with finish soffits. Install Drips as indicated on drawings.

13. Interrupt insulation for expansion joints where indicated.

14. Form joints for sealant application by leaving gaps between adjoining insulation edges and between insulation edges and dissimilar adjoining surfaces. Make gaps wide enough to produce joint widths indicated after encapsulating joint substrates with base coat and reinforcing mesh.

15. Form joints for sealant application with back-to-back casing beads for joints within EIFS and with perimeter casing beads at dissimilar adjoining surfaces. Make gaps between casing beads and between perimeter casing beads and adjoining surfaces of width indicated.

16. After installing insulation and before applying field-applied reinforcing mesh, fully wrap board edges. Cover edges of board and extend encapsulating mesh not less than 2-1/2 inches over front and back face unless otherwise indicated on Drawings.

17. Treat exposed edges of insulation as follows:
   
a. Except for edges forming substrates of sealant joints, encapsulate with base coat, reinforcing mesh, and finish coat.
   
b. Encapsulate edges forming substrates of sealant joints within EIFS or between EIFS and other work with base coat and reinforcing mesh.
   
c. At edges trimmed by accessories, extend base coat, reinforcing mesh, and finish coat over face leg of accessories.

18. Coordinate installation of flashing and insulation to produce wall assembly that does not allow water to penetrate behind flashing and water-resistive barrier.

### 3.8 BASE-COAT INSTALLATION

A. Reinforcing Mesh: Embed reinforcing mesh in wet base coat to produce wrinkle-free installation with mesh continuous at corners, overlapped not less than 2-1/2 inches or otherwise treated at joints to comply with ASTM C 1397 and EIFS manufacturer's written instructions. Do not lap reinforcing mesh within 8 inches of corners. Completely embed mesh, applying additional basecoat material if necessary, so reinforcing-mesh color and pattern are invisible.

B. Additional Reinforcing Mesh: Apply strip reinforcing mesh around openings, extending 4 inches beyond perimeter. Apply additional 9-by-12-inch strip reinforcing mesh diagonally at corners of openings (re-entrant corners). Apply 8-inch wide, strip reinforcing mesh at both inside and outside corners unless base layer of mesh is lapped not less than 4 inches on each side of corners.

   1. At aesthetic reveals, apply strip reinforcing mesh not less than 8 inches wide.
   
   2. Embed strip reinforcing mesh in base coat before applying first layer of reinforcing mesh.

C. Double Base-Coat Application: For Reflectit Smooth apply second base coat in same manner and thickness as first application, except without reinforcing mesh.

D. Ultrafil Smoothing Base Coat Application: 1-2 passes with sanding to achieve a smooth surface free of trowel marks and small ridges.

### 3.9 FINISH-COAT INSTALLATION
A. Primer: Spray apply over dry Ultrafil base coat according to EIFS manufacturer’s written instructions.

B. Finish Coat: Spray Apply over dry primed Ultrafil base coat, maintaining a wet edge at all times for uniform appearance, in thickness required by EIFS manufacturer to produce a uniform finish of color and texture matching approved sample and free of cold joints, shadow lines, and texture variations.

1. Finish: To be equal to Dryvit Reflectit Smooth finish.

3.10 CLEANING AND PROTECTION

A. Remove temporary covering and protection of other work. Promptly remove coating materials from window and door frames and other surfaces outside areas indicated to receive EIFS coatings.

END OF SECTION 07 2419
SECTION 07 2619 – TOPICAL MOISTURE VAPOR MITIGATION SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes a single-coat, fast curing, 100% solids epoxy moisture management system formulated to suppress excessive moisture vapor emissions in new concrete prior to installing flooring.

B. This section will only be required if the slab moisture content is such that flooring cannot be laid. Provide a unit cost per square foot as indicated on the bid form and indicated in Unit Price Section.

C. Related Requirements:
   1. Section 03 3000 “Cast-in-Place Concrete”.
   2. Division 09 Flooring Sections.

1.3 REFERENCES

A. ASTM f2170 – Relative Humidity in Concrete Floor Slabs Using in situ Probes.
B. ASTM F1869 – Moisture Vapor Emission Rate of Concrete subfloor Using Anhydrous Calcium Chloride.
C. ASTM 710 – Standard Practice for preparing concrete floors to receive resilient flooring.

1.4 SUBMITTALS

A. Product Data: For each type of product.

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

1.5 QUALITY ASSURANCE
A. Installation of Topical Moisture Vapor Mitigation System must be completed by a certified applicator using mixing equipment and tools approved by the manufacturer.

B. Manufacturer Experience: Provide products of this section by companies which have successfully specialized in production of this type of work for not less than 5 years. Contact Manufacturer’s representative prior to installation.

1.6 WARRANTY

A. Certified applicator must file a pre-installation checklist with the manufacturer and receive written confirmation of the approval to proceed in order to obtain the extended 10 year Warranty.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver products in original packaging, labeled with product identification, manufacturer, batch number and shelf life.

B. Store Products in a dry area with temperature maintained between 50 and 85 degrees F and protect from direct daylight.

C. Handle products in accordance with manufacturer’s printed recommendations.

1.8 PROJECT CONDITIONS

A. Do not install material below 50 degrees F surface and air temperatures. These temperatures must also be maintained during and for 48 hours after the installation of products included in this section.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Topical Moisture Vapor Emission System:

1. Basis-of-Design Product: Subject to compliance with requirements, provide ARDEX MC Rapid or comparable product by one of the following:

   a. Mapei: Planiseal EMB
   b. HB Fuller Construction Products: Chapco’s Defender

PART 3 - EXECUTION

3.1 PREPARATION

A. Concrete Subfloors: prepare subfloor in accordance with manufacturer’s instructions.

1. Prior to proceeding refer to ASTM F710 Standard Practice for Preparing Concrete Floors to Receive Resilient Flooring. All concrete subfloors must be sound, solid, clean, and free
of all oil, grease, dirt, curing compound and any substance that might act as a bond breaker before application.

2. Mechanical preparation of the surface is required to obtain a minimum ICRI concrete surface profile of 3 (CSP 3). This substrate preparation must be by mechanical means, such as shot blasting.

3. The concrete must have a minimum tensile strength of at least 150 psi for areas to receive normal foot traffic, and 200 psi for areas of heavy commercial traffic when tested in accordance with ASTM C1583. The concrete surface can be damp, but must be free of standing water.

4. Prior to beginning the installation, measure the relative humidity within the concrete (ASTM F2170). Alternately, you can also measure the surface relative humidity in accordance with ASTM F2420. For these relative humidity methods, the RH shall not exceed 100%. No standing water shall be present.

5. If the concrete substrate is too uneven to provide a uniform film thickness the substrate can be pre-smoothed using self-leveling exterior concrete topping.

B. Joint Preparation

1. Moving Joints – honor all expansion and isolation joints up through the moisture mitigation system and underlayment. A flexible sealing compound may be installed.

2. Saw cuts and control joints – fill all non-moving joints with joint filler, as recommended by manufacturer.

3.2 APPLICATION OF TOPICAL MOISTURE MITIGATION SYSTEM

A. Examine substrates and conditions under which materials will be installed. Do not proceed with installation until unsatisfactory conditions are corrected.

B. Coordinate installation with adjacent work to ensure proper sequence of construction. Protect adjacent areas from contact due to mixing and handling of materials.

C. Mixing: Comply with manufacturer’s printed instructions and the following:

1. Apply the first coat of freshly mixed material to the prepared concrete surface in a uniform direction to achieve a coating thickness of 10 mils. Use a short-nap paint roller or notched squeegee for smoother surfaces, and a longer nap roller for more uneven substrates. To minimize the potential for pinhole formation, work the material into the surface with the roller to ensure maximum penetration. The material can also be worked into the surface with a paint brush for hard to reach areas and corners. Once the area is completely coated, allow to dry for a minimum of 4 –hours (Maximum 24-hours). It is not necessary to re-test the substrate for moisture emissions prior to installing the floor covering.

3.3 PROTECTION

A. Prior to the installation of the finish flooring, the surface of the underlayment should be protected from abuse by the other trades by use of plywood, Masonite, or other suitable protection course.
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Concealed-fastener, lap-seam metal wall panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.

B. Shop Drawings:

1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.

2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.

C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.

1. Include Samples of trim and accessories involving color selection.

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

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

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.

B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.

C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.

D. Retain strippable protective covering on metal panels during installation.

1.7 FIELD CONDITIONS

A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.

1.8 COORDINATION

A. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including rupturing, cracking, or puncturing.
   b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.

1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

2. Finish Warranty Period: 20 years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
   1. Wind Loads: As indicated on Drawings.
   2. Other Design Loads: As indicated on Drawings.
   3. Deflection Limits: For wind loads, no greater than 1/180 of the span.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. when tested according to ASTM E 283 at the following test-pressure difference:

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

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

2.2 CONCEALED-FASTENER, LAP-SEAM METAL WALL PANELS

A. General: Provide factory-formed metal panels designed to be field assembled by lapping and interconnecting side edges of adjacent panels and mechanically attaching through panel to supports using concealed fasteners and factory-applied sealant in side laps. Include accessories required for weathertight installation.

B. Reveal-Joint, Concealed-Fastener Metal Wall Panels: Formed with vertical panel edges and intermediate stiffening ribs symmetrically spaced a flat pan between panel edges; with narrow reveal joint between panels.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide Berridge Manufacturing Company, HS-12 panel or comparable product by one of the following:
      a. Berridge Manufacturing Company;
      b. CENTRIA Architectural Systems.
      c. MBCI;
      d. Metal Sales Manufacturing Corporation.
      e. PAC-CLAD; Petersen Aluminum Corporation;
   2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
      c. Color: As selected by Architect from manufacturer’s full range.

2.3 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645, cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 coating designation or ASTM A 792/A 792M, Class A250 aluminum-zinc-alloy coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.
1. Closures: Provide closures at eaves and rakes, fabricated of same metal as metal panels.
2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch-thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, end walls, framed openings, rakes, fasciae, parapet caps, soffits, reveals, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.

D. Panel Fasteners: Self-tapping screws designed to withstand design loads. Provide exposed fasteners with heads matching color of metal panels by means of plastic caps or factory-applied coating. Provide EPDM or PVC sealing washers for exposed fasteners.

E. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.

2.4 FABRICATION

A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.

B. On-Site Fabrication: Subject to compliance with requirements of this Section, metal panels may be fabricated on-site using UL-certified, portable roll-forming equipment if panels are of same profile and warranted by manufacturer to be equal to factory-formed panels. Fabricate according to equipment manufacturer's written instructions and to comply with details shown.
C. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

D. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.

E. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.

1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
2. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.
3. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
4. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
5. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
   a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal wall panel manufacturer for application but not less than thickness of metal being secured.

2.5 FINISHES

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

B. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Steel Panels and Accessories:

1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers’ written instructions.
2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.

1. Examine wall framing to verify that girts, angles, channels, studs, and other structural panel support members and anchorage have been installed within alignment tolerances required by metal wall panel manufacturer.
2. Examine wall sheathing to verify that sheathing joints are supported by framing or blocking, and that installation is within flatness tolerances required by metal wall panel manufacturer.
   a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.

B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.

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

3.2 PREPARATION

A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 METAL PANEL INSTALLATION

A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

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

B. Fasteners:

1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.
C. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

D. Lap-Seam Metal Panels: Fasten metal panels to supports with fasteners at each lapped joint at location and spacing recommended by manufacturer.
   1. Lap ribbed or fluted sheets one full rib. Apply panels and associated items true to line for neat and weathertight enclosure.
   2. Provide metal-backed washers under heads of exposed fasteners bearing on weather side of metal panels.
   3. Install screw fasteners with power tools having controlled torque adjusted to compress washer tightly without damage to washer, screw threads, or panels. Install screws in predrilled holes.
   4. Flash and seal panels with weather closures at perimeter of all openings.

E. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting and provide for thermal expansion. Coordinate installation with flashings and other components.
   1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

F. Flashing and Trim: Comply with performance requirements, manufacturer’s written installation instructions, and SMACNA’s “Architectural Sheet Metal Manual.” Provide concealed fasteners where possible and set units true to line and level as indicated. Install work with laps, joints, and seams that are permanently watertight.
   1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof performance.
   2. 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 waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch deep, filled with mastic sealant (concealed within joints).

3.4 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Water-Spray Test: After installation, test area of assembly as directed by Architect for water penetration according to AAMA 501.2.

C. Manufacturer’s Field Service: Engage a factory-authorized service representative to test and inspect completed metal wall panel installation, including accessories.

D. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.

E. Additional tests and inspections, at Contractor’s expense, are performed to determine compliance of replaced or additional work with specified requirements.

F. Prepare test and inspection reports.
3.5 CLEANING AND PROTECTION

A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer’s written installation instructions. On completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

B. After metal panel installation, clear weep holes and drainage channels of obstructions, dirt, and sealant.

C. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 07 4213.13
PART 1 - GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the Contract. Including General and Supplementary Conditions and other Division one Specifications Sections, apply to this Section.

1.2 SUMMARY
A. Provide and install a thermal and air barrier wall system for exterior cold-formed metal wall assemblies. Work includes:
   1. Exterior wall insulation.
   2. Interior spray polyurethane foam.
   3. Air Barrier, Accessories, Etc.

B. Related Sections:
   1. Section 05 4000 Cold-Formed Metal Framing: Load-bearing, metal exterior wall framing assemblies.
   2. Section 09 2900 Gypsum Board: Interior gypsum board wall finish.

1.3 REFERENCES
A. Reference standards:
   1. ASTM International (ASTM):
      a. ASTM C203: Test Methods for Breaking Load and Flexural Properties of Block-Type Thermal Insulation.
      e. ASTM C1289: Specification for Faced Rigid Cellular Polyisocyanurate Thermal Insulation Board.
      g. ASTM D1622: Test Method for Apparent Density of Rigid Cellular Plastics.
      h. ASTM D2126: Test Method for Response of Rigid Cellular Plastics to Thermal and Humid Aging.
      k. ASTM E331: Test Method for Water Penetration of Exterior Windows, Curtain Walls and Doors by Uniform Static Air Pressure Difference
   2. Factory Mutual (FM):
      a. FM 4880: Class I Wall and Ceiling Panels Building Corner Fire Test.
3. Underwriters Laboratories Inc. (UL):
   a. UL 723: Surface Burning Characteristics of Building Materials.

1.4 SYSTEM DESCRIPTION

A. Furnish and install an exterior wall system that effectively controls thermal, air and water performance and provides continuity of the building envelope enclosure. The system shall include the following:
   1. Insulated sheathing secured to the exterior of the metal wall framing assembly.
   2. Spray polyurethane foam applied to the interior wall cavity.
   3. Joint, penetration and gap sealing material for sealing component joints, penetrations through the wall system and gaps between the building envelope enclosure components and wall opening frames.

B. Performance Characteristics:

1. Thermal performance:
   a. Exterior insulation: ASTM C518, Stabilized R-value of 6.5 per inch of thickness with a minimum six month exposure capability to outdoor elements and 15 year thermal warranty.
   b. Interior spray polyurethane foam: ASTM C518, 140degreeF/90day Aged R-Value (measured at 75degree F Mean Temp.), for product with a minimum 30 degree F ambient and substrate application temperature is R6.1/inch and 140degree F/90day Aged R-Value (measured at 75degree F Mean Temp.), for product with a minimum 45 degree F ambient and substrate application temperature is R6.4/inch and 140 degree F/90day Aged R-Value (measured at 75 degree F Mean Temp.), for product with a minimum 60 degree F ambient and substrate application temperature is R6.1/inch.
   1) Core density: ASTM D1622, Minimum 2.0 pcf.
   2) Acceptable adhesion to substrate based on specific minimum application temperature.

2. Air barrier performance: When tested in accordance with ASTM E2357, at a test pressure of not less than 6.24 psf, air infiltration shall not exceed 0.04 cfm per square foot (0.2 L/s*m2) of fixed wall area. Testing should be conducted at positive and negative sustained wind loading of 12.5psf (600Pa) for one-hour duration in each direction, pressure cycling of the wall at 2000 cycles in both the positive and negative direction, ending with wind gust loading at 25psf.

3. Water penetration: When tested in accordance with ASTM E331, no uncontrolled water penetration shall occur at a minimum differential pressure of 6.24 psf for minimum test duration of 2hrs.

4. Mold resistance: Thermal wall and air barrier system components shall provide non-food source for fungal growth.

C. Code Compliance: Exterior wall system and component materials shall comply with the following requirements:

1. Exterior Insulation:
   a. Class 1 (<and/or= 25 Flame Spread Index and < 450 Smoke Developed Index) classified at Max. thickness per UL 723 criteria or ASTM E84 criteria.
2. Spray Polyurethane Foam:
   a. Class 1 (<and/or= 25 Flame Spread Index and < 450 Smoke Developed Index) classified at Max. thickness per UL 723 criteria or ASTM E84 criteria.


D. Fire Resistance:

2. Fire-stopping measures, per code, should be included at the floor line in the stud cavity when the wall assembly extends beyond the edge of the floor line.
3. The spray applied insulation musts be separated from the interior of the building by an approved thermal barrier complying with IBC section 26 03.4 as applicable.

E. All joints, penetrations and gaps of the thermal and air barrier wall system shall be made watertight and air-tight.

1.5 SUBMITTALS

A. Product Data: Submit manufacturer's product data and installation instructions for each thermal wall and air barrier system component product required.

B. Shop Drawings: For the following:
   1. Project specific details for systems and repairs required during construction.

C. Submit compatibility letter for other materials that may need to tie into the weather barrier system.

D. Reports:
   1. Submit Test Reports, summarized by Manufacturer of material(s), verifying qualities of thermal and air barrier wall system components meet or exceed specified requirements.
      a. Include results of ASTM E2357 air barrier system testing and ASTM E331 water penetration tests.
      b. Include mill certificates indicating steel framing sheet complies with the specified requirements.
   2. Submit Field Inspection and Test Reports in accordance with Field Quality Control requirements

1.6 QUALITY ASSURANCE

A. Spray Polyurethane Foam Installation: Spray polyurethane foam installer shall be accredited by Thermal and Air Barrier Wall System manufacturer.

B. Installer Qualifications:
1. The air barrier Installer shall be, during the award period as well as for the duration of the installation, officially recognized as a Certified Installer by the Thermal and Air Barrier Wall System Manufacturer (Certified Installer). The Certified Installer shall carry liability insurance and bonding.

2. Each worker who is installing air barriers must be a, or accompanied by a, Certified Installer.

3. Each Certified Installer can supervise a maximum of five workers. The Certified Installer shall be thoroughly trained and experienced in the installation of air barriers of the types being applied. Certified Installers shall perform or directly supervise all air/vapor barrier work on the project.

4. Certified Installers shall have their Thermal and Air Barrier Wall System Manufacturer Certification photo-identification cards in their possession and available on the project site, for inspection upon request.

C. Pre-installation Meeting: Prior to commencement of application of spray polyurethane foam review and document methods and procedures related to installation, including the following:


2. Review metal wall framing assemblies for potential interference and conflicts and coordinate layout and support provisions for interfacing work.

3. Review insulated sheathing and spray polyurethane foam methods and procedures related to application, including manufacturer's installation guidelines, Thermal and Air Barrier Wall System Manufacturer’s Certification Program.

4. Review construction schedule and confirm availability of products, applicator personnel, equipment and facilities.

5. Review governing regulatory requirements, and requirements for insurance and certificates as applicable.

6. Review field quality control procedures.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver Thermal and Air Barrier Wall System materials in Manufacturer's unopened containers or bundles, fully identified by name, brand, type and grade. Exercise care to avoid damage during unloading, storing and installation.

B. Store, protect and handle Thermal and Air Barrier Wall System materials in accordance with the Manufacturer’s recommendations to prevent damage, contamination and deterioration. Keep materials free of dirt and other foreign matter.

1.8 PROJECT CONDITIONS

A. Environmental Requirements: Install Thermal and Air Barrier Wall System work only when weather conditions are in compliance with Manufacturer's specific environmental requirements and conditions will permit work to be performed in accordance with Manufacturer's recommendations and warranty requirements.

1. Do not expose materials to sunlight longer than as recommended by the manufacturer.

B. Spray polyurethane foam:

1. Do not proceed with installation of spray polyurethane foam until sheathing substrate construction is complete and openings and penetrating items have been installed and sealed.
2. Do not proceed with installation of spray polyurethane foam until substrate surface temperatures accepting the spray polyurethane are above the manufacturer's recommended minimum surface temperatures.
3. Verify that substrate surfaces to receive spray polyurethane foam are free of frost, oil, grease, oxidation, dirt, loose paint, loose scale, or other deleterious material that would impair bond.
4. Do not apply spray polyurethane after the 6 months expiry date printed on the label of each container.
5. Ventilate area to receive spray polyurethane foam by introducing fresh air and exhausting air continuously during and 24 hour after application to maintain non-toxic, unpolluted, safe working conditions.
6. Provide temporary enclosures to prevent spray and noxious vapors from contaminating air beyond application area.
7. Protect workers as recommended by spray polyurethane foam manufacturer.
8. Protect adjacent surfaces and equipment from damage by overspray, fall-out, and dusting of insulation materials.
9. Dispose of waste foam daily in location designated by Architect [Engineer] and empty drums in accordance with foam manufacturer's instructions.

1.9 WARRANTY

A. Submit the following warranties:
   2. 15 Year Water Resistant Warranty (must use Thermax XARMOR ci and LiquidArmor CM)
   3. Spray Polyurethane Foam: Limited Warranty

B. Special Project Warranty: Submit Thermal and Air Barrier wall system Installer's warranty, signed by Installer, covering the Work of this Section, including all components of Thermal and Air Barrier system such as base flashing, wall insulation/sheathing, fasteners, etc., for the following warranty period:
   1. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 INSULATION

A. Exterior Insulation: Glass-fiber-reinforced enhanced polyisocyanurate foam core sheathing faced with nominal 4 mil embossed white or blue acrylic-coated aluminum on one side and 1.25 mil embossed aluminum on the other side, complying with ASTM C1289 and meeting the following physical properties:
   1. ASTM C1289 Type 1, Class 2
   3. Aged Thermal Resistance (ASTM C518, measured at Mean Temp of 75F): R-6.5 at 1 inch of thickness with 15 year thermal warranty
   6. Water Vapor Permeance (ASTM E96): <0.3 perms.
   7. Maximum Use Temperature: 250 degrees F.


1. Panel Size: 4'-0" wide x 12'-0" long, square edge panels.
2. Thickness and Stabilized R-Value: 2 - inch thickness, R-12.9.

C. Accessories:

1. Fasteners: Provide insulated sheathing manufacturer's recommended polymer or other corrosion-protective coated steel screw fasteners for anchoring sheathing to metal wall framing. Fastener length and size based on wall sheathing thickness.
   a. Acceptable Products: Rodenhouse, Inc 2-inch diameter "Thermal Grip ci Prong Washers" plastic washers which can be installed using either bulk grip-deck self-drilling screws or collated Grip-Deck screws.

2. Liquid Applied Flashing: Provide insulation manufacturer's recommended board joint Liquid Flashing, seams and veneer tie penetrations through the insulation layer and at the base of the foundation where the insulation terminates at the footing.
   a. Acceptable Products:
   b. The Dow chemical company; Liquidarmor CM spray flashing and sealant.
   c. For gaps larger than ¼-inch use Gap Filler prior to sealing joint.

3. Wall Opening Flashing: Provide insulated sheathing manufacturer's recommended flashing sealing window and door wall openings.
   a. Acceptable Products: The Dow Chemical Company “LiquidArmor CM spray flashing and sealant at straight opening heads, jambs and sills or approved equal.
   b. When greater widths are required for through wall flashings butyl rubber adhesive is recommended.

   b. Acceptable Products: The Dow Chemical Company “Great Stuff™ Pro Window & Door” single-component polyurethane low-pressure foam sealant or approved equal.

5. Gap Air Infiltration Filler: Two Component, Quick Cure Polyurethane Foam:
   a. Acceptable Products: The Dow Chemical Company FROTH-PAK™ Foam Insulation two component, quick-cure polyurethane foam or approved equal.

   1) NFPA 286 Approval for Exposed use to the interior of the building without the need for a 15-min thermal barrier
   2) ASTM E-84 Class A

6. Flexible polyethylene foam gasketing strip to reduce air infiltration between a concrete foundation and sill plate.
   a. Acceptable Products: The Dow Chemical Company “WEATHERMATE™ SILL SEAL Foam Gasket or approved equal.

2.2 SPRAY POLYURETHANE FOAM
A. Spray Polyurethane Foam: Two-component spray polyurethane cellular plastic foam, complying with the following methods and meeting the following physical properties:

4. Smoke Developed (ASTM E84, Class A): 450 or less.
5. Compressive Strength minimum (ASTM D1621, 10% parallel to rise): 20 psi.
6. Closed Cell Content (ASTM D2856): minimum 90 percent.

B. Basis of Design: The Dow Chemical company STYROFOAM Spray Polyurethane Foam CM2030, CM 2045, CM2060. Formulation required will be dependent upon surface temperature of substrate. Refer to manufacturers recommendations. Acceptable manufacturers are BASF and Technical Roofing Solutions.

1. STYROFOAM Spray Polyurethane Foam CM2060:
   b. Minimum 1.5-inch thickness: Thermal Resistance (ASTM C518): 140degreeF/90day Aged R-Value, measured at 75F mean Temp: R9.2

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and installation conditions for compliance with requirements for installation conditions affecting performance of the work.

1. Verify that metal wall studs, opening framing, bridging, bracing and other framing support members and anchorage have been installed within thermal wall system alignment tolerances and requirements.
2. Verify that substrate surfaces to receive spray polyurethane foam are free of frost, oil, grease, oxidation, dirt, loose paint, loose scale, or other deleterious material that would impair bond.
3. Verify that items required to penetrate the thermal wall system are placed and penetration gaps and cracks are properly sealed before installation of spray polyurethane foam.
4. Do not proceed with thermal and air barrier wall system installation until unsatisfactory conditions have been corrected.

B. Installation constitutes acceptance of existing conditions and responsibility for satisfactory performance.

3.2 INSULATION INSTALLATION

A. Install insulation in accordance with manufacturer's recommendations. Fasten to exterior face of exterior metal stud wall framing using sheathing manufacturer’s recommended type and length screw fasteners with washers. Abut panels tightly together and around openings and penetrations.

1. Install sheathing panels horizontally with blue aluminum facing to exterior. Use maximum lengths to minimize number of joints. Locate edge joints parallel to and on framing. Center
end joints over supports and stagger in each course. Provide additional framing wherever panel joints do not bear against framing, plates or sill members.

2. Fasten panels to each support with fasteners spaced 12 inches on center at perimeter and 16 inches on center in panel field. Set back perimeter fasteners 3/8” from edges and ends of panel units. Drive fasteners to bear tight and flush with surface of insulation. Do not countersink. Perimeter fasteners can be detailed to bridge the gap of abutting board joints due to the 1.75” diameter of the washer used to fasten the board to the studs. Maximum of two board joints may be bridged per fastener. Board joints should be tightly butted, “Butt all joints tightly”.

3. Install liquid spray overlapping joints and seams 2” minimum including other penetrations in accordance with sheathing manufacturer’s joint sealing recommendations.

4. Seal sheathing joints and penetrations of sheathing in accordance with sheathing manufacturer’s joint and penetration sealing recommendations. Note: do not use silicone products.

5. After base flashing, which may include a termination bar running horizontally along the top edge of the flashing, is installed on exterior of insulated sheathing, install LiquidArmor CM spray flashing and sealant to the exterior sheathing and lapped over the top edge of the base flashing.

3.3 SPRAY POLYURETHANE FOAM INSTALLATION

A. Preparation

1. Mask and cover adjacent areas to protect from overspray.
2. Apply primers for special conditions as recommended by manufacturer.
3. Cover wide joints with transition sheet membrane as recommended by manufacturer.
4. Clean work area prior to application of sprayed insulation.
5. Verify substrate temperature meets manufacturer’s requirements for specific formulations used.
6. Ensure that all stud cavity fire-stopping is installed prior to application of spray foam.

B. Application: Spray apply polyurethane foam in accordance with ASTM C1029 and manufacturer’s installation guidelines; complying with preparation methods outlined in 3.3.A.

1. Apply spray polyurethane foam by picture framing around the interior studs at the insulated sheathing – steel stud interface and one pass across all board joints and penetrations.
2. Finish applying spray polyurethane foam with one pass not exceeding 1.5 inches in thickness. Two passes are acceptable to reach maximum thickness of 1.5 inch.
3. If more than one layer is being applied, allow the layer applied first to cool to the max. substrate temperature or less recommended for the STYROFOAM™ Spray Polyurethane Foam CM Series.
4. Avoid formation of sub-layer air pockets.
5. Apply spray polyurethane foam in overlapping layers, in a manner to obtain a smooth, uniform surface. Total thickness as indicated.
6. Maintain 3 inch clearance around chimneys, heating vents, steam pipes, recessed lighting fixtures and other heat sources.
7. Do not apply spray polyurethane foam to inside of exit openings or electrical junction boxes.
8. Maintain a continuous layer of spray foam from floor to floor to roof to complete air barrier.

C. Field Quality Control. Submit spray polyurethane foam field inspection and test reports for the following:

1. The Certified Installer shall complete the Daily Work Record and record all information required including the results of the testing. The Daily Work Record shall be kept on site for routine inspection. Copies of the Daily Work Record shall be forwarded to the manufacturer, owner or owner’s representative upon request.
2. The costs incurred for daily testing and inspection by the Certified Installer and the completion of the Daily Work Record shall be borne by the Accredited Contractor.

3. If required by the owner, arrange for site inspections by a qualified third party inspector. The frequency and cost of inspections shall be included in the bid at the owner’s request. If the site inspection reveals any defects, the Accredited Contractor shall immediately rectify all such defects at his cost.

4. The Certified Installer’s daily work record shall verify conformance with the Thermal and Air Barrier Wall System Manufacturer’s instructions, the standard ULC S705.2-02 Installation standard and this section of the project specification.

   a. Follow Manufacturer guidelines for proper temperature settings regarding spray equipment as stated on Manufacturer product information sheets.
   b. Follow Manufacturer guidelines for proper spray polyurethane foam formulation based on substrate and ambient temperatures product will be applied to.
   c. Test completed application daily for core density and cohesion/adhesion to substrate. Record results daily in test reports.
   d. After product has properly cured, conduct tests to verify adhesion between the spray polyurethane foam and the substrate.
   e. Conduct adhesion tests on all corners and building angles, at wall-to-slab junctions, and at wall-to-roof junctions.
   f. Perform one adhesion test for every wall less than 100 feet in length. Perform two tests for every wall greater than 100 feet and less than 200 feet in length, with an additional test conducted for every additional 100 feet, or part thereof, in wall length.
   g. Transition membranes shall be pull tested in accordance with the Certified Installer training program requirements before installing the spray polyurethane air barrier material.

3.4 CLEANING

   A. Remove overspray from non-prescribed surfaces without causing damage to surfaces.
   B. Remove protective covers from adjacent surfaces.

END OF SECTION 07 4265
SECTION 07 5419 - POLYVINYL-CHLORIDE (PVC) ROOFING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Adhered polyvinyl-chloride (PVC) roofing system.
2. Simulated standing seam material
3. Roof insulation.
4. PVC Coated metal gutters and edge flashing.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
2. Section 07 9200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

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

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

A. Product Data: For each type of product.

B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:
   1. Tapered insulation, including slopes.
   2. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
   3. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.

C. Samples for Verification: For the following products:
   1. Sheet roofing, of color required.
   2. Walkway pads or rolls, of color required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.

B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
   1. Submit evidence of compliance with performance requirements.

C. Product Test Reports: For components of roofing system, for tests performed by manufacturer and witnessed by a qualified testing agency.

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

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

1.7 CLOSEOUT SUBMITTALS

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

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is FM Global approved for roofing system identical to that used for this Project.

B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.
B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

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

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes membrane roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, and other components of roofing system.

2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as membrane roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain components including roof insulation and fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.
1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:

D. FM Global Listing: Roofing, base flashings, and component materials shall comply with requirements in FM Global 4450 or FM Global 4470 as part of a built-up roofing system, and shall be listed in FM Global's "RoofNav" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
   1. Fire/Windstorm Classification: Class 1A-90.
   2. Hail-Resistance Rating: SH.

E. Energy Performance: Roofing system shall have an initial solar reflectance of not less than 0.70 and an emissivity of not less than 0.75 when tested according to CRRC-1.

F. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

2.3 PVC ROOFING

A. PVC Sheet: ASTM D 4434, Type II, Grade I, glass fiber reinforced, felt backed.
   1. Basis-of-Design Product: Provide Sarnafil Inc.; Sarnafil G410, Décor Roof Systems or a comparable product by one of the following:
      a. Versico Roofing Systems
      b. Duro-Last Roofing Inc, Duro-Fleece
      c. GAF – Everguard PVC Fleece-back
   2. Thickness: 72mils, nominal with a minimum of 36 mils over scrim.
   3. Exposed Face Color: Gray.

B. Basis-of-Design Product for PVC Profile: Sarnafil, Inc. Décor Roof System. (Drop Off Canopy only)
   1. 1 ¼” x ¾” x 10 foot PVC extrusion, used to emulate the appearance of standing seam metal rib roof system.
   2. Other Manufacturers that make a similar profile are:
      b. Duro-Last Vinyl Rib System
2.4 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.

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

C. Bonding Adhesive: Manufacturer's standard, water based.

D. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8-inch-thick; with anchors.

E. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.

F. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

G. PVC Coated metal: Provide the following:

1. PVC Coated stainless steel snap lock roof edge. 4" x 4".
2. PVC Coated stainless steel internal gutter system as indicated on drawings.

2.5 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/4 inch thick.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.6 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by PVC roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated and that produce FM Global-approved roof insulation.

B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 3, felt or glass-fiber mat facer on both major surfaces.

2.7 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.
B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roof insulation and cover boards to substrate, and acceptable to roofing system manufacturer.

C. Insulation Adhesive: Insulation manufacturer’s recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Full-spread spray-applied, low-rise, two-component urethane adhesive.

D. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/4-inch-thick, factory primed.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corporation; GlasRoc Sheathing.
   b. Georgia-Pacific Gypsum LLC; Dens Deck Prime.
   c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
   d. USG Corporation; Securock Glass Mat Roof Board.

2.8 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16-inch-thick and acceptable to roofing system manufacturer.

1. Fully adhered.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 3100 "Steel Decking."

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

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer’s written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.
C. Install insulation strips according to acoustical roof deck manufacturer's written instructions.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at end of workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck according to recommendations in FM Global's "RoofNav" and FM Global Loss Prevention Data Sheet 1-29 for specified Windstorm Resistance Classification.
2. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers’ written instructions.

3.5 INSULATION INSTALLATION

A. Coordinate installing roofing system components so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.

1. Where installing composite and noncomposite insulation in two or more layers, install noncomposite board insulation for bottom layer and intermediate layers, if applicable, and install composite board insulation for top layer.

E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

G. Mechanically Fastened and Adhered Insulation: Install each layer of insulation to deck using mechanical fasteners specifically designed and sized for fastening specified board-type roof insulation to deck type.
1. Fasten first layer of insulation according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten first layer of insulation to resist uplift pressure at corners, perimeter, and field of roof.
3. Set each subsequent layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together.

1. Fasten cover boards according to requirements in FM Global's "RoofNav" for specified Windstorm Resistance Classification.
2. Fasten cover boards to resist uplift pressure at corners, perimeter, and field of roof.

3.6 ADHERED ROOFING INSTALLATION

A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

1. Install sheet according to ASTM D 5036.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer and allow to partially dry before installing roofing. Do not apply to splice area of roofing.

E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.

F. Apply roofing with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.7 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate, and allow to partially dry. Do not apply to seam area of flashing.
C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.8 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer's written instructions.

3.9 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer's technical personnel to inspect roofing installation on completion.

B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor's expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.10 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.11 ROOFING INSTALLER'S WARRANTY

A. WHEREAS ___________________________________________, herein called the "Roofing Installer," has performed roofing and associated work ("work") on the following project:

1. Owner: <Insert name of Owner>.
2. Address: <Insert address>.
3. Building Name/Type: <Insert information>.
4. Address: <Insert address>.
5. Area of Work: <Insert information>.
6. Acceptance Date: ________________.
7. Warranty Period: Three (3) years.
8. Expiration Date: ________________.
B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
   a. lightning;
   b. peak gust wind speed exceeding 72 MPH;
   c. fire;
   d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. vapor condensation on bottom of roofing; and
   g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.

3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

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

E. IN WITNESS THEREOF, this instrument has been duly executed this ___________ day of __________________, ________________.
1. Authorized Signature: ____________________________________________.
2. Name: ________________________________________________________.
3. Title: __________________________________________________________.

END OF SECTION 07 5419
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Adhered thermoplastic polyolefin (TPO) roofing system.
   2. Vapor retarder.
   3. Roof insulation.
   4. TPO Coated metal gutters and edge flashing.

B. Section includes the installation of insulation strips in ribs of roof deck. Insulation strips are furnished under Section 05 3100 "Steel Decking."

C. Related Requirements:
   1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking; and for wood-based, structural-use roof deck panels.
   2. Section 07 6200 "Sheet Metal Flashing and Trim" for metal roof flashings and counterflashings.
   3. Section 07 9200 "Joint Sealants" for joint sealants, joint fillers, and joint preparation.
   4. Section 22 1423 "Storm Drainage Piping Specialties" for roof drains.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary in NRCA’s "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 PREINSTALLATION MEETINGS

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

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Shop Drawings: For roofing system. Include plans, elevations, sections, details, and attachments to other work, including:
   1. Base flashings and membrane terminations.
   2. Tapered insulation, including slopes.
   3. Roof plan showing orientation of steel roof deck and orientation of roofing, fastening spacings, and patterns for mechanically fastened roofing.
   4. Insulation fastening patterns for corner, perimeter, and field-of-roof locations.
C. Samples for Verification: For the following products:
   1. Sheet roofing, of color required.
   2. Walkway pads or rolls, of color required.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer and manufacturer.
B. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.
   1. Submit evidence of compliance with performance requirements.
C. Product Test Reports: For components of roofing system, tests performed by manufacturer and witnessed by a qualified testing agency.
D. Research/Evaluation Reports: For components of roofing system, from ICC-ES.
E. Field quality-control reports.
F. Sample Warranties: For manufacturer's special warranties.

1.7 CLOSEOUT SUBMITTALS

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

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer that is UL listed for roofing system identical to that used for this Project.
B. Installer Qualifications: A qualified firm that is approved, authorized, or licensed by roofing system manufacturer to install manufacturer's product and that is eligible to receive manufacturer's special warranty.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver roofing materials to Project site in original containers with seals unbroken and labeled with manufacturer's name, product brand name and type, date of manufacture, approval or listing agency markings, and directions for storing and mixing with other components.

B. Store liquid materials in their original undamaged containers in a clean, dry, protected location and within the temperature range required by roofing system manufacturer. Protect stored liquid material from direct sunlight.

1. Discard and legally dispose of liquid material that cannot be applied within its stated shelf life.

C. Protect roof insulation materials from physical damage and from deterioration by sunlight, moisture, soiling, and other sources. Store in a dry location. Comply with insulation manufacturer's written instructions for handling, storing, and protecting during installation.

D. Handle and store roofing materials, and place equipment in a manner to avoid permanent deflection of deck.

1.10 FIELD CONDITIONS

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

1.11 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of roofing system that fail in materials or workmanship within specified warranty period.

1. Special warranty includes roofing, base flashings, roof insulation, fasteners, cover boards, substrate board, roofing accessories, and other components of roofing system.

2. Warranty Period: 20 years from date of Substantial Completion.

B. Special Project Warranty: Submit roofing Installer's warranty, on warranty form at end of this Section, signed by Installer, covering the Work of this Section, including all components of roofing system such as roofing, base flashing, roof insulation, fasteners, cover boards, substrate boards, vapor retarders, roof pavers, and walkway products, for the following warranty period:

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Carlisle SynTec Incorporated.
2. Firestone Building Products.
3. Versico Roofing Systems; VersiWeld TPO Membrane.

C. Source Limitations: Obtain components including roof insulation and fasteners for roofing system from same manufacturer as membrane roofing or manufacturer approved by membrane roofing manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Installed roofing and base flashings shall withstand specified uplift pressures, thermally induced movement, and exposure to weather without failure due to defective manufacture, fabrication, installation, or other defects in construction. Roofing and base flashings shall remain watertight.

1. Accelerated Weathering: Roofing system shall withstand 2000 hours of exposure when tested according to ASTM G 152, ASTM G 154, or ASTM G 155.
2. Impact Resistance: Roofing system shall resist impact damage when tested according to ASTM D 3746 or ASTM D 4272.

B. Material Compatibility: Roofing materials shall be compatible with one another and adjacent materials under conditions of service and application required, as demonstrated by roofing manufacturer based on testing and field experience.

C. Roofing System Design: Tested by a qualified testing agency to resist the following uplift pressures:


D. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class A; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

E. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 TPO ROOFING


1. Thickness: 60 mils, nominal.
2. Exposed Face Color: Gray in the field and Tan indicating 15 foot barrier.

2.4 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

1. Liquid-type auxiliary materials shall comply with VOC limits of authorities having jurisdiction.
B. Sheet Flashing: Manufacturer's standard unreinforced TPO sheet flashing, 55 mils thick, minimum, of same color as TPO sheet.

C. Bonding Adhesive: Manufacturer's standard.

D. Slip Sheet: Manufacturer's standard, of thickness required for application.

E. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8-inch-thick; with anchors.

F. Metal Battens: Manufacturer's standard, aluminum-zinc-alloy-coated or zinc-coated steel sheet, approximately 1 inch wide by 0.05 inch thick, prepunched.

G. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening roofing to substrate, and acceptable to roofing system manufacturer.

H. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, preformed inside and outside corner sheet flashings, T-joint covers, lap sealants, termination reglets, and other accessories.

I. TPO Coated Stainless Steel metal: Provide the following:
   1. TPO Coated stainless steel snap lock roof edge. 4” x 4” at entrance lobby vestibule.

2.5 SUBSTRATE BOARDS

A. Substrate Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/4 inch thick.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. CertainTeed Corporation; GlasRoc Sheathing.
      b. Georgia-Pacific Gypsum LLC; Dens Deck Prime.
      c. National Gypsum Company;.
      d. USG Corporation; Securock Glass-Fiber Roof Board.

B. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening substrate board to roof deck.

2.6 VAPOR RETARDER

A. Self-Adhering-Sheet Vapor Retarder: Polyethylene film laminated to layer of butyl rubber adhesive, minimum 30-mil-total thickness; maximum permeance rating of 0.1 perm; cold applied, with slip-resisting surface and release paper backing. Provide primer when recommended by vapor-retarder manufacturer.

2.7 ROOF INSULATION

A. General: Preformed roof insulation boards manufactured or approved by TPO roofing manufacturer, selected from manufacturer's standard sizes suitable for application, of thicknesses indicated.
B. Polyisocyanurate Board Insulation: ASTM C 1289, Type II, Class 1, Grade 3, felt or glass-fiber mat facer on both major surfaces.

C. Tapered Insulation: Provide factory-tapered insulation boards fabricated to slope of 1/4 inch per 12 inches unless otherwise indicated.

D. Provide preformed saddles, crickets, tapered edge strips, and other insulation shapes where indicated for sloping to drain. Fabricate to slopes indicated.

2.8 INSULATION ACCESSORIES

A. General: Roof insulation accessories recommended by insulation manufacturer for intended use and compatibility with roofing.

B. Insulation Adhesive: Insulation manufacturer's recommended adhesive formulated to attach roof insulation to substrate or to another insulation layer as follows:

1. Full-spread spray-applied, low-rise, two-component urethane adhesive.

C. Cover Board: ASTM C 1177/C 1177M, glass-mat, water-resistant gypsum substrate, 1/4-inch-thick, factory primed.

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

   a. CertainTeed Corporation; GlasRoc Sheathing.
   b. Georgia-Pacific Gypsum LLC; Dens Deck Prime.
   c. National Gypsum Company; Gold Bond eXP Extended Exposure Sheathing.
   d. USG Corporation; Securock Glass Mat Roof Board.

2.9 WALKWAYS

A. Flexible Walkways: Factory-formed, nonporous, heavy-duty, slip-resisting, surface-textured walkway pads or rolls, approximately 3/16-inch-thick and acceptable to roofing system manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work:

1. Verify that roof openings and penetrations are in place, curbs are set and braced, and roof-drain bodies are securely clamped in place.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations and that nailers match thicknesses of insulation.
3. Verify that surface plane flatness and fastening of steel roof deck complies with requirements in Section 05 3100 “Steel Decking.”
4. Verify that minimum concrete drying period recommended by roofing system manufacturer has passed.
5. Verify that concrete substrate is visibly dry and free of moisture. Test for capillary moisture by plastic sheet method according to ASTM D 4263.
6. Verify that concrete-curing compounds that will impair adhesion of roofing components to roof deck have been removed.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean substrate of dust, debris, moisture, and other substances detrimental to roofing installation according to roofing system manufacturer's written instructions. Remove sharp projections.

B. Prevent materials from entering and clogging roof drains and conductors and from spilling or migrating onto surfaces of other construction. Remove roof-drain plugs when no work is taking place or when rain is forecast.

3.3 ROOFING INSTALLATION, GENERAL

A. Install roofing system according to roofing system manufacturer's written instructions.

B. Complete terminations and base flashings and provide temporary seals to prevent water from entering completed sections of roofing system at the end of the workday or when rain is forecast. Remove and discard temporary seals before beginning work on adjoining roofing.

3.4 SUBSTRATE BOARD INSTALLATION

A. Install substrate board with long joints in continuous straight lines, perpendicular to roof slopes with end joints staggered between rows. Tightly butt substrate boards together.

1. Fasten substrate board to top flanges of steel deck to resist uplift pressure at corners, perimeter, and field of roof according to roofing system manufacturers’ written instructions.

3.5 VAPOR-RETARDER INSTALLATION

A. Self-Adhering-Sheet Vapor Retarder: Prime substrate if required by manufacturer. Install self-adhering-sheet vapor retarder over area to receive vapor retarder, side and end lapping each sheet a minimum of 3-1/2 inches and 6 inches, respectively. Seal laps by rolling.

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

3.6 INSULATION INSTALLATION

A. Coordinate installing roofing system components, so insulation is not exposed to precipitation or left exposed at the end of the workday.

B. Comply with roofing system and insulation manufacturer's written instructions for installing roof insulation.

C. Install tapered insulation under area of roofing to conform to slopes indicated.

D. Install insulation under area of roofing to achieve required thickness. Where overall insulation thickness is 2.7 inches or greater, install two or more layers with joints of each succeeding layer staggered from joints of previous layer a minimum of 6 inches in each direction.
E. Trim surface of insulation where necessary at roof drains so completed surface is flush and does not restrict flow of water.

F. Install insulation with long joints of insulation in a continuous straight line with end joints staggered between rows, abutting edges and ends between boards. Fill gaps exceeding 1/4 inch with insulation.

1. Cut and fit insulation within 1/4 inch of nailers, projections, and penetrations.

G. Adhered Insulation: Install each layer of insulation and adhere to substrate as follows:

1. Set each layer of insulation in a uniform coverage of full-spread insulation adhesive, firmly pressing and maintaining insulation in place.

H. Install cover boards over insulation with long joints in continuous straight lines with end joints staggered between rows. Offset joints of insulation below a minimum of 6 inches in each direction. Loosely butt cover boards together.

3.7 ADHERED ROOFING INSTALLATION

A. Adhere roofing over area to receive roofing according to roofing system manufacturer's written instructions. Unroll roofing and allow to relax before retaining.

B. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

C. Accurately align roofing and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Bonding Adhesive: Apply to substrate and underside of roofing at rate required by manufacturer and allow to partially dry before installing roofing. Do not apply to splice area of roofing.

E. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeter of roofing.

F. Apply roofing with side laps shingled with slope of roof deck where possible.

G. Seams: Clean seam areas, overlap roofing, and hot-air weld side and end laps of roofing and sheet flashings according to manufacturer's written instructions, to ensure a watertight seam installation.

1. Test lap edges with probe to verify seam weld continuity. Apply lap sealant to seal cut edges of sheet.
2. Verify field strength of seams a minimum of twice daily, and repair seam sample areas.
3. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

H. Spread sealant bed over deck-drain flange at roof drains, and securely seal roofing in place with clamping ring.

3.8 BASE FLASHING INSTALLATION

A. Install sheet flashings and preformed flashing accessories and adhere to substrates according to roofing system manufacturer's written instructions.

B. Apply bonding adhesive to substrate and underside of sheet flashing at required rate and allow to partially dry. Do not apply to seam area of flashing.
C. Flash penetrations and field-formed inside and outside corners with cured or uncured sheet flashing.

D. Clean seam areas, overlap, and firmly roll sheet flashings into the adhesive. Hot-air weld side and end laps to ensure a watertight seam installation.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

3.9 WALKWAY INSTALLATION

A. Flexible Walkways: Install walkway products in locations indicated. Heat weld to substrate or adhere walkway products to substrate with compatible adhesive according to roofing system manufacturer’s written instructions.

3.10 FIELD QUALITY CONTROL

A. Final Roof Inspection: Arrange for roofing system manufacturer’s technical personnel to inspect roofing installation on completion.

B. Repair or remove and replace components of roofing system where inspections indicate that they do not comply with specified requirements.

C. Additional testing and inspecting, at Contractor’s expense, will be performed to determine if replaced or additional work complies with specified requirements.

3.11 PROTECTING AND CLEANING

A. Protect roofing system from damage and wear during remainder of construction period. When remaining construction does not affect or endanger roofing, inspect roofing for deterioration and damage, describing its nature and extent in a written report, with copies to Architect and Owner.

B. Correct deficiencies in or remove roofing system that does not comply with requirements, repair substrates, and repair or reinstall roofing system to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

C. Clean overspray and spillage from adjacent construction using cleaning agents and procedures recommended by manufacturer of affected construction.

3.12 ROOFING INSTALLER’S WARRANTY

A. WHEREAS _______________________________ of ______________________, herein called the “Roofing Installer,” has performed roofing and associated work (“work”) on the following project:

1. Owner: <Insert name of Owner>.
2. Address: <Insert address>.
3. Building Name/Type: <Insert information>.
4. Address: <Insert address>.
5. Area of Work: <Insert information>.
6. Acceptance Date: ________________.
7. Warranty Period: <Insert time>.
8. Expiration Date: __________________.
B. AND WHEREAS Roofing Installer has contracted (either directly with Owner or indirectly as a subcontractor) to warrant said work against leaks and faulty or defective materials and workmanship for designated Warranty Period,

C. NOW THEREFORE Roofing Installer hereby warrants, subject to terms and conditions herein set forth, that during Warranty Period he will, at his own cost and expense, make or cause to be made such repairs to or replacements of said work as are necessary to correct faulty and defective work and as are necessary to maintain said work in a watertight condition.

D. This Warranty is made subject to the following terms and conditions:

1. Specifically excluded from this Warranty are damages to work and other parts of the building, and to building contents, caused by:
   a. lightning;
   b. peak gust wind speed exceeding 72 MPH
   c. fire;
   d. failure of roofing system substrate, including cracking, settlement, excessive deflection, deterioration, and decomposition;
   e. faulty construction of parapet walls, copings, chimneys, skylights, vents, equipment supports, and other edge conditions and penetrations of the work;
   f. vapor condensation on bottom of roofing; and
   g. activity on roofing by others, including construction contractors, maintenance personnel, other persons, and animals, whether authorized or unauthorized by Owner.

2. When work has been damaged by any of foregoing causes, Warranty shall be null and void until such damage has been repaired by Roofing Installer and until cost and expense thereof have been paid by Owner or by another responsible party so designated.

3. Roofing Installer is responsible for damage to work covered by this Warranty but is not liable for consequential damages to building or building contents resulting from leaks or faults or defects of work.

4. During Warranty Period, if Owner allows alteration of work by anyone other than Roofing Installer, including cutting, patching, and maintenance in connection with penetrations, attachment of other work, and positioning of anything on roof, this Warranty shall become null and void on date of said alterations, but only to the extent said alterations affect work covered by this Warranty. If Owner engages Roofing Installer to perform said alterations, Warranty shall not become null and void unless Roofing Installer, before starting said work, shall have notified Owner in writing, showing reasonable cause for claim, that said alterations would likely damage or deteriorate work, thereby reasonably justifying a limitation or termination of this Warranty.

5. During Warranty Period, if original use of roof is changed and it becomes used for, but was not originally specified for, a promenade, work deck, spray-cooled surface, flooded basin, or other use or service more severe than originally specified, this Warranty shall become null and void on date of said change, but only to the extent said change affects work covered by this Warranty.

6. Owner shall promptly notify Roofing Installer of observed, known, or suspected leaks, defects, or deterioration and shall afford reasonable opportunity for Roofing Installer to inspect work and to examine evidence of such leaks, defects, or deterioration.

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

E. IN WITNESS THEREOF, this instrument has been duly executed this ___________ day of __________________, ________________.
1. Authorized Signature: ________________________________.
2. Name: ____________________________________________.
3. Title: ____________________________________________.

END OF SECTION 07 5423
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SECTION 07 7100 - ROOF SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Copings.

B. Related Requirements:

1. Section 06 1053 "Miscellaneous Rough Carpentry" for wood nailers, curbs, and blocking.
2. Section 07 5419 Polyvinyl-Chloride (PVC) Roofing for PVC coated metal edge flashing and internal gutters.
3. Section 07 5423 Thermoplastic-Polyolefin (TPO) Roofing for TPO coated metal edge flashing.
4. Section 07 6200 "Sheet Metal Flashing and Trim" for custom- and site-fabricated sheet metal flashing and trim.
5. Section 07 7200 "Roof Accessories" for roof hatches and other manufactured roof accessory units.
6. Section 07 7253 "Snow Guards" for manufactured snow guard devices.
7. Section 07 9200 "Joint Sealants" for field-applied sealants between roof specialties and adjacent materials.

C. Preinstallation Conference: Conduct conference at Project site.

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

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For roof specialties.
1. Include plans, elevations, expansion-joint locations, keyed details, and attachments to other work. Distinguish between plant- and field-assembled work.

2. Include details for expansion and contraction; locations of expansion joints, including direction of expansion and contraction.

3. Indicate profile and pattern of seams and layout of fasteners, cleats, clips, and other attachments.

4. Detail termination points and assemblies, including fixed points.

5. Include details of special conditions.

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

D. Samples for Initial Selection: For each type of roof specialty indicated with factory-applied color finishes.

E. Samples for Verification:

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

2. Include copings, roof-edge specialties and roof-edge drainage systems made from 12-inch-lengths of full-size components in specified material, and including fasteners, cover joints, accessories, and attachments.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

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

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

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

1.5 CLOSEOUT SUBMITTALS

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

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications: A qualified manufacturer offering products meeting requirements that are FM Approvals listed for specified class and SPRI ES-1 tested to specified design pressure.

B. Source Limitations: Obtain roof specialties approved by manufacturer providing roofing-system warranty specified in Section 07 5419 "PVC Membrane Roofing, 07 5423 "Thermoplastic Polyolefin (TPO) Roofing" and 07 5216 SBS Membrane Roofing (Add Alternate #3)

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

1. Build mockup of typical roof edge as part of Integrated Exterior Mockup specified in Section 01 4000 "Quality Requirements"

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

1.7 DELIVERY, STORAGE, AND HANDLING

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

B. Protect strippable protective covering on roof specialties from exposure to sunlight and high humidity, except to extent necessary for the period of roof-specialty installation.

1.8 FIELD CONDITIONS

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

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

1.9 WARRANTY

A. Roofing-System Warranty: Roof specialties are included in warranty provisions in Section 07 5423 “Thermoplastic-Polyolefin (TPO) Roofing”.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. General Performance: Roof specialties shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

B. FM Approvals' Listing: Manufacture and install copings and roof-edge specialties that are listed in FM Approvals' "RoofNav" and approved for windstorm classification, Class 1-90. Identify materials with FM Approvals' markings.
C. SPRI Wind Design Standard: Manufacture and install copings and roof-edge specialties tested and certified according to SPRI ES-1 and capable of resisting the following design pressures:

1. Design Pressure: As indicated on Drawings.

D. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes to prevent buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Provide clips that resist rotation and avoid shear stress as a result of thermal movements. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

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

2.2 COPINGS

A. Metal Copings: Manufactured coping system consisting of metal coping cap in section lengths not exceeding 12 feet, concealed anchorage; with corner units, end cap units, and concealed splice plates with finish matching coping caps.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Metal Era, Perma-Tite Gold coping or comparable product by one of the following:

a. Metal-Era, Inc.

b. PAC-CLAD; Petersen Aluminum Corporation; a Carlisle company.

c. SAF (Southern Aluminum Finishing Company, Inc.);

2. Metallic-Coated Steel Sheet Coping Caps: Zinc-coated (galvanized) steel, nominal thickness as required to meet performance requirements.

a. Surface: Smooth, flat finish.

b. Finish: Two-coat fluoropolymer.

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


4. Coping-Cap Attachment Method: Snap-on or face leg hooked to continuous cleat with back leg fastener exposed, fabricated from coping-cap material.


b. Face-Leg Cleats: Concealed, continuous galvanized-steel sheet.

2.3 MATERIALS

A. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 coating designation.

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

2.4 UNDERLAYMENT MATERIALS

A. 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.

2. Low-Temperature Flexibility: ASTM D 1970/D 1970M; passes after testing at minus 20 deg F.

2.5 MISCELLANEOUS MATERIALS

A. Fasteners: Manufacturer's recommended fasteners, suitable for application and designed to meet performance requirements. Furnish the following unless otherwise indicated:
   1. Exposed Penetrating Fasteners: Gasketed screws with hex washer heads matching color of sheet metal.
   2. Fasteners for Aluminum: Aluminum or Series 300 stainless steel.
   3. Fasteners for Zinc-Coated (Galvanized) Steel Sheet: Series 300 stainless steel or hot-dip zinc-coated steel according to ASTM A 153/A 153M or ASTM F 2329.

B. Elastomeric Sealant: ASTM C 920, elastomeric silicone polymer sealant of type, grade, class, and use classifications required by roofing-specialty manufacturer for each application.

C. Butyl Sealant: ASTM C 1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for hooked-type joints with limited movement.

D. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.


2.6 FINISHES

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

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

C. Appearance of Finished Work: Noticeable variations in same piece are unacceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

D. Coil-Coated Galvanized-Steel Sheet Finishes:
   1. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with ASTM A 755/A 755M and coating and resin manufacturers' written instructions.
      a. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in both color coat and clear topcoat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.
      b. Concealed Surface Finish: Apply pretreatment and manufacturer's standard acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Examine walls, roof edges, and parapets for suitable conditions for roof specialties.

C. Verify that substrate is sound, dry, smooth, clean, sloped for drainage where applicable, and securely anchored.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 UNDERLAYMENT INSTALLATION

A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches staggered 24 inches between courses. Overlap side edges not less than 3-1/2 inches. Roll laps with roller. Cover underlayment within 14 days.
   1. Apply continuously under copings and roof-edge specialties.
   2. Coordinate application of self-adhering sheet underlayment under roof specialties with requirements for continuity with adjacent air barrier materials.

3.3 INSTALLATION, GENERAL

A. General: Install roof specialties according to manufacturer's written instructions. Anchor roof specialties securely in place, with provisions for thermal and structural movement. Use fasteners, solder, protective coatings, separators, underlayment, sealants, and other miscellaneous items as required to complete roof-specialty systems.
   1. Install roof specialties level, plumb, true to line and elevation; with limited oil-canning and without warping, jogs in alignment, buckling, or tool marks.
   2. Provide uniform, neat seams with minimum exposure of solder and sealant.
   3. Install roof specialties to fit substrates and to result in weather-tight performance. Verify shapes and dimensions of surfaces to be covered before manufacture.
   4. Torch cutting of roof specialties is not permitted.
   5. Do not use graphite pencils to mark metal surfaces.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.
   1. Coat concealed side of uncoated aluminum roof specialties with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.
   2. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof specialties for waterproof performance.

   1. Space movement joints at a maximum of 12 feet with no joints within 18 inches of corners or intersections unless otherwise indicated on Drawings.
2. When ambient temperature at time of installation is between 40 and 70 deg F, set joint members for 50 percent movement each way. Adjust setting proportionately for installation at higher ambient temperatures.

D. Fastener Sizes: Use fasteners of sizes that penetrate substrate not less than recommended by fastener manufacturer to achieve maximum pull-out resistance.

E. Seal concealed joints with butyl sealant as required by roofing-specialty manufacturer.

F. Seal joints as required for weathertight construction. Place sealant to be completely concealed in joint. Do not install sealants at temperatures below 40 deg F.

G. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pre-tin edges of sheets to be soldered to a width of 1-1/2 inches; however, reduce pre-tinning where pre-tinned surface would show in completed Work. Tin edges of uncoated copper sheets using solder for copper. Do not use torches for soldering. Heat surfaces to receive solder and flow solder into joint. Fill joint completely. Completely remove flux and spatter from exposed surfaces.

3.4 COPING INSTALLATION

A. Install cleats, anchor plates, and other anchoring and attachment accessories and devices with concealed fasteners.

B. Anchor copings with manufacturer's required devices, fasteners, and fastener spacing to meet performance requirements.

    1. Interlock face-leg drip edge into continuous cleat anchored to substrate at manufacturer's required spacing that meets performance requirements. Anchor back leg of coping with screw fasteners and elastomeric washers at manufacturer's required spacing that meets performance requirements.

3.5 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Clean and neutralize flux materials. Clean off excess solder and sealants.

C. Remove temporary protective coverings and strippable films as roof specialties are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain roof specialties in a clean condition during construction.

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

END OF SECTION 07 7100
SECTION 07 7200 - ROOF ACCESSORIES

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Roof hatches.
B. Related Requirements:
   2. Section 07 7100 "Roof Specialties" for manufactured fasciae, copings, gravel stops, gutters and downspouts, and counterflashing.
   3. Section 07 7253 "Snow Guards" for snow guards.

1.3 COORDINATION
A. Coordinate layout and installation of roof accessories with roofing membrane and base flashing and interfacing and adjoining construction to provide a leakproof, weather tight, secure, and noncorrosive installation.
B. Coordinate dimensions with rough-in information or Shop Drawings of equipment to be supported.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of roof accessory.
   4. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
B. Shop Drawings: For roof accessories.
   5. Include plans, elevations, keyed details, and attachments to other work. Indicate dimensions, loadings, and special conditions. Distinguish between plant- and field-assembled work.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
A. General Performance: Roof accessories shall withstand exposure to weather and resist thermally induced movement without failure, rattling, leaking, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.
2.2 ROOF HATCHES

A. Roof Hatches: Metal roof-hatch units with lids and insulated double-walled curbs, welded or mechanically fastened and sealed corner joints, continuous lid-to-curb counterflashing and weathertight perimeter gasketing, and integrally formed deck-mounting flange at perimeter bottom.

6. Basis-of-Design Product: Subject to compliance with requirements, provide BILCO Company (The); TYPE L SERVICE STAIR ACCESS or comparable product by one of the following:
   a. Babcock-Davis.
   b. JL Industries, Inc.; a division of the Activar Construction Products Group.
   c. Milcor; Commercial Products Group of Hart & Cooley, Inc.
   d. Nystrom.

B. Type and Size: Single-leaf lid, 3'-0" x 14'-0".


D. Hatch Material: Aluminum sheet.

7. Thickness: 11 gage.

E. Construction:

   a. R-Value: 12.0 according to ASTM C1363.


11. Hatch Lid: Opaque, insulated, and double walled, with manufacturer's standard metal liner of same material and finish as outer metal lid.

12. Curb Liner: Manufacturer's standard, of same material and finish as metal curb.

13. On ribbed or fluted metal roofs, form flange at perimeter bottom to conform to roof profile.

14. Fabricate curbs to minimum height of 36-inches above roofing surface unless otherwise indicated.

15. Sloping Roofs: Where slope or roof deck exceeds 1:48, fabricate curb with perimeter curb height that is tapered to accommodate roof slope so that top surfaces of perimeter curb are level. Equip hatch with water diverter or cricket on side that obstructs water flow.

F. Hardware: Spring operators, hold-open arm, stainless steel spring latch with turn handles, galvanized stainless steel butt- or pintle-type hinge system, and padlock hasps inside and outside.

16. Provide two-point latch on lids larger than 84 inches.

G. Safety Railing System: Roof-hatch manufacturer's standard system including rails, clamps, fasteners, safety barrier at railing opening, and accessories required for a complete installation; attached to roof hatch and complying with 29 CFR 1910.23 requirements and authorities having jurisdiction.

17. Height: 42 inches above finished roof deck.

18. Posts and Rails: Aluminum pipe (11 gage), 1-1/2 inches in diameter.

20. Self-Latching Gate: Fabricated of same materials and rail spacing as safety railing system. Provide manufacturer’s standard hinges and self-latching mechanism.

21. Post and Rail Tops and Ends: Weather resistant, closed or plugged with prefabricated end fittings.

22. Provide weep holes or another means to drain entrapped water in hollow sections of handrail and railing members.

23. Fabricate joints exposed to weather to be watertight.

24. Fasteners: Manufacturer’s standard, finished to match railing system.

25. Finish: Manufacturer’s standard.

   a. Color: As indicated by manufacturer's designations as selected by Architect from manufacturer's full range.

2.3 METAL MATERIALS

A. Aluminum Sheet: ASTM B209, manufacturer’s standard alloy for finish required, with temper to suit forming operations and performance required.


B. Stainless Steel Sheet and Shapes: ASTM A240/A240M or ASTM A666, Type 304.

2.4 MISCELLANEOUS MATERIALS

A. Provide materials and types of fasteners, protective coatings, sealants, and other miscellaneous items required by manufacturer for a complete installation.

B. Polysiocyanurate Board Insulation: ASTM C1289, thickness and thermal resistivity as indicated.

C. Wood Nailers: Softwood lumber, pressure treated with waterborne preservatives for aboveground use, acceptable to authorities having jurisdiction, containing no arsenic or chromium, and complying with AWPA C2; not less than 1-1/2 inches thick.

D. Fasteners: Roof accessory manufacturer’s recommended fasteners suitable for application and metals being fastened. Match finish of exposed fasteners with finish of material being fastened. Provide nonremovable fastener heads to exterior exposed fasteners. Furnish the following unless otherwise indicated:

27. Fasteners for Stainless Steel Sheet: Series 300 stainless steel.

E. Gaskets: Manufacturer’s standard tubular or fingered design of neoprene, EPDM, PVC, or silicone or a flat design of foam rubber, sponge neoprene, or cork.

F. Elastomeric Sealant: ASTM C920, elastomeric polyurethane polymer sealant as recommended by roof accessory manufacturer for installation indicated; low modulus; of type, grade, class, and use classifications required to seal joints and remain watertight.

G. Butyl Sealant: ASTM C1311, single-component, solvent-release butyl rubber sealant; polyisobutylene plasticized; heavy bodied for expansion joints with limited movement.

2.5 GENERAL FINISH REQUIREMENTS

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

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions, and other conditions affecting performance of the Work.

B. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.

C. Verify dimensions of roof openings for roof accessories.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install roof accessories according to manufacturer's written instructions.

28. Install roof accessories level; plumb; true to line and elevation; and without warping, jogs in alignment, buckling, or tool marks.

29. Anchor roof accessories securely in place so they are capable of resisting indicated loads.

30. Use fasteners, separators, sealants, and other miscellaneous items as required to complete installation of roof accessories and fit them to substrates.

31. Install roof accessories to resist exposure to weather without failing, rattling, leaking, or loosening of fasteners and seals.

B. Metal Protection: Protect metals against galvanic action by separating dissimilar metals from contact with each other or with corrosive substrates by painting contact surfaces with bituminous coating or by other permanent separation as recommended by manufacturer.

32. Coat concealed side of uncoated aluminum roof accessories with bituminous coating where in contact with wood, ferrous metal, or cementitious construction.

33. Underlayment: Where installing roof accessories directly on cementitious or wood substrates, install a course of underlayment and cover with manufacturer's recommended slip sheet.

34. Bed flanges in thick coat of asphalt roofing cement where required by manufacturers of roof accessories for waterproof performance.

C. Equipment Support Installation: Install equipment supports so top surfaces are level with each other.

D. Roof-Hatch Installation:

35. Verify that roof hatch operates properly. Clean, lubricate, and adjust operating mechanism and hardware.

36. Attach safety railing system to roof-hatch curb.

37. Attach ladder-assist post according to manufacturer's written instructions.
E. Seal joints with elastomeric or butyl sealant as required by roof accessory manufacturer.

3.3 REPAIR AND CLEANING

A. Clean exposed surfaces according to manufacturer's written instructions.

B. Clean off excess sealants.

C. Replace roof accessories that have been damaged or that cannot be successfully repaired by finish touchup or similar minor repair procedures.

END OF SECTION 07 7200
PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:

1.3 ACTION SUBMITTALS
   A. Product Data: Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for snow guards.
   B. Shop Drawings: Include roof plans showing layouts and attachment details of snow guards.

   1. Include details of rail-type snow guards.
   2. Include calculation of number and location of snow guards based on snow load, roof slope, roof type, components, spacings, and finish.

   C. Samples: Base, bracket, and 12-inch-long rail.

1.4 INFORMATIONAL SUBMITTALS
   A. Product Test Reports: For each type of snow guard, for tests performed by manufacturer and witnessed by a qualified testing agency.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS
   A. Performance Requirements: Provide snow guards that withstand exposure to weather and resist thermally induced movement without failure, rattling, or fastener disengagement due to defective manufacture, fabrication, installation, or other defects in construction.

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

   B. Structural Performance:

   1. Snow Loads: As indicated on Drawings.
2.2 RAIL-TYPE SNOW GUARDS

A. Flat-Mounted, Rail-Type Snow Guards:

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

   a. Alpine SnowGuards, a division of Vermont Slate & Copper Services, Inc.
   b. IceBlox Inc.
   c. Rocky Mountain Snow Guards, Inc.
   d. TRA Snow and Sun, Inc.

2. Description: Units fabricated from metal baseplate anchored to adjustable bracket and equipped with two bars.

3. Brackets and Baseplate: Aluminum.

4. Bars: Aluminum; color to match roofing.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Installer present, for compliance with requirements for installation tolerances, snow guard attachment, and other conditions affecting performance of the Work.

   1. Verify compatibility with and suitability of substrates including compatibility with existing finishes or primers.

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

3.2 PREPARATION

A. Clean and prepare substrates for bonding snow guards.

B. Prime substrates according to snow guard manufacturer’s written instructions.

3.3 INSTALLATION

A. Install snow guards according to manufacturer’s written instructions. Space rows as recommended by manufacturer.

B. Attachment for Asphalt Shingle Roofing:

   1. Flat-Mounted, Rail-Type Snow Guards: Mounting plates bolted or screwed to the roof in place of a single ply roofing.

END OF SECTION 07 7253
PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Penetrations in fire-resistance-rated walls.

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

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

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

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

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

B. Install and cure penetration firestopping materials per manufacturer’s written instructions using natural means of ventilations or, where this is inadequate, forced-air circulation.

1.8 COORDINATION

A. Coordinate construction of openings and penetrating items to ensure that penetration firestopping systems can be installed according to specified firestopping system design.

B. Coordinate sizing of sleeves, openings, core-drilled holes, or cut openings to accommodate penetration firestopping systems.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics:

1. Perform penetration firestopping system tests by a qualified testing agency acceptable to authorities having jurisdiction.

2. Test per testing standards referenced in “Penetration Firestopping Systems” Article. Provide rated systems complying with the following requirements:

   a. Penetration firestopping systems shall bear classification marking of a qualified testing agency.

      1) UL in its “Fire Resistance Directory.”
      2) Intertek Group in its “Directory of Listed Building Products.”
      3) FM Global in its “Building Materials Approval Guide.”

2.2 PENETRATION FIRESTOPPING SYSTEMS

A. Penetration Firestopping Systems: Systems that resist spread of fire, passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated. Penetration firestopping systems shall be compatible with one another, with the substrates forming openings, and with penetrating items if any.

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

   a. 3M Fire Protection Products.
   b. Hilti, Inc; CFS-DID.
   c. Specified Technologies, Inc.
   d. Tremco, Inc.
B. Penetrations in Fire-Resistance-Rated Walls: Penetration firestopping systems with ratings determined per ASTM E 814 or UL 1479, based on testing at a positive pressure differential of 0.01-inch wg.

1. F-Rating: Not less than the fire-resistance rating of constructions penetrated.

C. Exposed Penetration Firestopping Systems: Flame-spread and smoke-developed indexes of less than 25 and 450, respectively, per ASTM E 84.

D. Accessories: Provide components for each penetration firestopping system that are needed to install fill materials and to maintain ratings required. Use only those components specified by penetration firestopping system manufacturer and approved by qualified testing and inspecting agency for conditions indicated.

1. Permanent forming/damming/backing materials.
2. Substrate primers.
3. Collars.
4. Steel sleeves.

2.3 FILL MATERIALS

A. Latex Sealants: Single-component latex formulations that do not re-emulsify after cure during exposure to moisture.

B. Firestop Devices: Factory-assembled collars formed from galvanized steel and lined with intumescent material sized to fit specific diameter of penetrant.

C. Intumescent Composite Sheets: Rigid panels consisting of aluminum-foil-faced intumescent elastomeric sheet bonded to galvanized-steel sheet.

D. Intumescent Putties: Nonhardening, water-resistant, intumescent putties containing no solvents or inorganic fibers.

E. Intumescent Wrap Strips: Single-component intumescent elastomeric sheets with aluminum foil on one side.

F. Mortars: Prepackaged dry mixes consisting of a blend of inorganic binders, hydraulic cement, fillers and lightweight aggregate formulated for mixing with water at Project site to form a nonshrinking, homogeneous mortar.

G. Pillows/Bags: Reusable heat-expanding pillows/bags consisting of glass-fiber cloth cases filled with a combination of mineral-fiber, water-insoluble expansion agents, and fire-retardant additives. Where exposed, cover openings with steel-reinforcing wire mesh to protect pillows/bags from being easily removed.

H. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, nonshrinking foam.


2.4 MIXING

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

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 PREPARATION

A. Surface Cleaning: Before installing penetration firestopping systems, clean out openings immediately to comply with manufacturer's written instructions and with the following requirements:

1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of penetration firestopping materials.
2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with penetration firestopping materials. Remove loose particles remaining from cleaning operation.
3. Remove laitance and form-release agents from concrete.

B. Prime substrates where recommended in writing by manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.3 INSTALLATION

A. General: Install penetration firestopping systems to comply with manufacturer’s written installation instructions and published drawings for products and applications.

B. Install forming materials and other accessories of types required to support fill materials during their application and in the position needed to produce cross-sectional shapes and depths required to achieve fire ratings.

1. After installing fill materials and allowing them to fully cure, remove combustible forming materials and other accessories not forming permanent components of firestopping.

C. Install fill materials by proven techniques to produce the following results:

1. Fill voids and cavities formed by openings, forming materials, accessories and penetrating items to achieve required fire-resistance ratings.
2. Apply materials so they contact and adhere to substrates formed by openings and penetrating items.
3. For fill materials that will remain exposed after completing the Work, finish to produce smooth, uniform surfaces that are flush with adjoining finishes.
3.4 IDENTIFICATION

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

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

B. Penetration Identification: Identify each penetration firestopping system with legible metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of penetration firestopping system edge so labels are visible to anyone seeking to remove penetrating items or firestopping systems. Use mechanical fasteners or self-adhering-type labels with adhesives capable of permanently bonding labels to surfaces on which labels are placed. Include the following information on labels:

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

3.5 FIELD QUALITY CONTROL

A. Owner will engage a qualified testing agency to perform tests and inspections according to ASTM E 2174.

B. Where deficiencies are found or penetration firestopping system is damaged or removed because of testing, repair or replace penetration firestopping system to comply with requirements.

C. Proceed with enclosing penetration firestopping systems with other construction only after inspection reports are issued and installations comply with requirements.

3.6 CLEANING AND PROTECTION

A. Clean off excess fill materials adjacent to openings as the Work progresses by methods and with cleaning materials that are approved in writing by penetration firestopping system manufacturers and that do not damage materials in which openings occur.

B. Provide final protection and maintain conditions during and after installation that ensure that penetration firestopping systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, immediately cut out and remove damaged or deteriorated penetration firestopping material and install new materials to produce systems complying with specified requirements.

3.7 PENETRATION FIRESTOPPING SYSTEM SCHEDULE

A. Where UL-classified systems are indicated, they refer to system numbers in UL’s "Fire Resistance Directory" under product Category XHEZ.

B. Where Intertek Group-listed systems are indicated, they refer to design numbers in Intertek Group's "Directory of Listed Building Products" under "Firestop Systems."
C. Where FM Global-approved systems are indicated, they refer to design numbers listed in FM Global's "Building Materials Approval Guide" under "Wall and Floor Penetration Fire Stops."

END OF SECTION 07 8413
SECTION 07 9200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Nonstaining silicone joint sealants.
2. Urethane joint sealants.
3. Mildew-resistant joint sealants.
4. Butyl joint sealants.
5. Latex joint sealants.

B. Related Requirements:

1. Section 32 1373 "Concrete Paving Joint Sealants" for sealing joints in paved roads, parking lots, walkways, and curbing.

1.3 ACTION SUBMITTALS

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

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

C. Samples for Verification: For each kind and color of joint sealant required, provide Samples with joint sealants in 1/2-inch-wide joints formed between two 6-inch-long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

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

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.

1.4 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each kind of joint sealant, for tests performed by a qualified testing agency.

B. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:

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

C. Preconstruction Laboratory Test Reports: From sealant manufacturer, indicating the following:
   1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
   2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.


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

F. Sample Warranties: For special warranties.

1.5 QUALITY ASSURANCE

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

B. Product Testing: Test joint sealants using a qualified testing agency.
   1. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

C. Mockups: Install sealant in mockups of assemblies specified in other Sections that are indicated to receive joint sealants specified in this Section. Use materials and installation methods specified in this Section.

1.6 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:
   1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
   2. When joint substrates are wet.
   3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
   4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.7 WARRANTY

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

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

C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from causes exceeding design specifications.
3. Mechanical damage caused by individuals, tools, or other outside agents.
4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 JOINT SEALANTS, GENERAL

A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.

B. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 NONSTAINING SILICONE JOINT SEALANTS

A. Nonstaining Joint Sealants: No staining of substrates when tested according to ASTM C 1248.

B. Silicone, Nonstaining, S, NS, 50, NT: Nonstaining, single-component, nonsag, plus 50 percent and minus 50 percent movement capability, nontraffic-use, neutral-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 50, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. Pecora Corporation; Pecora 895NST.
   b. Sika Corporation; Joint Sealants; Sikasil WS-295.
   c. The Dow Chemical Company; Dow Corning® 795 Silicone Building Sealant.
   d. Tremco Incorporated; Spectrem 3.

2.3 URETHANE JOINT SEALANTS

A. Urethane, S, NS, 25, NT: Single-component, nonsag, nontraffic-use, plus 25 percent and minus 25 percent movement capability, urethane joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. BASF Corporation; MasterSeal NP 1 (Pre-2014: Sonolastic NP1).
   b. Bostik, Inc; Chem-Calk 916.
   c. Sherwin-Williams Company (The); Stampede-1.
   d. Sika Corporation; Joint Sealants; Sikaflex Textured Sealant.
2.4 MILDEW-RESISTANT JOINT SEALANTS
   A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.
   B. Silicone, Mildew Resistant, Acid Curing, S, NS, 25, NT: Mildew-resistant, single-component, nonsag, plus 25 percent and minus 25 percent movement capability, nontraffic-use, acid-curing silicone joint sealant; ASTM C 920, Type S, Grade NS, Class 25, Use NT.

2.5 BUTYL JOINT SEALANTS
   A. Butyl-Rubber-Based Joint Sealants: ASTM C 1311.

2.6 LATEX JOINT SEALANTS
   A. Acrylic Latex: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

2.7 JOINT-SEALANT BACKING
   A. Sealant Backing Material, General: Nonstaining; compatible with joint substrates, sealants, primers, and other joint fillers; and approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.
   B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), Type O (open-cell material), Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
   C. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.8 MISCELLANEOUS MATERIALS
   A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
   B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
   C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.
PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:

1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.

2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
   a. Concrete.
   b. Masonry.

3. Remove laitance and form-release agents from concrete.

4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
   a. Metal.
   b. Glass.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193 unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:

1. Extent of Testing: Test completed, and cured sealant joints as follows:
   a. Perform at least one test per elevation for each kind of sealant and joint substrate.

   a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.

3. Inspect tested joints and report on the following:
   a. Whether sealants filled joint cavities and are free of voids.
   b. Whether sealant dimensions and configurations comply with specified requirements.
   c. Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.

4. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
a. Provide test results to Architect for review.

5. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.

B. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.5 CLEANING

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

3.6 PROTECTION

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

3.7 JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal nontraffic surfaces [JS-1].

1. Joint Locations:

   b. Control and expansion joints in unit masonry.
   c. Joints in dimension stone cladding.
   d. Joints between metal panels.
   e. Joints between different materials listed above.
   f. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
   g. Control and expansion joints in ceilings and other overhead surfaces.
   h. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, nonstaining, S, NS, 50, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer’s full range of colors.

B. Joint-Sealant Application: Interior joints in horizontal traffic surfaces [JS-2].

1. Joint Locations:

   b. Control and expansion joints in stone flooring.
   c. Control and expansion joints in brick flooring.
   d. Control and expansion joints in tile flooring.
   e. Other joints as indicated on Drawings.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

C. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal nontraffic surfaces not subject to significant movement [JS-3].

1. Joint Locations:
   a. Control joints on exposed interior surfaces of exterior walls.
   b. Perimeter joints between interior wall surfaces and frames of interior doors and windows.
   c. Other joints as indicated on Drawings.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

D. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal nontraffic surfaces [JS-4].

1. Joint Locations:
   a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
   b. Tile control and expansion joints where indicated.
   c. Other joints as indicated on Drawings.

2. Joint Sealant: Silicone, mildew resistant, acid curing, S, NS, 25, NT.
3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

E. Joint-Sealant Application: Concealed mastics [JS-5].

1. Joint Locations:
   a. Aluminum thresholds.
   b. Sill plates.
   c. Other joints as indicated on Drawings.

3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.

END OF SECTION 07 9200
SECTION 08 1113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes hollow-metal work.
B. Related Requirements:
   1. Section 08 7100 "Door Hardware" for door hardware for hollow-metal doors.
   2. Section 13 4900 "Radiation Protection" for lead-lined, hollow-metal doors and frames.

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

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

1.5 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: Include the following:
   1. Elevations of each door type.
   2. Details of doors, including vertical- and horizontal-edge details and metal thicknesses.
   3. Frame details for each frame type, including dimensioned profiles and metal thicknesses.
   4. Locations of reinforcement and preparations for hardware.
   5. Details of each different wall opening condition.
   6. Details of anchorages, joints, field splices, and connections.
   7. Details of accessories.
   8. Details of moldings, removable stops, and glazing.
   9. Details of conduit and preparations for power, signal, and control systems.
C. Schedule: Provide a schedule of hollow-metal work prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final Door Hardware Schedule.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver hollow-metal work palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.

B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.

C. Store hollow-metal work vertically under cover at Project site with head up. Place on minimum 4-inch-high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Ceco Door; ASSA ABLOY.
2. Curries Company; ASSA ABLOY.
3. Mesker Door Inc.
4. Republic Doors and Frames.
5. Steelcraft; an Allegion brand; Steelcraft Hollow Metal Doors and Frames.

B. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.

2.3 INTERIOR DOORS AND FRAMES

A. Construct interior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

B. Heavy-Duty Doors and Frames: SDI A250.8, Level 2. At all locations unless noted otherwise.

1. Physical Performance: Level B according to SDI A250.4.
2. Doors:
   a. Type: As indicated in the Door and Frame Schedule.
   c. Face: Metallic-coated, cold-rolled steel sheet, minimum thickness of 0.042 inch.
   d. Edge Construction: Model 2, Seamless.
   e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.
   f. Core: Polyurethane.
3. Frames:
   a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch.
   b. Construction: Face welded.


2.4 EXTERIOR HOLLOW-METAL DOORS AND FRAMES

   A. Construct exterior doors and frames to comply with the standards indicated for materials, fabrication, hardware locations, hardware reinforcement, tolerances, and clearances, and as specified.

   B. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3. At all locations unless noted otherwise.

   1. Physical Performance: Level A according to SDI A250.4.
   2. Doors:
      a. Type: As indicated in the Door and Frame Schedule.
      b. Thickness: 1-3/4 inches
      c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
      d. Edge Construction: Model 2, Seamless.
      e. Core: Polyurethane.

         1) Thermal-Rated Doors: Provide doors fabricated with thermal-resistance value (R-value) of not less than 2.1 deg F x h x sq. ft./Btu when tested according to ASTM C 1363.

   3. Frames:
      a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch, with minimum A40 coating.
      b. Construction: Full profile welded.


2.5 FRAME ANCHORS

   A. Jamb Anchors:

      1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042-inch-thick, with corrugated or perforated straps not less than 2 inches wide by 10 inches long; or wire anchors not less than 0.177 inch thick.
      2. Stud-Wall Type: Designed to engage stud, welded to back of frames; not less than 0.042 inch thick.

   B. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch, and as follows:

      1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
2.6 MATERIALS

A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.

B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B.

D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z coating designation; mill phosphatized.
   1. For anchors built into exterior walls, steel sheet complying with ASTM A 1008/A 1008M or ASTM A 1011/A 1011M, hotdip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hotdip galvanized according to ASTM A 153/A 153M.

F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow-metal frames of type indicated.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches, as measured according to ASTM C 143/C 143M.

H. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.

I. Glazing: Comply with requirements in Section 08 8000 "Glazing."

J. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.7 FABRICATION

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

B. Hollow-Metal Doors:
   1. Vertical Edges for Single-Acting Doors: Provide beveled or square edges at manufacturer's discretion.
   2. Top Edge Closures: Close top edges of doors with flush closures of same material as face sheets.
   3. Bottom Edge Closures: Close bottom edges of doors where required for attachment of weather stripping with end closures or channels of same material as face sheets.
   4. Exterior Doors: Provide weep-hole openings in bottoms of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
1. Sidelight and Transom Bar Frames: Provide closed tubular members with no visible face seams or joints, fabricated from same material as door frame. Fasten members at crossings and to jambs by butt welding.

2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.

3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.

4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.

5. Jamb Anchors: Provide number and spacing of anchors as follows:
   a. Masonry Type: Locate anchors not more than 16 inches from top and bottom of frame. Space anchors not more than 32 inches o.c., to match coursing, and as follows:
      1) Two anchors per jamb up to 60 inches high.
      2) Three anchors per jamb from 60 to 90 inches high.
      3) Four anchors per jamb from 90 to 120 inches high.
      4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 120 inches high.
   b. Stud-Wall Type: Locate anchors not more than 18 inches from top and bottom of frame. Space anchors not more than 32 inches o.c. and as follows:
      1) Three anchors per jamb up to 60 inches high.
      2) Four anchors per jamb from 60 to 90 inches high.
      3) Five anchors per jamb from 90 to 96 inches high.
      4) Five anchors per jamb plus one additional anchor per jamb for each 24 inches or fraction thereof above 96 inches high.

6. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction.
   a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
   b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Fabricate concealed stiffeners and edge channels from either cold- or hot-rolled steel sheet.

E. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

F. Stops and Moldings: Provide stops and moldings around glazed lites and louvers where indicated. Form corners of stops and moldings with butted or mitered hairline joints.

1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of hollow-metal work.
2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
3. Provide loose stops and moldings on inside of hollow-metal work.
4. Coordinate rabbet width between fixed and removable stops with glazing and installation types indicated.
2.8 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer’s standard primer.

1. Shop Primer: Manufacturer’s standard, fast-curing, lead- and chromate-free primer complying with SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.

2.9 ACCESSORIES

A. Mullions and Transom Bars: Join to adjacent members by welding or rigid mechanical anchors.

B. Grout Guards: Formed from same material as frames, not less than 0.016 inch thick.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations before frame installation.

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

3.2 PREPARATION

A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces.

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

3.3 INSTALLATION

A. General: Install hollow-metal work plumb, rigid, properly aligned, and securely fastened in place. Comply with Drawings and manufacturer's written instructions.

B. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

   a. At fire-rated openings, install frames according to NFPA 80.

   b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install frames with removable stops located on secure side of opening.
d. Install door silencers in frames before grouting.
e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
g. Field apply bituminous coating to backs of frames that will be filled with grout containing antifreezing agents.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.
a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.


4. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.

5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:
a. Squareness: Plus or minus 1/16 inch, measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
b. Alignment: Plus or minus 1/16 inch, measured at jambs on a horizontal line parallel to plane of wall.
c. Twist: Plus or minus 1/16 inch, measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
d. Plumbness: Plus or minus 1/16 inch, measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Steel Doors:
a. Between Door and Frame Jambs and Head: 1/8 inch plus or minus 1/32 inch.
b. Between Edges of Pairs of Doors: 1/8 inch to 1/4 inch plus or minus 1/32 inch.
c. At Bottom of Door: 5/8 inch plus or minus 1/32 inch.
d. Between Door Face and Stop: 1/16 inch to 1/8 inch plus or minus 1/32 inch.

D. Glazing: Comply with installation requirements in Section 08 8000 "Glazing" and with hollow-metal manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches o.c. and not more than 2 inches o.c. from each corner.

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after unacceptable.

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer’s written instructions.

END OF SECTION 08 1113
SECTION 08 1416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer and plastic-laminate faces.
2. Factory finishing flush wood doors.
3. Factory fitting flush wood doors to frames and factory machining for hardware.

B. Related Requirements:

1. Section 08 8000 "Glazing" for glass view panels in flush wood doors.
2. Section 13 4900 "Radiation Protection" for lead-lined flush wood doors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of door. Include details of core and edge construction and trim for openings. Include factory-finishing specifications.

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

1. Dimensions and locations of blocking.
2. Dimensions and locations of mortises and holes for hardware.
3. Dimensions and locations of cutouts.
4. Undercuts.
5. Fire-protection ratings for fire-rated doors.
6. Requirements for veneer matching.
7. Doors to be factory finished and finish requirements.

C. Samples for Initial Selection: For plastic-laminate door faces and factory-finished doors.

D. Samples for Verification:

1. Factory finishes applied to actual door face materials, approximately 8 by 10 inches, for each material and finish. For each wood species and transparent finish, provide set of three Samples showing typical range of color and grain to be expected in finished Work.
2. Plastic laminate, 6 inches square, for each color, texture, and pattern selected.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.
1.5 DELIVERY, STORAGE, AND HANDLING

A. Comply with requirements of referenced standard and manufacturer’s written instructions.

B. Package doors individually in cardboard cartons and wrap bundles of doors in plastic sheeting.

C. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.6 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install doors until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during remainder of construction period.

1.7 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace doors that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Warping (bow, cup, or twist) more than 1/4 inch in a 42-by-84-inch section.
   b. Telegraphing of core construction in face veneers exceeding 0.01 inch in a 3-inch span.

2. Warranty shall also include installation and finishing that may be required due to repair or replacement of defective doors.


PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Algoma Hardwoods, Inc.
2. Eggers Industries.
3. Graham Wood Doors; ASSA ABLOY Group company.
5. VT Industries Inc.

2.2 FLUSH WOOD DOORS, GENERAL

A. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

B. WDMA I.S.1-A Performance Grade:

1. Heavy Duty unless otherwise indicated.
C. Particleboard-Core Doors:
   2. Particleboard: Straw-based particleboard complying with ANSI A208.1, Grade LD-2 or M-2, except for density.
   3. Provide doors with glued-wood-stave or structural-composite-lumber cores instead of particleboard cores for doors indicated to receive exit devices.

D. Fire-Rated Wood Doors: Doors complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C.
   1. Cores: Provide core specified or mineral core as needed to provide fire-protection rating indicated.
   2. Edge Construction: Provide edge construction with intumescent seals concealed by outer stile. Comply with specified requirements for exposed edges.

E. Mineral-Core Doors:
   1. Core: Noncombustible mineral product complying with requirements of referenced quality standard and testing and inspecting agency for fire-protection rating indicated.
   2. Edge Construction: At hinge stiles, provide laminated-edge construction with improved screw-holding capability and split resistance. Comply with specified requirements for exposed edges.

2.3 VENEER-FACED DOORS FOR TRANSPARENT FINISH

A. Interior Solid-Core Doors SCWD:
   1. Grade: Premium, with Grade A faces.
   2. Species: Select white birch.
   3. Cut: Plain sliced (flat sliced).
   5. Assembly of Veneer Leaves on Door Faces: Balance match.
   6. Pair and Set Match: Provide for doors hung in same opening or separated only by mullions.
   7. Transom Match: Continuous match.
   8. Blueprint Match: Where indicated, provide doors with faces produced from same flitches as adjacent wood paneling and arranged to provide blueprint match with wood paneling. Comply with requirements in Section 06 4216 “Flush Wood Paneling.”
   9. Exposed Vertical Edges: Applied wood edges of same species as faces and covering edges of crossbands - edge Type D.
   11. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before veneering.
   12. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.4 PLASTIC-LAMINATE-FACED DOORS

A. Interior Solid-Core Doors (PL):
   1. Grade: Premium.
   2. Plastic-Laminate Faces: High-pressure decorative laminates complying with NEMA LD 3, Grade HGS.
3. Colors, Patterns, and Finishes: Refer to Appendix A “Interior Finish Key” for manufacturer, color and texture. Door panels are to match wall panels.

   
a. Polymer Edging Color: Same color as faces.

5. Core: Particleboard.

6. Construction: Five plies. Stiles and rails are bonded to core, then entire unit is abrasive planed before faces and crossbands are applied. Faces are bonded to core using a hot press.

7. WDMA I.S.1-A Performance Grade: Heavy Duty.

2.5 LIGHT FRAMES AND LOUVERS

A. Wood Beads for Light Openings in Wood Doors: Provide manufacturer’s standard wood beads unless otherwise indicated.

   1. Wood Species: Same species as door faces.
   2. Profile: Manufacturer’s standard shape.
   3. At wood-core doors with 20-minute fire-protection ratings, provide wood beads and metal glazing clips approved for such use.

2.6 FABRICATION

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

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

B. Factory machine doors for hardware that is not surface applied. Locate hardware to comply with DHI-WDHS-3. Comply with final hardware schedules, door frame Shop Drawings, BHMA-156.115-W, and hardware templates.

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

2.7 FACTORY FINISHING

A. General: Comply with referenced quality standard for factory finishing. Complete fabrication, including fitting doors for openings and machining for hardware that is not surface applied, before finishing.

   1. Finish faces, all four edges, edges of cutouts, and mortises. Stains and fillers may be omitted on top and bottom edges, edges of cutouts, and mortises.

B. Factory finish doors.

C. Transparent Finish:

   1. Grade: Premium.
   2. Finish: WDMA TR-4 conversion varnish or WDMA TR-6 catalyzed polyurethane.
4. Effect: Semifilled finish, produced by applying an additional finish coat to partially fill the wood pores.
5. Sheen: Semigloss.

PART 3 - EXECUTION

3.1 EXAMINATION

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

3.2 INSTALLATION

A. Hardware: For installation, see Section 08 7100 “Door Hardware.”
B. Installation Instructions: Install doors to comply with manufacturer's written instructions and referenced quality standard, and as indicated.
   1. Install fire-rated doors according to NFPA 80.
C. Job-Fitted Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted for fire-rated doors. Machine doors for hardware. Seal edges of doors, edges of cutouts, and mortises after fitting and machining.
   1. Clearances: Provide 1/8 inch at heads, jambs, and between pairs of doors. Provide 1/8 inch from bottom of door to top of decorative floor finish or covering unless otherwise indicated. Where threshold is shown or scheduled, provide 1/4 inch from bottom of door to top of threshold unless otherwise indicated.
      a. Comply with NFPA 80 for fire-rated doors.
   2. Bevel non-fire-rated doors 1/8 inch in 2 inches at lock and hinge edges.
   3. Bevel fire-rated doors 1/8 inch in 2 inches at lock edge; trim stiles and rails only to extent permitted by labeling agency.
D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.
E. Factory-Finished Doors: Restore finish before installation if fitting or machining is required at Project site.

3.3 ADJUSTING

A. Operation: Rehang or replace doors that do not swing or operate freely.
B. Finished Doors: Replace doors that are damaged or that do not comply with requirements. Doors may be repaired or refinished if Work complies with requirements and shows no evidence of repair or refinishing.
SECTION 08 3113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Access doors and frames for walls and ceilings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, materials, individual components and profiles, and finishes.

B. Shop Drawings:

1. Include plans, elevations, sections, details, and attachments to other work.
2. Detail fabrication and installation of access doors and frames for each type of substrate.

C. Samples: For each door face material, at least 3 by 5 inches in size, in specified finish.

D. Product Schedule: Provide complete access door and frame schedule, including types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

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

1. Babcock-Davis.
2. JL Industries, Inc.; a division of the Activar Construction Products Group.
3. Larsens Manufacturing Company.
4. Milcor; Commercial Products Group of Hart & Cooley, Inc.
5. Nystrom.

B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.

C. Flush Access Doors with Exposed Flanges:

1. Basis-of-Design Product: Provide an Elmdor, 24” x 24” weather gasketed access door.
2. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size and gasketed.
3. Locations: Ceiling.
4. Door Size: 24" x 24".
5. Metallic-Coated Steel Sheet for Door: Nominal 0.064-inch, 16 gage.
6. Frame Material: Same material, thickness, and finish as door.
8. Hardware: Latch.

D. Hardware:
   1. Latch: Cam latch operated by knurled knob.

2.2 MATERIALS
A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
B. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 or A60 metallic coating.
C. Frame Anchors: Same type as door face.
D. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.3 FABRICATION
A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
   1. For concealed flanges with drywall bead, provide edge trim for gypsum board securely attached to perimeter of frames.
   2. Provide mounting holes in frames for attachment of units to metal or wood framing.
   3. Provide mounting holes in frame for attachment of masonry anchors.
D. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
E. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
F. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
G. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

H. Steel and Metallic-Coated-Steel Finishes:
   1. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer’s standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil for topcoat.

PART 3 - EXECUTION

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

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

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

END OF SECTION 08 3113
SECTION 08 4113 - ALUMINUM-FRAMED ENTRANCES AND STOREFRONTS

PART 1 - GENERAL

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

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

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
B. Shop Drawings: For aluminum-framed entrances and storefronts. Include plans, elevations, sections, full-size details, and attachments to other work.
   1. Include details of provisions for assembly expansion and contraction and for draining moisture occurring within the assembly to the exterior.
      a. Shop drawing details are to be project specific and shown all interfaces with surrounding materials.
   2. Include full-size isometric details of each vertical-to-horizontal intersection of aluminum-framed entrances and storefronts, showing the following:
      a. Joinery, including concealed welds.
      b. Anchorage.
      c. Expansion provisions.
      d. Glazing.
      e. Flashing and drainage.
   3. Show connection to and continuity with adjacent thermal, weather, air, and vapor barriers.
C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.
D. Entrance Door Hardware Schedule: Prepared by or under supervision of supplier, detailing fabrication and assembly of entrance door hardware, as well as procedures and diagrams.
Coordinate final entrance door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of entrance door hardware.

E. Delegated-Design Submittal: For aluminum-framed entrances and storefronts indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.4 INFORMATIONAL SUBMITTALS

A. Energy Performance Certificates: For aluminum-framed entrances and storefronts, accessories, and components, from manufacturer.
   1. Basis for Certification: NFRC-certified energy performance values for each aluminum-framed entrance and storefront.

B. Sample Warranties: For special warranties.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For aluminum-framed entrances and storefronts to include in maintenance manuals.

1.6 QUALITY ASSURANCE

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

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

1.7 MOCKUPS

A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for fabrication and installation.
   1. Build in place mockup of typical wall area as directed by Owner's representative and Architect.
   2. Testing shall be performed on mockups according to requirements in "Field Quality Control" Article.
   3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
   4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.
1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration created by wind and thermal and structural movements.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   d. Water penetration through fixed glazing and framing areas.
   e. Failure of operating components.
   f. Condensation

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

B. Special Finish Warranty: Standard form in which manufacturer agrees to repair finishes or replace aluminum that shows evidence of deterioration of factory-applied finishes within specified warranty period.

1. Deterioration includes, but is not limited to, the following:
   a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
   b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
   c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

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

C. Special Installers Warranty: Installer agrees to repair or replace components of aluminum-framed entrances and storefronts that do not comply with requirements or that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Noise or vibration created by wind and thermal and structural movements.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
   d. Water penetration through fixed glazing and framing areas.
   e. Failure of operating components.
   f. Condensation

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design aluminum-framed entrances and storefronts.

B. General Performance: Comply with performance requirements specified, as determined by testing of aluminum-framed entrances and storefronts representing those indicated for this
Project without failure due to defective manufacture, fabrication, installation, or other defects in construction.

1. Aluminum-framed entrances and storefronts shall withstand movements of supporting structure including, but not limited to, story drift, twist, column shortening, long-term creep, and deflection from uniformly distributed and concentrated live loads.

2. Failure also includes the following:
   a. Thermal stresses transferring to building structure.
   b. Glass breakage.
   c. Noise or vibration created by wind and thermal and structural movements.
   d. Loosening or weakening of fasteners, attachments, and other components.
   e. Failure of operating units.
   f. Water Infiltration.
   g. Condensation

C. Structural Loads:
   1. Wind Loads: As indicated on Drawings.
   2. Other Design Loads: As indicated on Drawings.

D. Deflection of Framing Members: At design wind pressure, as follows:
   1. Deflection Normal to Wall Plane: Limited to 1/175 of clear span for spans up to 13 feet 6 inches and to 1/240 of clear span plus 1/4 inch for spans greater than 13 feet 6 inches or an amount that restricts edge deflection of individual glazing lites to 3/4 inch, whichever is less.
   2. Deflection Parallel to Glazing Plane: Limited to amount not exceeding that which reduces glazing bite to less than 75 percent of design dimension and that which reduces edge clearance between framing members and glazing or other fixed components to less than 1/8 inch.

E. Structural: Test according to ASTM E 330 as follows:
   1. When tested at positive and negative wind-load design pressures, assemblies do not evidence deflection exceeding specified limits.
   2. When tested at 150 percent of positive and negative wind-load design pressures, assemblies, including anchorage, do not evidence material failures, structural distress, or permanent deformation of main framing members exceeding 0.2 percent of span.
   3. Test Durations: As required by design wind velocity, but not less than 10 seconds.

F. Air Infiltration: Test according to ASTM E 283 for infiltration as follows:
   1. Fixed Framing and Glass Area:
      a. Maximum air leakage of 0.06 cfm/sq. ft. at a static-air-pressure differential of 6.24 lbf/sq. ft.
   2. Entrance Doors:
      a. Pair of Doors: Maximum air leakage of 1.0 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
      b. Single Doors: Maximum air leakage of 0.5 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.

G. Water Penetration under Static Pressure: Test according to ASTM E 331 as follows:
1. No evidence of water penetration through fixed glazing and framing areas when tested according to a minimum static-air-pressure differential of 20 percent of positive wind-load design pressure, but not less than 8 lbf/sq. ft.

H. Water Penetration under Dynamic Pressure: Test according to AAMA 501.1 as follows:

1. No evidence of water penetration through fixed glazing and framing areas when tested at dynamic pressure equal to 20 percent of positive wind-load design pressure, but not less than 12 lbf/sq. ft.
2. Maximum Water Leakage: No uncontrolled water penetrating assemblies or water appearing on assemblies’ normally exposed interior surfaces from sources other than condensation. Water leakage does not include water controlled by flashing and gutters, or water that is drained to exterior.

I. Seismic Performance: Aluminum-framed entrances and storefronts shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1. Seismic Drift Causing Glass Fallout: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.6 at design displacement and 1.5 times the design displacement.
2. Vertical Interstory Movement: Complying with criteria for passing based on building occupancy type when tested according to AAMA 501.7 at design displacement and 1.5 times the design displacement.

J. Energy Performance: Certify and label energy performance according to NFRC as follows:

1. Thermal Transmittance (U-factor): Fixed glazing and framing areas shall have U-factor of not more than 0.57 Btu/sq. ft. x h x deg F as determined according to NFRC 100.
2. Solar Heat Gain Coefficient: Fixed glazing and framing areas shall have a solar heat gain coefficient of no greater than 0.40 as determined according to NFRC 200.
3. Condensation Resistance: Fixed glazing and framing areas shall have an NFRC-certified condensation resistance rating of no less than 35 as determined according to NFRC 500.

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

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

2.2 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Kawneer North America, an Alconic company, Trifab VG451T for exterior and Trifab 451 for interior, or comparable product by one of the following:

1. EFCO Corporation.
2. Kawneer North America, an Arconic company.
5. Vistawall Architectural Products.

2.3 FRAMING

A. Framing Members: Manufacturer’s extruded- or formed-aluminum framing members of thickness required and reinforced as required to support imposed loads.

2. **Glazing System:** Retained mechanically with gaskets on four sides.
3. **Glazing Plane:** Front.
4. **Finish:** Clear anodic finish.
5. **Fabrication Method:** Field-fabricated stick system.

B. **Backer Plates:** Manufacturer's standard, continuous backer plates for framing members, if not integral, where framing abuts adjacent construction.

C. **Brackets and Reinforcements:** Manufacturer's standard high-strength aluminum with nonstaining, nonferrous shims for aligning system components.

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

2.4 **ENTRANCE DOOR SYSTEMS**

A. **Entrance Doors:** Manufacturer's standard glazed entrance doors for manual-swing operation.
   1. **Door Construction:** 2-inch overall thickness, with minimum 0.188-inch thick, extruded-aluminum tubular rail and stile members. Mechanically fasten corners with reinforcing brackets that are deeply penetrated and fillet welded or that incorporate concealed tie rods.
   2. **Door Design:** Medium stile; 3-1/2-inch nominal width.
   3. **Glazing Stops and Gaskets:** Beveled, snap-on, extruded-aluminum stops and preformed gaskets.
      - a. Provide nonremovable glazing stops on outside of door.

2.5 **ENTRANCE DOOR HARDWARE**

A. **Entrance Door Hardware:** Hardware not specified in this Section is specified in Section 08 7100 "Door Hardware."

B. **General:** Provide entrance door hardware and entrance door hardware sets indicated in "Entrance Door Hardware Sets" Article for each entrance door to comply with requirements in this Section.
   1. **Entrance Door Hardware Sets:** Provide quantity, item, size, finish or color indicated, and named manufacturers' products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

3. Opening-Force Requirements:
   a. Egress Doors: Not more than 15 lbf to release the latch and not more than 30 lbf to set the door in motion and not more than 15 lbf to open the door to its minimum required width.
   b. Accessible Interior Doors: Not more than 5 lbf to fully open door.

C. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of entrance door hardware are indicated in "Entrance Door Hardware Sets" Article. Products are identified by using entrance door hardware designations as follows:

1. Named Manufacturers’ Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers’ names are abbreviated in "Entrance Door Hardware Sets" Article.

D. Continuous-Gear Hinges: Manufacturer's standard with stainless-steel bearings between knuckles, fabricated to full height of door and frame.

E. Mortise Auxiliary Locks: BHMA A156.5, Grade 1.

F. Panic Exit Devices: BHMA A156.3, Grade 1, listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305.

G. Cylinders: As specified in Section 08 7100 "Door Hardware."

1. Keying: Master key system. Permanently inscribe each key with a visual key control number and include notation “DO NOT DUPLICATE”.

H. Strikes: Provide strike with black-plastic dust box for each latch or lock bolt; fabricated for aluminum framing.

I. Operating Trim: BHMA A156.6.

J. Removable Mullions: BHMA A156.3, extruded aluminum.

1. When used with panic exit devices, provide removable mullions listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for panic protection, based on testing according to UL 305. Use only mullions that have been tested with exit devices to be used.

K. Closers: BHMA A156.4, Grade 1, with accessories required for a complete installation, sized as required by door size, exposure to weather, and anticipated frequency of use; adjustable to comply with field conditions and requirements for opening force.

L. Door Stops: BHMA A156.16, Grade 1, floor or wall mounted, as appropriate for door location indicated, with integral rubber bumper.

M. Weather Stripping: Manufacturer’s standard replaceable components.

1. Compression Type: Made of ASTM D 2000, molded neoprene, or ASTM D 2287, molded PVC.
2. Sliding Type: AAMA 701/702, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.
N. Weather Sweeps: Manufacturer’s standard exterior-door bottom sweep with concealed fasteners on mounting strip.

O. Silencers: BHMA A156.16, Grade 1.

P. Thresholds: BHMA A156.21, raised thresholds beveled with a slope of not more than 1:2, with maximum height of 1/2 inch.

2.6 GLAZING

A. Glazing: Comply with Section 08 8000 "Glazing."

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

C. Glazing Sealants: As recommended by manufacturer.

2.7 ACCESSORIES

A. Fasteners and Accessories: Manufacturer’s standard corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

1. Use self-locking devices where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration.

2. Reinforce members as required to receive fastener threads.

3. Use exposed fasteners with countersunk Phillips screw heads, finished to match framing system and fabricated from 300 series stainless steel.

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

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

C. Concealed Flashing: Manufacturer's standard corrosion-resistant, nonstaining, nonbleeding flashing compatible with adjacent materials.

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

2.8 FABRICATION

A. Form or extrude aluminum shapes before finishing.

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

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

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

2. Accurately fitted joints with ends coped or mitered.

3. Physical and thermal isolation of glazing from framing members.
4. Accommodations for thermal and mechanical movements of glazing and framing to maintain required glazing edge clearances.
5. Provisions for field replacement of glazing from interior.
6. Fasteners, anchors, and connection devices that are concealed from view to greatest extent possible.

D. Mechanically Glazed Framing Members: Fabricate for flush glazing without projecting stops.

E. Structural-Sealant-Glazed Framing Members: Include accommodations for using temporary support device to retain glazing in place while structural sealant cures.

F. Entrance Door Frames: Reinforce as required to support loads imposed by door operation and for installing entrance door hardware.

G. Entrance Doors: Reinforce doors as required for installing entrance door hardware.

H. Entrance Door Hardware Installation: Factory install entrance door hardware to the greatest extent possible. Cut, drill, and tap for factory-installed entrance door hardware before applying finishes.

I. After fabrication, clearly mark components to identify their locations in Project according to Shop Drawings.

2.9 ALUMINUM FINISHES

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 PREPARATION

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

3.3 INSTALLATION

A. General:

1. Comply with manufacturer’s written instructions.
2. Do not install damaged components.
3. Fit joints to produce hairline joints free of burrs and distortion.
4. Rigidly secure nonmovement joints.
5. Install anchors with separators and isolators to prevent metal corrosion and electrolytic deterioration and to prevent impeding movement of moving joints.
6. Seal perimeter and other joints watertight unless otherwise indicated.

B. Metal Protection:

1. Where aluminum is in contact with dissimilar metals, protect against galvanic action by painting contact surfaces with materials recommended by manufacturer for this purpose or by installing nonconductive spacers.
2. Where aluminum is in contact with concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

C. Set continuous sill members and flashing in full sealant bed as specified in Section 07 9200 "Joint Sealants" to produce weathertight installation.

D. Install components plumb and true in alignment with established lines and grades.

E. Install operable units level and plumb, securely anchored, and without distortion. Adjust weather-stripping contact and hardware movement to produce proper operation.

F. Install glazing as specified in Section 08 8000 "Glazing."

G. Entrance Doors: Install doors to produce smooth operation and tight fit at contact points.

   1. Exterior Doors: Install to produce weathertight enclosure and tight fit at weather stripping.
   2. Field-Installed Entrance Door Hardware: Install surface-mounted entrance door hardware according to entrance door hardware manufacturers' written instructions using concealed fasteners to greatest extent possible.

3.4 ERECTION TOLERANCES

A. Erection Tolerances: Install aluminum-framed entrances and storefronts to comply with the following maximum tolerances:

   1. Plumb: 1/8 inch in 10 feet; 1/4 inch in 40 feet.
   2. Level: 1/8 inch in 20 feet; 1/4 inch in 40 feet.
   3. Alignment:

      a. Where surfaces abut in line or are separated by reveal or protruding element up to 1/2-inch-wide, limit offset from true alignment to 1/16 inch.
      b. Where surfaces are separated by reveal or protruding element from 1/2 to 1 inch wide, limit offset from true alignment to 1/8 inch.
      c. Where surfaces are separated by reveal or protruding element of 1 inch wide or more, limit offset from true alignment to 1/4 inch.

   4. Location: Limit variation from plane to 1/8 inch in 12 feet; 1/2 inch over total length.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections.

B. Test Area: Perform tests on two punched opening and one Entrance framing representative areas of glazed aluminum storefront and mockups.

C. Field Quality-Control Testing: Perform the following test on representative areas of glazed aluminum curtain walls and mockups.
1. Water-Spray Test: Before installation of interior finishes has begun, areas designated by Architect shall be tested according to ASTM E1105 and shall not evidence water penetration.
   a. Perform a minimum of two tests in areas as directed by Architect.

2. Air Infiltration: ASTM E 783 at 1.5 times the rate specified for laboratory testing in "Performance Requirements" Article but not more than 0.09 cfm/sq. ft. at a static-air-pressure differential of 1.57 lbf/sq. ft.
   a. Perform a minimum of two tests in areas as directed by Architect.

3. Water Penetration: ASTM E 1105 at a minimum uniform and cyclic static-air-pressure differential of 0.67 times the static-air-pressure differential specified for laboratory testing in "Performance Requirements" Article, but not less than 8 lbf/sq. ft. and shall not evidence water penetration.
   a. Provide a minimum of two tests.

D. Glazed aluminum-framed entrances and storefront will be considered defective if they do not pass tests and inspections.

   1. For each failed test, test an additional similar condition until successful results are achieved. All failures shall be considered systemic failures requiring corrective work at all similar conditions. Remedial measures shall maintain standards of aesthetics, quality, and durability, and are subject to approval by the architect.
   2. Owner will only pay for the first two test all others are born by the contractor.

E. Prepare test and inspection reports.

3.6 MAINTENANCE SERVICE

A. Entrance Door Hardware:

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

3.7 ENTRANCE DOOR HARDWARE SETS

Group A (Door V1002A)

<table>
<thead>
<tr>
<th>Item</th>
<th>Description</th>
<th>Quantity</th>
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</thead>
<tbody>
<tr>
<td>1 ea.</td>
<td>Cont. Hinge</td>
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<tr>
<td>1 ea.</td>
<td>Exit Device</td>
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<tr>
<td>1 ea.</td>
<td>Cylinder</td>
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<tr>
<td>1 ea.</td>
<td>Electric Strike</td>
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<tr>
<td>1 ea.</td>
<td>Door Operator</td>
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<tr>
<td>1 ea.</td>
<td>Sweeps</td>
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<tr>
<td>1 ea.</td>
<td>Threshold</td>
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<tr>
<td>1 set</td>
<td>Weatherseal</td>
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<tr>
<td>1 ea.</td>
<td>Reader</td>
<td>(By Owner)</td>
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END OF SECTION 08 4113
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PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes exterior and interior, sliding, power-operated automatic entrances.
B. Related Requirements:
   1. Section 08 7113 "Automatic Door Operators" for automatic door operators furnished separately from doors and frames.

1.3 DEFINITIONS
A. AAADM: American Association of Automatic Door Manufacturers.
B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.
D. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.
E. For automatic door terminology, refer to BHMA A156.10 for definitions of terms.

1.4 COORDINATION
A. Templates: Distribute for doors, frames, and other work specified to be factory prepared for installing automatic entrances.
B. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish. Coordinate hardware for automatic entrances with hardware required for rest of Project.
C. Electrical System Roughing-in: Coordinate layout and installation of automatic entrances with connections to power supplies and access-control system.

1.5 ACTION SUBMITTALS
A. Product Data: For each type of product.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic entrances.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For automatic entrances.
   1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
   2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
   3. Include diagrams for power, signal, and control wiring.
   4. Indicate locations of activation and safety devices.
   5. Include hardware schedule and indicate hardware types, functions, quantities, and locations.

C. Samples for Verification: For each type of exposed finish required, in manufacturer's standard sizes.

D. Delegated-Design Submittal: For automatic entrances.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For manufacturer.

B. Product Certificates: For each type of automatic entrance. Include emergency-exit features of automatic entrances serving as a required means of egress.

C. Product Test Reports: For each type of automatic entrance, for tests performed by a qualified testing agency.

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

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For automatic entrances, safety devices, and control systems to include in operation and maintenance manuals.

1.8 QUALITY ASSURANCE

A. Manufacturer Qualifications: A manufacturer with company certificate issued by AAADM indicating that manufacturer has a Certified Inspector on staff.

B. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for installation and maintenance of units required for this Project.
   1. Maintenance Proximity: Not more than two hours’ normal travel time from Installer’s place of business to Project site.

C. Certified Inspector Qualifications: Certified by AAADM.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic entrances that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
   a. Structural failures including, but not limited to, excessive deflection.
   b. Faulty operation of operators, controls, and hardware.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Two years from date of Substantial Completion.

B. Special Finish Warranty: Manufacturer agrees to repair or replace components on which finishes fail in materials or workmanship within specified warranty period.
   1. Deterioration includes, but is not limited to, the following:
      a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
      b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
      c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.

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

PART 2 - PRODUCTS

2.1 AUTOMATIC ENTRANCE ASSEMBLIES

A. Source Limitations: Obtain sliding automatic entrances from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Power-Operated Door Standard: BHMA A156.10.

2.2 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer, as defined in Section 01 4000 "Quality Requirements," to design automatic entrances.

B. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes.
   1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

C. Operating Temperature Range: Automatic entrances shall operate within minus 20 to plus 122 deg F.

D. Air Infiltration: Maximum air leakage through fixed glazing and framing areas of 1.25 cfm/sq. ft. of fixed entrance-system area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.

E. Opening Force:
   1. Power-Operated Doors: Not more than 50 lbf required to manually set door in motion if power fails, and not more than 15 lbf required to open door to minimum required width.
2. Breakaway Device for Power-Operated Doors: Not more than 50 lbf required for a breakaway door or panel to open.

F. Entrapment-Prevention Force:

1. Power-Operated Sliding Doors: Not more than 30 lbf required to prevent stopped door from closing.

2.3 SLIDING AUTOMATIC ENTRANCES

A. General: Provide manufacturer's standard automatic entrances including doors, sidelites, framing, headers, carrier assemblies, roller tracks, door operators, controls, and accessories required for a complete installation.

B. Sliding Automatic Entrance:

1. Basis-of-Design: Subject to compliance with requirements, provide Stanley Access Technologies; Dura-Glide™ 2000 Series sliding automatic entrances or comparable product by one of the following:
   a. Single- and Biparting-Sliding Units:
      1) Besam Entrance Solutions; Subsidiary of ASSA ABLOY Entrance Systems.
      2) DORMA Automatics; Division of DORMA Group North America.
      3) Horton Automatics; a division of Overhead Door Corporation.
      4) record-usa.
      5) Stanley Access Technologies, LLC; Division of Stanley Security Solutions.

2. Configuration: Single-sliding door with one sliding leaf, transom, and pocketed sidelite.
   a. Traffic Pattern: Two way.
   c. Mounting: Between jambs.

3. Configuration: Biparting-sliding doors with two sliding leaves, transom, and pocketed sidelites on each side.
   a. Traffic Pattern: Two way.
   c. Mounting: Between jambs.

4. Operator Features:
   a. Power opening and closing.
   b. Drive System: Chain or belt.
   c. Adjustable opening and closing speeds.
   d. Adjustable hold-open time between zero and 30 seconds.
   e. Obstruction recycle.
   f. On-off/hold-open switch to control electric power to operator.

5. Sliding-Door Carrier Assemblies and Overhead Roller Tracks: Carrier assembly that allows vertical adjustment; consisting of nylon- or delrin-covered, ball-bearing-center steel wheels operating on a continuous roller track, or ball-bearing-center steel wheels operating on a nylon- or delrin-covered, continuous roller track. Support doors from carrier assembly by cantilever and pivot assembly.
a. Rollers: Minimum of two ball-bearing roller wheels and two antirise rollers for each active leaf.


7. Controls: Activation and safety devices according to BHMA standards.
   a. Activation Device: Motion sensor mounted on each side of door header to detect pedestrians in activating zone and to open door.
   b. Safety Device: Two photoelectric beams mounted in sidelite jambs on each side of door to detect pedestrians in presence zone and to prevent door from closing.
   c. Safety Device: Presence sensor mounted to underside of door header and two photoelectric beams mounted in sidelite jambs on one side of the door to detect pedestrians in presence zone and to prevent door from closing.
   d. Safety Device: Presence sensor mounted on each side of door header and two photoelectric beams mounted in sidelite jambs on one side of the door to detect pedestrians in presence zone and to prevent door from closing.
   e. Sidelite Safety Device: Presence sensor, mounted above each sidelite on side of door opening through which doors travel, to detect obstructions and to prevent door from opening.
   f. Opening-Width Control: Two-position switch that in the normal position allows sliding doors to travel to full opening width and in the alternate position reduces opening to a selected partial opening width.

8. Finish: Finish framing, door(s), and header with Class I, clear anodic finish.

2.4 ENTRANCE COMPONENTS

A. Framing Members: Extruded aluminum, minimum 0.125-inch-thick and reinforced as required to support imposed loads.
   1. Nominal Size: 1-3/4 by 4-1/2 inches.
   2. Extruded Glazing Stops and Applied Trim: Minimum 0.062-inch wall thickness.

B. Stile and Rail Doors: 1-3/4-inch-thick, glazed doors with minimum 0.125-inch-thick, extruded-aluminum tubular stile and rail members. Mechanically fasten corners with reinforcing brackets that are welded or incorporate concealed tie-rods that span full length of top and bottom rails.
   2. Stile Design: Medium stile, 3-1/2-inch nominal width.
   3. Rail Design: 5-inch nominal height.

C. Headers: Fabricated from minimum 0.125-inch-thick extruded aluminum and extending full width of automatic entrance units to conceal door operators and controls. Provide hinged or removable access panels for service and adjustment of door operators and controls. Secure panels to prevent unauthorized access.
   1. Mounting: Surface mounted.
   2. Capacity: Capable of supporting doors up to 175 lb per leaf over spans up to 14 feet without intermediate supports.
      a. Provide sag rods for spans exceeding 14 feet.
D. Brackets and Reinforcements: High-strength aluminum with nonstaining, nonferrous shims for aligning system components.

E. Signage: As required by cited BHMA standard.
   1. Application Process: Door manufacturer's standard process.
   2. Provide sign materials with instructions for field application after glazing is installed.

2.5 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Extrusions: ASTM B 221.

B. Steel Reinforcement: Reinforcement with corrosion-resistant primer complying with SSPC-PS Guide No. 12.00 applied immediately after surface preparation and pretreatment. Use surface preparation methods according to recommendations in SSPC-SP COM and prepare surfaces according to applicable SSPC standard.

C. Stainless-Steel Bars: ASTM A 276 or ASTM A 666, Type 304.

D. Stainless-Steel Tubing: ASTM A 554, Grade MT 304.

E. Glazing: As specified in Section 08 8000 "Glazing."

F. Sealants and Joint Fillers: As specified in Section 07 9200 "Joint Sealants."

G. Nonmetallic, Shrinkage-Resistant Grout: Premixed, nonmetallic, noncorrosive, nonstaining grout; complying with ASTM C 1107/C 1107M; of consistency suitable for application.

H. Bituminous Coating: Cold-applied asphalt emulsion complying with ASTM D 1187.

I. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.6 DOOR OPERATORS AND CONTROLS

A. General: Provide operators and controls, which include activation and safety devices, according to BHMA standards, for condition of exposure, and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.

B. Door Operators: Provide door operators of size recommended by manufacturer for door size, weight, and movement.
   1. Door Operator Performance: Door operators shall open and close doors and maintain them in fully closed position when subjected to Project's design wind loads.
   2. Electromechanical Operators: Concealed, self-contained, overhead unit powered by fractional-horsepower, permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor; with solid-state microprocessor controller; UL 325; and with manual operation with power off.

C. Motion Sensors: Self-contained, K-band-frequency, microwave-scanner units; fully enclosed by its plastic housing; adjustable to provide detection-field sizes and functions required by BHMA A156.10.
1. Provide capability for switching between bidirectional and unidirectional detection.

D. Presence Sensors: Self-contained, active-infrared scanner units; adjustable to provide detection-field sizes and functions required by BHMA A156.10. Sensors shall remain active at all times.

E. Photoelectric Beams: Pulsed infrared, sender-receiver assembly for recessed mounting. Beams shall not be active when doors are fully closed.

F. Electrical Interlocks: Unless units are equipped with self-protecting devices or circuits, provide electrical interlocks to prevent activation of operator when door is locked, latched, or bolted.

2.7 HARDWARE

A. General: Provide units in sizes and types recommended by automatic entrance and hardware manufacturers for entrances and uses indicated. Finish exposed parts to match door finish unless otherwise indicated.

B. Breakaway Device for Power-Operated Doors: Device that allows door to swing out in direction of egress to full 90 degrees from any operating position. Maximum force to open door shall be as stipulated in "Performance Requirements" Article. Interrupt powered operation of door operator while in breakaway mode.

C. Deadlocks: Deadbolt operated by exterior cylinder and interior thumb turn, with minimum 1-inch-long throw bolt; BHMA A156.5, Grade 1.

1. Cylinders: As specified in Section 08 7100 "Door Hardware."
   a. Keying: Integrate into building master key system.

2. Deadbolts: Laminated-steel hook, mortise type, BHMA A156.5, Grade 1.

3. Two-Point Locking for Stile and Rail Sliding Doors: Mechanism in stile of active door leaf that automatically extends second lockbolt into overhead carrier assembly or threshold.

D. Automatic Locking: Electrically controlled device mounted in header that automatically locks sliding door against sliding when in closed position. Provide fail safe operation if power fails.

1. Include concealed, vertical-rod exit devices, UL 305, with latching into threshold and overhead carrier assembly and released by full-width panic bar; and that prevent emergency breakaway doors from swinging unless released to permit emergency egress.

2. Include locking devices for sidelites to prevent manual break out.

E. Weather Stripping: Replaceable components.

1. Sliding Type: AAMA 701, made of wool, polypropylene, or nylon woven pile with nylon-fabric or aluminum-strip backing.

2.8 ACCESSORIES

A. Guide Rails: Anodized aluminum, fabricated from bars or tubing, minimum 30 inches high, and finished to match doors unless otherwise indicated; positioned and projecting from face of door jamb for distance as indicated, but not less than that required by BHMA A156.10 for type of door and direction of travel; with filler panel.

1. Mounting: As indicated on Drawings.

2. Aluminum Finish: Class I, clear anodic finish.
2.9 FABRICATION

A. General: Factory fabricate automatic entrance components to designs, sizes, and thicknesses indicated and to comply with indicated standards.

1. Form aluminum shapes before finishing.
2. Weld in concealed locations to greatest extent possible to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.
3. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, fabricated from stainless steel.
   a. Where fasteners are subject to loosening or turning out from thermal and structural movements, wind loads, or vibration, use self-locking devices.
   b. Reinforce members as required to receive fastener threads.
4. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

B. Framing: Provide automatic entrances as prefabricated assemblies. Complete fabrication, assembly, finishing, hardware application, and other work before shipment to Project site.

1. Fabricate tubular and channel frame assemblies with welded or mechanical joints. Provide subframes and reinforcement as required for a complete system to support required loads.
2. Perform fabrication operations in manner that prevents damage to exposed finish surfaces.
3. Form profiles that are sharp, straight, and free of defects or deformations.
4. Provide components with concealed fasteners and anchor and connection devices.
5. Fabricate components with accurately fitted joints with ends cope or mitered to produce hairline joints free of burrs and distortion.
6. Fabricate exterior components to drain condensation and water passing joints within system to the exterior.
7. Provide anchorage and alignment brackets for concealed support of assembly from building structure.
8. Allow for thermal expansion of exterior units.

C. Doors: Factory fabricated and assembled in profiles indicated. Reinforce as required to support imposed loads and for installing hardware.

D. Door Operators: Factory fabricated and installed in headers, including adjusting and testing.

E. Glazing: Fabricate framing with minimum glazing edge clearances for thickness and type of glazing indicated, according to GANA's "Glazing Manual."

F. Hardware: Factory install hardware to greatest extent possible; remove only as required for final finishing operation and for delivery to and installation at Project site. Cut, drill, and tap for factory-installed hardware before applying finishes.

1. Provide sliding-type weather stripping, mortised into door, at perimeter of doors and breakaway sidelites.

G. Controls:

1. General: Factory install activation and safety devices in doors and headers as required by BHMA A156.10 for type of door and direction of travel.
2. Install photoelectric beams in vertical jambs of sidelites, with dimension above finished floor as follows:
   b. Bottom Beam: 24 inches.

2.10 GENERAL FINISH REQUIREMENTS

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

2.11 ALUMINUM FINISHES

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, header support, and other conditions affecting performance of automatic entrances.

B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic entrance installation.

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

3.2 INSTALLATION

A. General: Install automatic entrances according to manufacturer’s written instructions and cited BHMA standard for direction of pedestrian travel, including signage, controls, wiring, and connection to the building’s power supply.

1. Do not install damaged components. Fit frame joints to produce hairline joints free of burrs and distortion. Rigidly secure nonmovement joints. Seal joints watertight.

2. Where aluminum will contact dissimilar metals, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

3. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous coating.

B. Entrances: Install automatic entrances plumb and true in alignment with established lines and grades without warp or rack of framing members and doors. Anchor securely in place.

1. Install surface-mounted hardware using concealed fasteners to greatest extent possible.

2. Set headers, carrier assemblies, tracks, operating brackets, and guides level and true to location with anchorage for permanent support.

3. Install components to drain water passing joints, condensation occurring within framing members, and moisture migrating within system to exterior.

4. Level recesses for recessed thresholds using nonshrink grout.

C. Door Operators: Connect door operators to electrical power distribution system.
D. Access-Control Devices: Connect access-control devices to access-control system as specified in Section 28 1300 "Access Control."

E. Controls: Install and adjust activation and safety devices according to manufacturer's written instructions and cited BHMA standard for direction of pedestrian travel. Connect control wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

F. Guide Rails: Install rails according to BHMA A156.10, including Appendix A, and manufacturer's written instructions unless otherwise indicated.

G. Glazing: Install glazing as specified in Section 08 8000 "Glazing."

H. Sealants: Comply with requirements specified in Section 07 9200 "Joint Sealants" to provide weathertight installation.

   1. Set thresholds, framing members and flashings in full sealant bed.
   2. Seal perimeter of framing members with sealant.

I. Signage: Apply signage on both sides of each door and breakaway sidelite as required by cited BHMA standard for direction of pedestrian travel.

J. Wiring within Automatic Entrance Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's written limitations on bending radii. Provide and use lacing bars and distribution spools.

3.3 ADJUSTING

A. Adjust hardware, moving parts, door operators, and controls to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

   1. Adjust exterior doors for weathertight closure.

B. Readjust door operators and controls after repeated operation of completed installation equivalent to three days' use by normal traffic (100 to 300 cycles).

C. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.4 CLEANING

A. Clean glass and metal surfaces promptly after installation. Remove excess glazing and sealant compounds, dirt, and other substances. Repair damaged finish to match original finish.

   1. Comply with requirements in Section 08 8000 "Glazing" for cleaning and maintaining glass.

3.5 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain automatic entrances.

END OF SECTION 08 4229.23
SECTION 08 5653 - SECURITY WINDOWS WITH TRANSACTION DRAWER

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fixed, transaction security windows.

1.3 COORDINATION

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

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for window units.

B. Shop Drawings: For security windows.

1. Include plans, elevations, sections, and attachments to other work.
2. Full-size section details of framing members, including internal armoring, reinforcement, and stiffeners.
3. Location of weep holes.
4. Hardware for sliding window units.
5. Glazing details.
6. Details of transaction drawer and transaction counter.

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

1. Framing: 12-inch-long sections of frame members.

1.5 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For each type of security window and accessory indicated as ballistics or forced-entry resistant, for tests performed by a qualified testing agency.
B. Configuration Disclosure Drawing: For each type of forced-entry-resistant security window, complying with ASTM F 1233.

C. Sample Warranty: For special warranty.

D. Examination reports documenting inspections of substrates, areas, and conditions.

E. Anchor inspection reports documenting inspections of built-in and cast-in anchors.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Pack security windows in wood crates for shipment. Crate glazing separate from frames unless factory glazed.

B. Label security window packaging with drawing designation.

C. Store crated security windows on raised blocks to prevent moisture damage.

1.7 FIELD CONDITIONS

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

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace security windows that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Structural failures including deflections exceeding 1/4 inch.
   b. Failure of welds.
   c. Excessive air leakage.
   d. Faulty operation of transaction drawers.
   e. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Attack Resistance: Provide units identical to those tested for compliance with requirements indicated, and as follows:

1. Ballistics Resistance: Level 1 when tested according to UL 752.
2. Ballistics Resistance: HG1 when tested according to ASTM F 1233.
3. Forced-Entry Resistance: Level I when tested according to HPW-TP-0500.03.
4. Forced-Entry Resistance: Class I when tested according to ASTM F 1233.
B. Structural Loads: Detention windows shall withstand the effects of wind loads, with no permanent deformation or breakage of components within window assembly when tested according to ASTM E 330.

1. Wind Loads: As indicated on Drawings.

C. Air Infiltration: Provide windows with maximum air leakage through fixed glazing and framing areas of 0.06 cfm/sq. ft. of fixed wall area when tested according to ASTM E 283 at a minimum static-air-pressure difference of 6.24 lbf/sq. ft.

D. Water Penetration under Static Pressure: Provide windows that do not evidence water penetration through fixed glazing and framing areas when tested according to ASTM E 331 at a minimum static-air-pressure difference of 20 percent of positive wind-load design pressure, but not less than 6.24 lbf/sq. ft.

2.2 FIXED, TRANSACTION SECURITY WINDOWS AND TRANSACTION DRAWER

A. Provide fixed vision security windows with framing on four sides and no operable sash or ventilator.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Hamilton Safe, Model # RX-SYS04 with DCD-18 Transaction Drawer or comparable product by one of the following:
   b. Collier Safe Company, Inc.
   c. Diebold, Incorporated.

B. Framing: Fabricate perimeter framing, mullions, and glazing stops from stainless steel as follows:

1. Profile: Manufacturer's standard, with minimum face dimension indicated.
2. Depth: Manufacturer's standard.
3. Glass Orientation: Incline subframe 5 degrees to vertical, with top of frame slanted away from secure side of window.

C. Materials:

1. Mild Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
2. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, CS (Commercial Steel), Type B; suitable for exposed applications.
3. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, CS (Commercial Steel), Type B; with G60 zinc (galvanized) or A60 zinc-iron-alloy (galvannealed) coating designation.
4. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, CS (Commercial Steel), Type B; free of scale, pitting, or surface defects; pickled and oiled.
5. Stainless-Steel Sheet, Strip, Plate, and Flat Bars: ASTM A 666 or ASTM A 240/A 240M, austenitic stainless steel, Type 304.
6. Aluminum Extrusions: ASTM B 221. Provide alloy and temper recommended by manufacturer for strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength.

D. Window Size: 5'-0" wide x 3'-0" high
2.3 FABRICATION

A. General: Fabricate security windows to provide a complete system for assembly of components and anchorage of window units.
   1. Provide units that are reglazable from the secure side without dismantling the nonsecure side of framing.

B. Provide weep holes and internal water passages for exterior security windows to conduct infiltrating water to the exterior.

C. Framing: Miter or cope corners the full depth of framing; weld and dress smooth.
   1. Fabricate framing with manufacturer's standard, internal opaque armoring in thicknesses required for security windows to comply with ballistics-resistance performance indicated.

D. Glazing Stops: Finish glazing stops to match security window framing.

E. Welding: Weld components to comply with referenced AWS standard. To greatest extent possible, weld before finishing and in concealed locations to minimize distortion or discoloration of finish. Remove weld spatter and welding oxides from exposed surfaces by descaling or grinding.

F. Metal Protection: Separate dissimilar metals to protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended by manufacturer for this purpose.

G. Factory-cut openings in glazing for speaking apertures.

H. Weather Stripping: Factory applied.

2.4 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA 500 for recommendations for applying and designating finishes.

B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   1. Run grain of directional finishes with long dimension of each piece.
   2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.
   3. Directional Satin Finish: No. 4.
2.6 ACCESSORIES

A. Transaction Drawers: Formed from stainless steel with bullet-resistant armoring; with ball-bearing, telescoping sliding mechanism; with cover on secure side of top of drawer that automatically closes when drawer is extended to nonsecure side.

1. Inside Dimensions: 12 wide x 15 tall x 18" deep.
2. Operation: Electric, with sliding handle for emergency manual operation during lack of power. Provide individual switches for power and drawer movement on secure side and call button on nonsecure side.
4. Listed and labeled as bullet resisting according to UL 752.

B. Speaking Apertures (Amplified): Fabricate from stainless steel, designed to allow passage of speech at normal speaking volume without distortion.

1. Shape: Rectangular.
2. Ballistics Resistance: Same as security window.
3. Listed and labeled as bullet resisting according to UL 752.

C. Concealed Bolts: ASTM A 307, Grade A unless otherwise indicated.

D. Cast-in-Place Anchors in Concrete: Fabricated from corrosion-resistant materials capable of sustaining, without failure, a load equal to four times the load imposed, as determined by testing according to ASTM E 488, conducted by a qualified testing agency; of type indicated below.

1. Threaded or wedge type; galvanized ferrous castings, either ASTM A 27/A 27M cast steel or ASTM A 47/A 47M malleable iron. Provide bolts, washers, and shims as required; hot-dip galvanized according to ASTM A 153/A 153M or ASTM F 2329.

E. Embedded Plate Anchors: Fabricated from mild steel shapes and plates, minimum 3/16 inch thick; with minimum 1/2-inch- diameter, headed studs welded to back of plate.

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

G. Compression-Type Glazing Strips and Weather Stripping: Unless otherwise indicated, provide compressible stripping for glazing and weather stripping, such as molded EPDM or neoprene gaskets complying with ASTM D 2000, Designations 2BC415 to 3BC620; molded PVC gaskets complying with ASTM D 2287; or molded, expanded EPDM or neoprene gaskets complying with ASTM C 509, Grade 4.

H. Miscellaneous Glazing Materials: Provide material, size, and shape complying with requirements of glass manufacturers and with a proven record of compatibility with surfaces contacted in installation.

1. Cleaners, Primers, and Sealers: Type recommended by sealant or gasket manufacturer.
2. Setting Blocks: Elastomeric material with a Type A Shore durometer hardness of 85, plus or minus 5.
3. Spacers: Elastomeric blocks or continuous extrusions with a Type A Shore durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
4. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

I. Anchors, Clips, and Window Accessories: Stainless steel; hot-dip, zinc-coated steel or iron, complying with ASTM B 633; provide sufficient strength to withstand design pressures indicated.
J. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of security windows.

B. Examine roughing-in for embedded and built-in anchors to verify actual locations of security window connections before security window installation.

C. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of security windows.

D. Inspect built-in and cast-in anchor installations, before installing security windows, to verify that anchor installations comply with requirements. Prepare inspection reports.
   1. Remove and replace anchors where inspections indicate that they do not comply with specified requirements. Reinspect after repairs or replacements are made.
   2. Perform additional inspections to determine compliance of replaced or additional work. Prepare anchor inspection reports.

E. For glazing materials whose orientation is critical for performance, verify installation orientation.

F. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

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

3.3 INSTALLATION

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

B. Voice-Communication-Type Framing: Attach removable glass spacers to jambs and head of glazing, located not more than 6 inches from each corner and spaced not more than 12 inches o.c.
C. Removable Glazing Stops and Trim: Fasten components with security fasteners.

D. Fasteners: Install security windows using fasteners recommended by manufacturer with head style appropriate for installation requirements, strength, and finish of adjacent materials. Provide stainless-steel fasteners in stainless-steel materials.

E. Sealants: Comply with requirements in Section 07 9200 "Joint Sealants" for installing sealants, fillers, and gaskets.
   1. Set continuous sill members and flashing in a full sealant bed to provide weathertight construction unless otherwise indicated.
   2. Seal frame perimeter with sealant to provide weathertight construction unless otherwise indicated.

F. Metal Protection: Where dissimilar metals will contact each other, protect against galvanic action by painting contact surfaces with primer or by applying sealant or tape recommended in writing by manufacturer for this purpose. Where aluminum will contact concrete or masonry, protect against corrosion by painting contact surfaces with bituminous paint.

3.4 ADJUSTING

A. Adjust transaction drawers to provide a tight fit at contact points and weather stripping for smooth operation and weathertight and secure enclosure.

B. Remove and replace defective work, including security windows that are warped, bowed, or otherwise unacceptable.

3.5 CLEANING AND PROTECTION

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

B. Clean glass of preglazed security windows promptly after installation. Comply with requirements in Section 08 8853 "Security Glazing" for cleaning and maintenance.

C. Provide temporary protection to ensure that security windows are without damage at time of Substantial Completion.

3.6 DEMONSTRATION

A. Train Owner’s maintenance personnel to adjust, operate, and maintain operable security windows and security windows with transaction drawers.

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SECTION 08 7100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:
   a. Swinging doors.

2. Cylinders for door hardware specified in other Sections.

3. Electrified door hardware.

B. Related Sections:

1. Section 08 1113 "Hollow Metal Doors and Frames" for door silencers provided as part of hollow-metal frames.

2. Section 08 1416 "Flush Wood Doors" for integral intumescent seals provided as part of labeled fire-rated assemblies.

3. Section 08 4113 "Aluminum-Framed Entrances and Storefronts" for installation of entrance door hardware, including cylinders.

4. Section 13 4900 "Radiation Protection" for lead-lined astragals provided as part of labeled fire-rated assemblies.

5. Section 28 1300 "Access Control" for access control devices installed at door openings and provided as part of a security system.

C. Products furnished, but not installed, under this Section include the products listed below. Coordinating and scheduling the purchase and delivery of these products remain requirements of this Section.

1. Lock cylinders to be installed under other Sections.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: Details of electrified door hardware, indicating the following:

1. Wiring Diagrams: For power, signal, and control wiring and including the following:
   a. Details of interface of electrified door hardware and building safety and security systems.
   b. Risers.
2. Operation Narrative: Describe the operation of doors controlled by electrified door hardware.

C. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

   a. Submittal Sequence: Submit door hardware schedule concurrent with submissions of Product Data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.

   b. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.

   c. Content: Include the following information:

      1) Identification number, location, hand, fire rating, size, and material of each door and frame.
      2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
      3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
      4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.
      5) Fastenings and other pertinent information.
      6) Explanation of abbreviations, symbols, and codes contained in schedule.
      7) Mounting locations for door hardware.
      8) List of related door devices specified in other Sections for each door and frame.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For electrified door hardware, from the manufacturer.

   1. Certify that door hardware approved for use on types and sizes of labeled fire-rated doors complies with listed fire-rated door assemblies.

B. Product Test Reports: For compliance with accessibility requirements, based on evaluation of comprehensive tests performed by manufacturer and witnessed by a qualified testing agency, for door hardware on doors located in accessible routes.

C. Warranty: Special warranty specified in this Section.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For each type of door hardware to include in maintenance manuals. Include final hardware schedule.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain each type of door hardware from a single manufacturer.
1. Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

B. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated.

C. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

D. Means of Egress Doors: Latches do not require more than 15 lb to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

E. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines and ICC/ANSI A117.1.
   1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lb.
   2. Comply with the following maximum opening-force requirements:
      a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
      b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
   3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
   4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches from the latch, measured to the leading edge of the door.

F. Keying Conference: Conduct conference at Project site to comply with requirements in Section 01 3100 "Project Management and Coordination." In addition to Owner Contractor, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate keying conference decisions into final keying schedule after reviewing door hardware keying system including, but not limited to, the following:
   1. Function of building, flow of traffic, purpose of each area, degree of security required, and plans for future expansion.
   2. Preliminary key system schematic diagram.
   3. Requirements for key control system.
   4. Requirements for access control.
   5. Address for delivery of keys.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and provide secure lock-up for door hardware delivered to Project site.

B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.

C. Deliver keys and permanent cores to Owner by registered mail or overnight package service.
1.8 COORDINATION

A. Coordinate layout and installation of floor-recessed door hardware with floor construction. Cast anchoring inserts into concrete.

B. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.

C. Security: Coordinate installation of door hardware, keying, and access control with Owner's security consultant.

D. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

1.9 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Structural failures including excessive deflection, cracking, or breakage.
   b. Faulty operation of doors and door hardware.
   c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

2. Warranty Period: Three years from date of Substantial Completion, unless otherwise indicated.

   a. Electromagnetic Locks: Five years from date of Substantial Completion.
   b. Exit Devices: Two years from date of Substantial Completion.
   c. Manual Closers: 10 years from date of Substantial Completion.

1.10 MAINTENANCE SERVICE

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

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door as scheduled in Part 3 "Door Hardware Schedule" Article to comply with requirements in this Section.

1. Door Hardware Sets: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.

2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.
B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers’ Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers’ names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allegion plc.
   b. Design Hardware.
   c. Hager Companies;
   d. McKinney Products Company; an ASSA ABLOY Group company.
   e. Stanley Commercial Hardware; a division of Stanley Security Solutions; Div. of The Stanley Works.

2.3 SELF-CLOSING HINGES AND PIVOTS

A. Self-Closing Hinges and Pivots: BHMA A156.17.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allegion plc.
   b. Hager Companies;
   c. McKinney Products Company; an ASSA ABLOY Group company.
   d. Stanley Commercial Hardware; a division of Stanley Security Solutions; Div. of The Stanley Works.

2.4 CENTER-HUNG AND OFFSET PIVOTS

A. Center-Hung and Offset Pivots: BHMA A156.4.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allegion plc.
   b. Hager Companies;
   c. Rixson Specialty Door Controls; an ASSA ABLOY Group company.

2.5 CONTINUOUS HINGES

A. Continuous Hinges: BHMA A156.26; minimum 0.120-inch-thick, hinge leaves with minimum overall width of 4 inches; fabricated to full height of door and frame and to template screw locations; with components finished after milling and drilling are complete.
B. Continuous, Gear-Type Hinges: Extruded-aluminum, pinless, geared hinge leaves joined by a continuous extruded-aluminum channel cap; with concealed, self-lubricating thrust bearings.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Allegion plc.
   b. Hager Companies;
   c. McKinney Products Company; an ASSA ABLOY Group company.
   d. Stanley Commercial Hardware; a division of Stanley Security Solutions.

2.6 MECHANICAL LOCKS AND LATCHES

A. Lock Functions: As indicated in door hardware schedule.

B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
   1. Bored Locks: Minimum 1/2-inch latch bolt throw.

C. Lock Backset: 2-3/4 inches, unless otherwise indicated.

D. Strikes: Provide manufacturer's standard strike for each lock bolt or latch bolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
   1. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.

E. Bored Locks: BHMA A156.2; Grade 1; Series 4000.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Best Access Systems: Stanley Security Solutions, Inc. (Best Preferred Patented 150 Series Cores with 1CF72P-1-626 keyway is the only allowable lockset – no substitutions.)

2.7 AUXILIARY LOCKS

A. Bored Auxiliary Locks: BHMA A156.5: Grade 1; with strike that suits frame.

2.8 ELECTRIC STRIKES

A. Electric Strikes: BHMA A156.31; Grade 1; with faceplate to suit lock and frame.

2.9 ELECTROMAGNETIC LOCKS

A. Electromagnetic Locks: BHMA A156.23; electrically powered; with electromagnet attached to frame and armature plate attached to door; full-exterior or full-interior type, as required by application indicated.
2.10 **ELECTROMECHANICAL LOCKS**

A. Electromechanical Locks: BHMA A156.25; Grade 1; motor or solenoid driven; bored; with strike that suits frame.

2.11 **SELF-CONTAINED ELECTRONIC LOCKS**

A. Self-Contained Electronic Locks: BHMA A156.25, bored; with internal, battery-powered, self-contained electronic locks; consisting of complete lockset, motor-driven lock mechanism, and actuating device; enclosed in zinc-dichromate-plated, wrought-steel case, and strike that suits frame. Provide key override, low-battery detection and warning, LED status indicators, and ability to program at the lock.

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

   a. Best Access Systems; Stanley Security Solutions, Inc.

2.12 **MANUAL FLUSH BOLTS**

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

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

   a. Adams Rite Manufacturing Co; an ASSA ABLOY Group company.
   b. Allegion plc.
   c. Don-Jo Mfg., Inc.

2.13 **AUTOMATIC AND SELF-LATCHING FLUSH BOLTS**

A. Automatic and Self-Latching Flush Bolts: BHMA A156.16; minimum 3/4-inch throw; designed for mortising into door edge.

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

   a. Allegion plc.
   b. Don-Jo Mfg., Inc.
   c. Door Controls International, Inc.
   d. Trimco.

2.14 **EXIT DEVICES AND AUXILIARY ITEMS**

A. Exit Devices and Auxiliary Items: BHMA A156.3.

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

   a. Allegion plc.
   b. Precision Hardware, Inc.; a Stanley company.
   c. SARGENT Manufacturing Company; ASSA ABLOY.
2.15 LOCK CYLINDERS
   
   A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.
      
      1. Manufacturer: Same manufacturer as for locking devices.
         
         a. Best Access Systems; Stanley Security Solutions, Inc.
      
   B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are interchangeable; face finished to match lockset.
   
   C. High-Security Lock Cylinders: BHMA A156.30; Grade 1; Type M, mechanical; permanent cores that are removable; face finished to match lockset.
   
   D. Construction Master Keys: Provide cylinders with feature that permits voiding of construction keys without cylinder removal. Provide 10 construction master keys.
   
   E. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.16 KEYING
   
      
      1. Existing System:
         
         a. Master key or grand master key locks to Owner’s existing system.
      
   B. Keys: Brass.
      
      1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
         
         a. Notation: Information to be furnished by Owner.

2.17 KEY CONTROL SYSTEM
   
   A. Key Control Cabinet: BHMA A156.5; metal cabinet with baked-enamel finish; containing key-holding hooks, labels, 2 sets of key tags with self-locking key holders, key-gathering envelopes, and temporary and permanent markers; with key capacity of 150 percent of the number of locks.
      
      1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
         
         a. American Key Boxes and Cabinets.
         b. GE Security, Inc.
         c. HPC, Inc.
         d. Lund Equipment Co., Inc.
2. Wall-Mounted Cabinet: Cabinet with hinged-panel door equipped with key-holding panels and pin-tumbler cylinder door lock.

B. Key Lock Boxes: Designed for storage of 10 keys.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:

2.18 ACCESSORIES FOR PAIRS OF DOORS

A. Astragals: BHMA A156.22.

2.19 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. DORMA Architectural Hardware; Member of The DORMA Group North America.
      b. LCN Closers; an Ingersoll-Rand company.
      c. Norton Door Controls; an ASSA ABLOY Group company.

2.20 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; polished cast brass, bronze, or aluminum base metal.

2.21 ELECTROMAGNETIC STOPS AND HOLDERS

A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; wall-mounted electromagnetic single unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire alarm system for labeled fire-rated door assemblies.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Architectural Builders Hardware Mfg., Inc.
      b. DORMA Architectural Hardware; Member of The DORMA Group North America.
      c. SARGENT Manufacturing Company; an ASSA ABLOY Group company

2.22 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or...
flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Hager Companies;
   b. National Guard Products, Inc.
   c. Pemko Manufacturing Co.

2.23 THRESHOLDS
   A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

2.24 METAL PROTECTIVE TRIM UNITS
   A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch-thick stainless steel; with manufacturer’s standard machine or self-tapping screw fasteners.

2.25 FABRICATION
   A. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and BHMA A156.18.

   B. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

      1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.

      2. Fire-Rated Applications:

         a. Wood or Machine Screws: For the following:

            1) Hinges mortised to doors or frames; use threaded-to-the-head wood screws for wood doors and frames.
            2) Strike plates to frames.
            3) Closers to doors and frames.

         b. Steel Through Bolts: For the following unless door blocking is provided:

            1) Surface hinges to doors.
            2) Closers to doors and frames.
            3) Surface-mounted exit devices.

      3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."
5. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.26 FINISHES
A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.
B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance.
B. Examine roughing-in for electrical power systems to verify actual locations of wiring connections before electrified door hardware installation.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.
B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

3.3 INSTALLATION
A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
   2. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."
B. Install each door hardware item to comply with manufacturer's 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. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

C. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.

E. Lock Cylinders: Install construction cores to secure building and areas during construction period.

1. Replace construction cores with permanent cores as directed by Owner.
2. Furnish permanent cores to Owner for installation.

F. Key Control System: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.

G. Boxed Power Supplies: Locate power supplies as indicated or, if not indicated, above accessible ceilings. Verify location with Architect.

1. Configuration: Provide one power supply for each door opening with electrified door hardware.

H. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 07 9200 “Joint Sealants.”

I. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

J. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

K. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

L. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 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.

1. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 30 degrees.
2. Electric Strikes: Adjust horizontal and vertical alignment of keeper to properly engage lock bolt.
3. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

3.5 CLEANING AND PROTECTION

A. Clean adjacent surfaces soiled by door hardware installation.

B. Clean operating items as necessary to restore proper function and finish.

C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.6 DOOR HARDWARE SCHEDULE

Group 1  (Doors 1001A, V1001A, V1001B, V1001C & V1002A)
Number and style of cylinders required per 08 4229.23 and 08 4113: Best 7 pins Keyway to match University standards.
1 ea. Reader at doors indicated to receive them on the plans (By Owner)

1 ½ pr. Butts BB1168 x 4 ½ x 4 ½ x 626 Hager
1 ea. Storeroom 93K-7-D-14D-S3 x 626 Best
1 ea. Electric Strike 6211 FSE 24 VDC US32D Von Duprin
1 ea. Closer 4040 x Alumn. LCN
1 ea. Wall Stop 409 x 630 Rockwood
1 set Sound Seals 700N Nat. Guard
1 ea. Reader (By Owner)
Note: Power Supplies by Owner.

Group 3  (Doors 1003, 1008A, 1009A, 1013, 1018, 1020, 1021, 1033, 1038, 1055, 1056, 1067, 1077A, 1079 & 1082)
1 ½ pr. Butts BB1168 x 4 ½ x 4 ½ x 626 Hager
1 ea. Privacy 93K-7-D-14D-S3 x 626 Best
1 ea. Kick Plate 193S- 34” x 12” x 630 Hager
1 ea. Wall Stop 409 x 630 Rockwood

Group 4  (Doors 1004 & 1093B)
1 ½ pr. Butts BB1168 x 4 ½ x 4 ½ x 626 Hager
1 ea. Closer 4040 x Alumn LCN
1 ea. Passage 93K-0-N-14D-S3 x 626 Best
1 ea. Wall Stop (1004) 409 x 626 Rockwood

Group 5  (Doors 1005 & 1008B)
1 ½ pr. Butts BB1168 x 4 ½ x 4 ½ x 626 Hager
1 ea. Storeroom 93K-7-D-14D-S3 x 626 Best
1 ea. Closer 4040 x Alumn LCN
1 ea. Wall Stop 409 x 630 Rockwood

Group 6  (Doors 1008C, 1008D, 1022-1029, 1032, 1035, 1040-1047, 1057-1064, 1066, 1069, 1071-1075, 1077 & 1078)
1 ea. Cont. Hinge 780-224HD-83-CL Hager Roton
1 ea. Passage 93K-0-N-14D-S3 x 626 Best
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END OF SECTION 08 7100
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Low-energy door operators for swinging doors.

1.3 DEFINITIONS

A. AAADM: American Association of Automatic Door Manufacturers.

B. Activation Device: A control that, when actuated, sends an electrical signal to the door operator to open the door.

C. Safety Device: A control that, to avoid injury, prevents a door from opening or closing.

D. For automatic door terminology, see BHMA A156.10 and BHMA A156.19 for definitions of terms.

1.4 COORDINATION

A. Coordinate sizes and locations of recesses in concrete floors for recessed control mats that control automatic door operators. Concrete, reinforcement, and formwork requirements are specified elsewhere.

B. Templates: Distribute for doors, frames, and other work specified to be factory prepared and reinforced for installing automatic door operators.

C. Coordinate hardware for doors with operators to ensure proper size, thickness, hand, function, and finish.

D. Electrical System Roughing-in: Coordinate layout and installation of automatic door operators with connections to power supplies and access-control system.

E. System Integration: Integrate automatic door operators with other systems as required for a complete working installation.

1. Provide electrical interface control capability for activation of automatic door operators by secure activation system on doors with electric locking.

2. Where indicated to be install both push plates and secure activation system, automatic door operators shall be configured to operate; by secure activation system when secured; by push plate when not secured.
3. Where required for proper operation, provide a time delay relay to signal automatic door operator to activate only after electric lock system is released.

1.5 PERFORMANCE REQUIREMENTS

A. General: Provide automatic door operators capable of withstanding structural loads and thermal movements based on testing manufacturers standard units in assemblies similar to those indicated for this project.

B. Operating Range: Minus 30 degrees F to 130 degrees F.

C. Opening-Force Requirements for Egress Doors: In the event power failure to the operator, swinging automatic entrance doors shall open with a manual force, not to exceed 30 lbf applied at 1” from latch edge of the door.

D. Door Energy: The kinetic energy of a door in motion shall not exceed 1.25 lbd-ft.

E. Closing Time:

1. Doors shall be field adjusted to close from 90 degrees to 10 degrees in 3 seconds or longer.
2. Doors shall be field adjusted to close 10 degrees to fully closed in not less than 1.5 seconds.

1.6 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for automatic door operators.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings: For automatic door operators.

1. Include plans, elevations, sections, hardware mounting heights, and attachment details.
2. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Indicate locations of activation and safety devices.
4. Include diagrams for power, signal, and control wiring.

1.7 INFORMATIONAL SUBMITTALS

A. Sample Warranties: For manufacturer’s special warranties.

1.8 CLOSEOUT SUBMITTALS

A. Maintenance Data: For automatic door operators, safety devices, and control systems, to include in maintenance manuals.
1.9 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by the manufacturer for installation and maintenance of units required for this Project and who employs a Certified Inspector.

1. Maintenance Proximity: Not more than two hours’ normal travel time from Installer’s place of business to Project site.

B. Certified Inspector Qualifications: Certified by AAADM.

C. Manufacturer Qualifications: A Qualified manufacturer with a manufacturing facility certified under ISO 9001 and with company certificate issued by AAADM.

D. Source Limitations: Obtain automatic operators and sliding doors through one source from a single manufacturer.

E. Product Options: Drawings indicate size, profiles, and dimensional requirements of swinging doors equipped with automatic door operators and are based on the specific system indicated. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect’s approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.


G. Electrical Components, Devices and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authority having jurisdiction and marked for intended use.

H. Emergency-Exit Door Requirements: Comply with requirements of authority having jurisdiction for swinging automatic entrance doors serving as a required means of egress.

1.10 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of automatic door operators that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Faulty or sporadic operation of automatic door operator, including controls.
   b. Deterioration of metals, metal finishes, and other materials beyond normal weathering or use.

2. Warranty Period: Two years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Stanley Access Technologies; Magic-Force Series automatic door operator or comparable product by one of the following:

1. Besam Entrance Solutions; ASSA ABLOY.
2. DORMA USA, Inc.
3. record-usa.

B. Source Limitations: Obtain automatic door operators, including activation and safety devices, from single source from single manufacturer.

### 2.2 AUTOMATIC DOOR OPERATORS, GENERAL

#### A. General

Provide operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for occupancy type indicated; and according to UL 325. Coordinate operator mechanisms with door operation, hinges, and activation and safety devices.

1. **Emergency Breakaway:** Where indicated for center-pivoted doors, provide emergency breakaway feature for reverse swing of doors. Equip system to discontinue power to automatic door operator when door is in emergency breakaway position, to return door to closed position after breakaway, and to automatically reset.

2. **Wind Load:** Provide door operators on exterior doors that will open and close doors and maintain them in fully closed position when subjected to wind load of 72 MPH.

#### B. Electromechanical Operating System

Self-contained unit powered by permanent-magnet dc motor; with closing speed controlled mechanically by gear train and dynamically by braking action of electric motor, connections for power and activation- and safety-device wiring, and manual operation including spring closing when power is off.

#### C. Cover for Surface-Mounted Operators

Fabricated from 0.125-inch-thick, extruded or formed aluminum; manufacturer’s standard width; with enclosed end caps, provision for maintenance access, and fasteners concealed when door is in closed position.

#### D. Brackets and Reinforcements

Fabricated from aluminum with nonstaining, nonferrous shims for aligning system components.

#### E. Electrical Components, Devices, and Accessories

Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

### 2.3 LOW-ENERGY DOOR OPERATORS

#### A. Standard

BHMA A156.19.

#### B. Performance Requirements:

1. **Opening Force if Power Fails:** Not more than 15 lbf required to release latch if provided, not more than 30 lbf required to manually set door in motion, and not more than 15 lbf required to fully open door.

2. **Entrapment-Prevention Force:** Not more than 15 lbf required to prevent stopped door from closing or opening.

#### C. Configuration

Operator to control single swinging door.

1. **Traffic Pattern:** Two way.

2. **Operator Mounting:** Surface.

#### D. Operation

Power opening and power-assisted spring closing. Provide time delay for door to remain open before initiating closing cycle as required by BHMA A156.19. When not in automatic mode, door operator shall function as manual door closer, with or without electrical power.
E. Operating System: Electromechanical.

F. Microprocessor Control Unit: Solid-state controller.

G. Features:
   1. Adjustable opening and closing speed.
   2. Adjustable opening and closing force.
   3. Adjustable backcheck.
   4. Adjustable hold-open time from zero to 30 seconds.
   5. Adjustable time delay.
   6. Adjustable acceleration.
   7. Obstruction recycle.
   8. On-off/hold-open switch to control electric power to operator; key operated.

H. Activation Device: on each side of door to activate door operator.

I. Exposed Finish: Class I, clear anodic finish.

2.4 MATERIALS

A. Aluminum: Alloy and temper recommended by manufacturer for type of use and finish indicated.
   1. Extrusions: ASTM B 221.

B. Fasteners and Accessories: Corrosion-resistant, nonstaining, nonbleeding fasteners and accessories compatible with adjacent materials.

2.5 SWINGING DOOR OPERATORS

A. General: Provide door operators of size recommended by manufacturer for door size, weight, and movement; for condition of exposure; and for long-term, maintenance-free operation under normal traffic load for type of occupancy indicated.

B. Electromechanical Operators: Self-contained unit powered by a minimum 3/16 horsepower, permanent-magnet DC motor; through a high torque reduction gear system.
   2. Operator Type: Low energy; readily convertible to full energy; no tools required to change type.
   3. Handing: Non-handed; no tools required to change handing.
   4. Capacity: Rated for door panels weighing up to 350 lb.
   5. Mounting: Visible
   6. Features:
      a. Adjustable opening and closing speeds.
      b. Adjustable opening and closing force.
      c. Adjustable back-check.
      d. Adjustable hold-open time between 0 and 30 seconds.
      e. Reverse on obstruction.
      f. Variable rate open/closed speed control.
      g. Closed loop speed control with active braking and acceleration.
      h. Variable obstruction recycle time delay.
      i. Optional Switch to open/Switch to close operation.
C. Field Adjustable Spring Closing Operation: The operator shall close the door by spring energy employing the motor, as a dynamic brake to provide closing speed control. The closing spring shall be a helical compression spring, adjustable for positive closing action. The spring shall be adjustable, without removing the operator from the header, to accommodate a wide range of field conditions.

D. Independent Adjustable Closing and Latching Speed Control: The operator shall employ a rheostat module to allow for independent field adjustment of closing and latching speeds using the motor as a dynamic brake.

E. Field Adjustable Open Stop: The operator shall provide a field adjustable open stop to accommodate opening angles from 80 to 135 degrees without the need for additional components.

F. Consistent Cycle: The operator shall deliver an even, consistent open force across the entire transition from door fully closed to door fully open. Additionally, the range of the force shall be field adjustable to accommodate a wide range of on-site conditions.

G. Quiet Performance: The operator shall be designed to output audible noise ratios less than or equal to 50dba.

H. Manual Use: The operator shall function as a manual door closer in the direction of swing with or without electrical power. The operator shall deliver an even, consistent open force across the entire transition from door fully closed to door fully open.

I. Electrical service to door operators shall be provided under Division 16 Electrical. Minimum service to be 120 VAC, 10 amps for doors with operators in pairs, 5 amps for single doors.

2.6 ELECTRICAL CONTROLS

A. Electrical Control System: Electrical control system shall include a microprocessor controller and position encoder. The encoder shall monitor revolutions of the operator shaft and send signals to microprocessor controller to define door position. Systems utilizing external magnets and magnetic switches are not acceptable.

B. Life Cycle Data Counter: The microprocessor control shall incorporate a non-re-settable counter to track door operation cycles.

C. Controller Protection: The microprocessor controller shall incorporate the following features to ensure trouble free operation:

1. Automatic Reset Upon Power Up
2. Main Fuse Protection
3. Electronic Surge Protection
4. Internal Power Supply Protection
5. Resettable sensor supply fuse protection
6. Software “Watchdog” protection in the case of software malfunction

D. Push Button Interface with LED: The controller shall have push button switches with LED readout to allow for selection or change of the following parameters: carpet or timer logic, single or dual door, activation options, normal back check or large back check, put-to-open assist on/off.

E. Soft Star/Stop: a “soft-start” “soft-stop” motor driving circuit shall be provided for smooth normal opening recycling.
F. Safety Search Circuitry: Provide system to recycle the swinging panels when an obstruction is encountered during the closing cycle. If an obstruction is detected, the system shall search for that object on the next closing cycle by reducing door closing speed prior to the previously encountered obstruction location, and will continue to close in check speed until doors are fully closed, at which time the doors will reset to normal speed. If obstruction is encountered again, the door will come to a full stop. The doors shall remain stopped until obstruction is removed and operate signal is given, resetting the door to normal operation.

G. Programmable Controller: Microprocessor controller shall be programmable and shall be designed for connection to a local configuration tool. Local configuration tool shall be software driven and shall be utilized via Palm® handheld interface. The following parameters may be adjusted via the configuration tool.

1. Operating speeds and forces as required to meet ANSI/BHMA A156.19
2. Adjustable and variable features as specified in 2.04, B
3. Firmware Update
4. Trouble Shooting
   a. I/O Status
   b. Electrical component monitoring including parameter summary
5. Entrance profile copy/paste
6. Software for local configuration tool shall be available as a free download from the automatic door operator manufacturer's internet site

H. Emergency Breakout Switch: A cam actuated emergency breakout switch shall be provided to disconnect power to the motor when an in-swinging door is manually pushed in the emergency out direction. The operator will then automatically reset and power will be resumed.

I. Control Switch: Automatic door operators shall be equipped with a three position function switch to control the operation of the door. Control switch shall provide three modes of operation, Automatic, Off, and Hold-Open.

J. Power Switch: Automatic door operators shall be equipped with a two position On/Off switch to control power to the door.

2.7 ACTIVATION DEVICES

A. Touchless Activation Switch: Provide 4 ½ inch square touchless activation switches for activation of automatic door operators. Face shall be polycarbonate. Face plates shall be engraved with waving hand logo and “Wave to Operate”.

1. Interior switches shall be flush mounted in single or double gang electrical box and hardwired to door operator controls.
2. Exterior switches shall be post or wall mounted and hardwired to door operator controls.
3. Units shall incorporate microwave frequency to detect all motion in the detection zone. Detection zone shall be adjustable from 4 inches to 24 inches.
4. Relay hold time shall be adjustable from 1 to 10 seconds. Relay shall be rated at 1A.
5. Touchless activation switches shall be equal to or better than BEA MS-08.

B. Where mounting posts are required provide 6 ¼ inch by 4 ¼ inch steel tube, black ABS plastic cap, and SS Mounting plate. Post finish shall be powder coat. “Silver”, inside and out. Post shall be 42 inches high configured for switch mounting.
2.8 FABRICATION

A. Factory fabricate automatic door operators to comply with indicated standards.
B. Form aluminum shapes before finishing.
C. Fabricate exterior components to drain condensation and water passing joints within operator enclosure to the exterior.
D. Use concealed fasteners to greatest extent possible. Where exposed fasteners are required, use countersunk Phillips flat-head machine screws, finished to match operator.

2.9 ACCESSORIES

A. Signage: As required by cited BHMA standard for type of door and its operation.
   2. Provide sign materials with instructions for field application when operators are installed.

2.10 GENERAL FINISH REQUIREMENTS

A. Protect mechanical finishes on exposed surfaces from damage by applying strippable, temporary protective covering before shipping.
B. Apply organic and anodic finishes to formed metal after fabrication unless otherwise indicated.
C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within range of approved Samples and are assembled or installed to minimize contrast.

2.11 ALUMINUM FINISHES

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

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances, door and frame preparation and reinforcements, and other conditions affecting performance of automatic door operators.
B. Examine roughing-in for electrical systems to verify actual locations of power connections before automatic door operator installation.
C. Verify that full-height finger guards are installed at each door with pivot hinges where door has a clearance at hinge side greater than 1/4 inch and less than 3/4 inch with door in any position.
D. Proceed with installation only after unsatisfactory conditions have been corrected.
3.2 INSTALLATION

A. General: Install automatic door operators according to manufacturer’s written instructions and cited BHMA standard for type of door operation and direction of pedestrian travel, including signage, controls, wiring, remote power units if any, and connection to building’s power supply.

1. Do not install damaged components. Fit joints to produce hairline joints free of burrs and distortion.
2. Install operators true in alignment with established lines and door geometry without warp or rack. Anchor securely in place.

B. Controls: Install activation and safety devices according to manufacturer’s written instructions and cited BHMA standard for operator type and direction of pedestrian travel. Connect control wiring according to Section 26 0519 "Low-Voltage Electrical Power Conductors and Cables."

C. Access-Control System: Connect operators to access-control system as specified in Section 28 1300 "Access Control."

D. Signage: Apply on both sides of each door as required by cited BHMA standard for type of door operator and direction of pedestrian travel.

3.3 ADJUSTING

A. Adjust automatic door operators to function smoothly, and lubricate as recommended by manufacturer; comply with requirements of applicable BHMA standards.

1. Adjust operators on exterior doors for weathertight closure.

B. After completing installation of automatic door operators, inspect exposed finishes on doors and operators. Repair damaged finish to match original finish.

C. Readjust automatic door operators and controls after repeated operation of completed installation equivalent to three days’ use by normal traffic (100 to 300 cycles).

D. Occupancy Adjustment: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner’s maintenance personnel to adjust, operate, and maintain automatic door operators.

END OF SECTION 08 7113
SECTION 08 8000 - GLAZING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:
   1. Glazing sealants and accessories.

B. Related Requirements:
   1. Section 08 8300 "Mirrors."
   2. Section 08 8853 "Security Glazing."

1.3 DEFINITIONS

A. Glass Manufacturers: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.

B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.


D. Interspace: Space between lites of an insulating-glass unit.

1.4 COORDINATION

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

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Glass Samples: For each type of the following products; 12 inches square.
   1. Tinted glass.
   2. Coated glass.
   3. Laminated glass.
   4. Insulating glass.

C. Glazing Schedule: List glass types and thicknesses for each size opening and location. Use same designations indicated on Drawings.
1.6 INFORMATIONAL SUBMITTALS

A. Product Certificates: For glass.

1.7 QUALITY ASSURANCE

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

B. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for materials and execution.
   1. Install glazing in mockups specified in Section 08 4113 "Aluminum-Framed Entrances and Storefronts" and 08 4413 "Glazed Aluminum Curtain Walls" to match glazing systems required for Project, including glazing methods.
   2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

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

B. Comply with insulating-glass manufacturer's written instructions for venting and sealing units to avoid hermetic seal ruptures due to altitude change.

1.9 FIELD CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.
   1. Do not install glazing sealants when ambient and substrate temperature conditions are outside limits permitted by sealant manufacturer or are below 40 deg F.

1.10 WARRANTY

A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer agrees to replace coated-glass units that deteriorate within specified warranty period. Deterioration of coated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in coating.
   1. Warranty Period: 10 years from date of Substantial Completion.

B. Manufacturer's Special Warranty for Laminated Glass: Manufacturer agrees to replace laminated-glass units that deteriorate within specified warranty period. Deterioration of laminated glass is defined as defects developed from normal use that are not attributed to glass breakage or to maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.
1. Warranty Period: 10 years from date of Substantial Completion.

C. Manufacturer's Special Warranty for Insulating Glass: Manufacturer agrees to replace insulating-glass units that deteriorate within specified warranty period. Deterioration of insulating glass is defined as failure of hermetic seal under normal use that is not attributed to glass breakage or to maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Glass Product: Subject to compliance with requirements, provide product indicated in glass schedules or comparable product by one of the following:

1. AGC Glass Company North America, Inc;
2. Cardinal Glass Industries.
3. Oldcastle BuildingEnvelope™.
5. Viracon, Inc.

B. Source Limitations for Glass: Obtain from single source from single manufacturer for each glass type.

1. Obtain tinted glass from single source from single manufacturer.

C. Source Limitations for Glazing Accessories: Obtain from single source from single manufacturer for each product and installation method.

2.2 PERFORMANCE REQUIREMENTS

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

B. Structural Performance: Glazing shall withstand the following design loads within limits and under conditions indicated determined according to the IBC and ASTM E 1300.

1. Design Wind Pressures: As indicated on Drawings.
2. Design Wind Pressures: Determine design wind pressures applicable to Project according to ASCE/SEI 7, based on heights above grade indicated on Drawings.
   a. Wind Design Data: As indicated on Drawings.
   b. Basic Wind Speed: 110 mph.
   c. Importance Factor: 1.0.
   d. Exposure Category: C.
3. Maximum Lateral Deflection: For glass supported on all four edges, limit center-of-glass deflection at design wind pressure to not more than 1/50 times the short-side length or 1 inch, whichever is less.
4. Differential Shading: Design glass to resist thermal stresses induced by differential shading within individual glass lites.

C. Safety Glazing: Where safety glazing is required, provide glazing that complies with 16 CFR 1201, Category II.

D. Thermal and Optical Performance Properties: Provide glass with performance properties specified, as indicated in manufacturer's published test data, based on procedures indicated below:

1. For monolithic-glass lites, properties are based on units with lites 6 mm thick.
2. For laminated-glass lites, properties are based on products of construction indicated.
3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
4. U-Factors: Center-of-glassing values, according to NFRC 100 and based on LBL's WINDOW 5.2 computer program, expressed as Btu/sq. ft. x h x deg F.
5. Solar Heat-Gain Coefficient and Visible Transmittance: Center-of-glassing values, according to NFRC 200 and based on LBL's WINDOW 5.2 computer program.
6. Visible Reflectance: Center-of-glassing values, according to NFRC 300.

2.3 GLASS PRODUCTS, GENERAL

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below unless more stringent requirements are indicated. See these publications for glazing terms not otherwise defined in this Section or in referenced standards.


B. Safety Glazing Labeling: Where safety glazing is required, permanently mark glazing with certification label of the SGCC or another certification agency acceptable to authorities having jurisdiction. Label shall indicate manufacturer's name, type of glass, thickness, and safety glazing standard with which glass complies.

C. Insulating-Glass Certification Program: Permanently marked either on spacers or on at least one component lite of units with appropriate certification label of IGCC.

D. Thickness: Where glass thickness is indicated, it is a minimum.

1. Minimum Glass Thickness for Exterior Lites: 6 mm.
2. Thickness of Tinted Glass: Provide same thickness for each tint color indicated throughout Project.

E. Strength: Where annealed float glass is indicated, provide annealed float glass, heat-strengthened float glass, or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where heat-strengthened float glass is indicated, provide heat-strengthened float glass or fully tempered float glass as needed to comply with "Performance Requirements" Article. Where fully tempered float glass is indicated, provide fully tempered float glass.

2.4 GLASS PRODUCTS

A. Clear Annealed Float Glass: ASTM C 1036, Type I, Class 1 (clear), Quality-Q3.

B. Tinted Annealed Float Glass: ASTM C 1036, Type I, Class 2 (tinted), Quality-Q3.
C. Fully Tempered Float Glass: ASTM C 1048, Kind FT (fully tempered), Condition A (uncoated) unless otherwise indicated, Type I, Class 1 (clear) or Class 2 (tinted) as indicated, Quality-Q3.

   1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed unless otherwise indicated.

2.5 LAMINATED GLASS

A. Laminated Glass: ASTM C 1172. Use materials that have a proven record of no tendency to bubble, discolor, or lose physical and mechanical properties after fabrication and installation.

   1. Construction: Laminate glass with polyvinyl butyral interlayer to comply with interlayer manufacturer's written instructions.
   2. Interlayer Thickness: Provide thickness not less than that indicated and as needed to comply with requirements.
   3. Interlayer Color: Clear unless otherwise indicated.

2.6 INSULATING GLASS

A. Insulating-Glass Units: Factory-assembled units consisting of sealed lites of glass separated by a dehydrated interspace, qualified according to ASTM E 2190.

   1. Sealing System: Dual seal, with manufacturer's standard primary and secondary sealants.
   2. Spacer: Thermally broken aluminum.
   3. Desiccant: Molecular sieve or silica gel, or a blend of both.

2.7 GLAZING SEALANTS

A. General:

   1. Compatibility: Compatible with one another and with other materials they contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
   2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
   3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.

B. Glazing Sealant: Neutral-curing silicone glazing sealant complying with ASTM C 920, Type S, Grade NS, Class 50, Use NT.

2.8 GLAZING TAPES

A. Back-Bedding Mastic Glazing Tapes: Preformed, butyl-based, 100 percent solids elastomeric tape; nonstaining and nonmigrating in contact with nonporous surfaces; with or without spacer rod as recommended in writing by tape and glass manufacturers for application indicated; and complying with ASTM C 1281 and AAMA 800 for products indicated below:

   1. AAMA 804.3 tape, where indicated.
   2. AAMA 806.3 tape, for glazing applications in which tape is subject to continuous pressure.
3. AAMA 807.3 tape, for glazing applications in which tape is not subject to continuous pressure.

B. Expanded Cellular Glazing Tapes: Closed-cell, PVC foam tapes; factory coated with adhesive on both surfaces; and complying with AAMA 800 for the following types:

1. AAMA 810.1, Type 1, for glazing applications in which tape acts as the primary sealant.
2. AAMA 810.1, Type 2, for glazing applications in which tape is used in combination with a full bead of liquid sealant.

2.9 MISCELLANEOUS GLAZING MATERIALS

A. General: Provide products of material, size, and shape complying with referenced glazing standard, with requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.

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

C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions of hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).

2.10 FABRICATION OF GLAZING UNITS

A. Fabricate glazing units in sizes required to fit openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.

1. Allow for thermal movements from ambient and surface temperature changes acting on glass framing members and glazing components.
   a. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites to produce square edges with slight chamfers at junctions of edges and faces.

C. Grind smooth and polish exposed glass edges and corners.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 PREPARATION

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

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

3.3 GLAZING, GENERAL

A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.

B. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass includes glass with edge damage or other imperfections that, when installed, could weaken glass, impair performance, or impair appearance.

C. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction testing.

D. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.

E. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

F. Provide spacers for glass lites where length plus width is larger than 50 inches.
   1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
   2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

G. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.

H. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

I. Set glass lites with proper orientation so that coatings face exterior or interior as specified.
J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 TAPE GLAZING

A. Position tapes on fixed stops so that, when compressed by glass, their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously, but not necessarily in one continuous length. Do not stretch tapes to make them fit opening.

C. Cover vertical framing joints by applying tapes to heads and sills first, then to jambs. Cover horizontal framing joints by applying tapes to jambs, then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until right before each glazing unit is installed.

F. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

3.5 GASKET GLAZING (DRY)

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

B. Insert soft compression gasket between glass and frame or fixed stop so it is securely in place with joints miter cut and bonded together at corners.

C. Installation with Drive-in Wedge Gaskets: Center glass lites in openings on setting blocks, and press firmly against soft compression gasket by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings. Compress gaskets to produce a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

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

E. Install gaskets so they protrude past face of glazing stops.

3.6 CLEANING AND PROTECTION

A. Immediately after installation remove nonpermanent labels and clean surfaces.
B. Protect glass from contact with contaminating substances resulting from construction operations. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains.

1. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended in writing by glass manufacturer. Remove and replace glass that cannot be cleaned without damage to coatings.

C. Remove and replace glass that is damaged during construction period.

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

3.7 MONOLITHIC GLASS SCHEDULE

A. Glass Type: Clear fully tempered float glass. (GL-1)

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

B. Glass Type: Obscured fully tempered float glass. (GL-7)

1. Minimum Thickness: 6 mm.
2. Safety Glazing required.
3. Clear Walker Velour acid etched.

3.8 LAMINATED-GLASS TYPES

A. Glass Type: Clear laminated glass with two plies of fully tempered float glass. (GL-2)

1. Thickness of Each Glass Ply: 4.0 mm.
2. Interlayer Thickness: 0.030 inch.
3. Provide safety glazing labeling.

3.9 INSULATING-GLASS TYPES

A. Glass Type: Low-e-coated, tinted insulating glass. (GL-3)

1. Overall Unit Thickness: 1 inch
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: PPG Graylite Tinted fully tempered float glass.
4. Interspace Content: Air.
5. Indoor Lite: SunGlass fully tempered float glass.
6. Low-E Coating: Pyrolytic or sputtered on third surface.
7. Visible Light Transmittance: 5 percent minimum.
8. Winter Nighttime U-Factor: 0.32 maximum.
9. Summer Daytime U-Factor: 0.28 maximum.
10. Solar Heat Gain Coefficient: 0.13 maximum.
11. Provide safety glazing labeling.

B. Glass Type: Low-e-coated, Clear insulating glass. (GL-4)

1. Overall Unit Thickness: 1 inch
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: SunGlass fully tempered float glass.
4. Interspace Content: Air.
5. Indoor Lite: Clear fully tempered float glass.
6. Low-E Coating: Pyrolytic or sputtered on second surface.
8. Winter Nighttime U-Factor: 0.29 maximum.
9. Summer Daytime U-Factor: 0.27 maximum.
10. Solar Heat Gain Coefficient: 0.25 maximum.
11. Provide safety glazing labeling.

C. Glass Type: Low-e-coated, clear/obscure insulating glass. (GL-5)

1. Overall Unit Thickness: 1 inch.
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: SunGlass fully tempered float glass.
4. Interspace Content: Air.
5. Indoor Lite: Clear Walker Velour #3 surface fully tempered float glass.
6. Low-E Coating: Pyrolytic or sputtered on two surface.
7. Visible Light Transmittance: 5 percent minimum.
8. Winter Nighttime U-Factor: 0.32 maximum.
9. Summer Daytime U-Factor: 0.28 maximum.
10. Solar Heat Gain Coefficient: 0.13 maximum.
11. Provide safety glazing labeling.

3.10 INSULATING-LAMINATED-GLASS SCHEDULE

A. Glass Type: Low-e-coated, Laminated, tinted, insulating glass. (GL-6)

1. Overall Unit Thickness: 1 inch
2. Thickness of Each Glass Lite: 6.0 mm.
3. Outdoor Lite: PPG Graylite Tinted fully tempered float glass.
4. Interspace Content: Air.
5. Indoor Lite: ¼” Laminated - SunGlass fully tempered float glass.
6. Low-E Coating: Pyrolytic or sputtered on third surface.
7. Visible Light Transmittance: 5 percent minimum.
8. Winter Nighttime U-Factor: 0.32 maximum.
9. Summer Daytime U-Factor: 0.28 maximum.
10. Solar Heat Gain Coefficient: 0.13 maximum.
11. Provide safety glazing labeling.

END OF SECTION 08 8000
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes the following types of silvered flat glass mirrors:
   1. Tempered glass mirrors qualifying as safety glazing.
   2. Related Requirements:
      1. Section 08 8000 "Glazing" for glass with reflective coatings used for vision and spandrel lites.
      2. Section 10 2800 "Toilet, Bath, and Laundry Accessories" for metal-framed mirrors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Mirrors. Include description of materials and process used to produce each type of silvered flat glass mirror specified that indicates sources of glass, glass coating components, edge sealer, and quality-control provisions.
B. Shop Drawings: Include mirror elevations, edge details, mirror hardware, and attachment details.
C. Samples: For each type of the following:
   1. Mirrors: 12 inches square, including edge treatment on two adjoining edges.

1.4 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For mirrors to include in maintenance manuals.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.
1.7 DELIVERY, STORAGE, AND HANDLING

A. Protect mirrors according to mirror manufacturer’s written instructions and as needed to prevent damage to mirrors from moisture, condensation, temperature changes, direct exposure to sun, or other causes.

B. Comply with mirror manufacturer’s written instructions for shipping, storing, and handling mirrors as needed to prevent deterioration of silvering, damage to edges, and abrasion of glass surfaces and applied coatings. Store indoors.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not install mirrors until ambient temperature and humidity conditions are maintained at levels indicated for final occupancy.

1.9 WARRANTY

A. Special Warranty: Manufacturer agrees to replace mirrors that deteriorate within specified warranty period. Deterioration of mirrors is defined as defects developed from normal use that are not attributed to mirror breakage or to maintaining and cleaning mirrors contrary to manufacturer’s written instructions. Defects include discoloration, black spots, and clouding of the silver film.

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations for Mirrors: Obtain mirrors from single source from single manufacturer.

B. Source Limitations for Mirror Accessories: Obtain mirror glazing accessories from single source.

2.2 SILVERED FLAT GLASS MIRRORS

A. Mirrors, General: ASTM C 1503; manufactured using copper-free, low-lead mirror coating process.

B. Tempered Glass Mirrors: Mirror Glazing Quality for blemish requirements and complying with ASTM C 1048 for Kind FT, Condition A, tempered float glass before silver coating is applied; clear.

1. Nominal Thickness: 6.0 mm.

C. Safety Glazing Products: For tempered mirrors, provide products that comply with 16 CFR 1201, Category II.

2.3 MISCELLANEOUS MATERIALS

A. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
B. Edge Sealer: Coating compatible with glass coating and approved by mirror manufacturer for use in protecting against silver deterioration at mirrored glass edges.

2.4 MIRROR HARDWARE

A. Aluminum J-Channels: Aluminum extrusions with a return deep enough to produce a glazing channel to accommodate mirrors of thickness indicated and in lengths required to cover edges of mirrors in a single piece.

1. Bottom Trim: J-channels formed with front leg and back leg not less than 3/8 and 7/8 inch in height, respectively, and a thickness of not less than 0.04 inch.
2. Top Trim: J-channels formed with front leg and back leg not less than 5/8 and 1 inch in height, respectively, and a thickness of not less than 0.04 inch.

B. Fasteners: Fabricated of same basic metal and alloy as fastened metal and matching it in finished color and texture where fasteners are exposed.

C. Anchors and Inserts: Provide devices as required for mirror hardware installation. Provide toothed or lead-shield, expansion-bolt devices for drilled-in-place anchors. Provide galvanized anchors and inserts for applications on inside face of exterior walls and where indicated.

2.5 FABRICATION

A. Fabricate mirrors in the shop to greatest extent possible.

B. Fabricate cutouts for notches and holes in mirrors without marring visible surfaces. Locate and size cutouts so they fit closely around penetrations in mirrors.

C. Mirror Edge Treatment: Flat polished.

1. Seal edges of mirrors with edge sealer after edge treatment to prevent chemical or atmospheric penetration of glass coating.
2. Require mirror manufacturer to perform edge treatment and sealing in factory immediately after cutting to final sizes.

D. Film-Backed Safety Mirrors: Apply film backing with adhesive coating over mirror backing paint, as recommended in writing by film-backing manufacturer, to produce a surface free of bubbles, blisters, and other imperfections.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, over which mirrors are to be mounted, with Installer present, for compliance with installation tolerances, substrate preparation, and other conditions affecting performance of the Work.

B. Verify compatibility with and suitability of substrates, including compatibility of existing finishes or primers with mirror mastic.

C. Proceed with installation only after unsatisfactory conditions have been corrected and surfaces are dry.
3.2 PREPARATION

A. Comply with mastic manufacturer's written installation instructions for preparation of substrates, including coating substrates with mastic manufacturer's special bond coating where applicable.

3.3 INSTALLATION

A. General: Install mirrors to comply with mirror manufacturer's written instructions and with referenced GANA publications. Mount mirrors accurately in place in a manner that avoids distorting reflected images.


B. Provide a minimum airspace of 1/8 inch between back of mirrors and mounting surface for air circulation between back of mirrors and face of mounting surface.

C. Install mirrors with mirror hardware. Attach mirror hardware securely to mounting surfaces with mechanical fasteners installed with anchors or inserts as applicable. Install fasteners so heads do not impose point loads on backs of mirrors.

1. Aluminum J-Channels: Provide setting blocks 1/8 inch thick by 4 inches long at quarter points. To prevent trapping water, provide, between setting blocks, two slotted weeps not less than 1/4 inch wide by 3/8 inch long at bottom channel.

3.4 CLEANING AND PROTECTION

A. Protect mirrors from breakage and contaminating substances resulting from construction operations.

B. Do not permit edges of mirrors to be exposed to standing water.

C. Maintain environmental conditions that prevent mirrors from being exposed to moisture from condensation or other sources for continuous periods of time.

D. Clean exposed surface of mirrors not more than four days before date scheduled for inspections that establish date of Substantial Completion. Clean mirrors as recommended in writing by mirror manufacturer.

END OF SECTION 08 8300
SECTION 08 9119 - FIXED LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fixed, formed-metal louvers.

1.3 DEFINITIONS

A. Louver Terminology: Definitions of terms for metal louvers contained in AMCA 501 apply to this Section unless otherwise defined in this Section or in referenced standards.

B. Horizontal Louver: Louver with horizontal blades (i.e., the axes of the blades are horizontal).

C. Drainable-Blade Louver: Louver with blades having gutters that collect water and drain it to channels in jambs and mullions, which carry it to bottom of unit and away from opening.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

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

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

1. Show mullion profiles and locations.

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

1.5 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of openings by field measurements before fabrication.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain louvers from single source from a single manufacturer where indicated to be of same type, design, or factory-applied color finish.

2.2 FIXED, FORMED-METAL LOUVERS

A. Horizontal, Drainable-Blade Louver:

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Airolite Company, LLC (The).
   b. Construction Specialties, Inc.
   c. Greenheck Fan Corporation.
   d. Ruskin Company.

2. Louver Depth: 4 inches.
3. Frame and Blade Material and Nominal Thickness: Galvanized-steel sheet, not less than 0.052 inch for frames and 0.040 inch for blades.
4. Mullion Type: Exposed.
5. Louver Performance Ratings:
   a. Free Area: Not less than 7.0 sq. ft. for 48-inch-wide by 48-inch-high louver.
   b. Air Performance: Not more than 0.15-inch wg static pressure drop at 950-fpm free-area velocity.

2.3 MATERIALS

A. Galvanized-Steel Sheet: ASTM A 653/A 653M, G60 zinc coating, mill phosphatized.

B. Fasteners: Use types and sizes to suit unit installation conditions.
   1. Use Phillips flat-head screws for exposed fasteners unless otherwise indicated.
   2. For fastening galvanized steel, use hot-dip-galvanized steel or 300 series stainless-steel fasteners.
   3. For color-finished louvers, use fasteners with heads that match color of louvers.

C. Postinstalled Fasteners for Concrete and Masonry: Torque-controlled expansion anchors, made from stainless-steel components, with capability to sustain, without failure, a load equal to 4 times the loads imposed, for concrete, or 6 times the load imposed for masonry, as determined by testing according to ASTM E 488, conducted by a qualified independent testing agency.

D. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.4 FABRICATION

A. Factory assemble louvers to minimize field splicing and assembly. Disassemble units as necessary for shipping and handling limitations. Clearly mark units for reassembly and coordinated installation.
B. Maintain equal louver blade spacing, including separation between blades and frames at head and sill, to produce uniform appearance.

C. Fabricate frames, including integral sills, to fit in openings of sizes indicated, with allowances made for fabrication and installation tolerances, adjoining material tolerances, and perimeter sealant joints.

1. Frame Type: Channel unless otherwise indicated.

D. Include supports, anchorages, and accessories required for complete assembly.

E. Provide vertical mullions of type and at spacings indicated, but not more than is recommended by manufacturer, or 72 inches o.c., whichever is less.

1. Exterior Corners: Prefabricated corner units with mitered and welded blades and with fully recessed mullions at corners.

F. Join frame members to each other and to fixed louver blades with fillet welds, threaded fasteners, or both, as standard with louver manufacturer unless otherwise indicated or size of louver assembly makes bolted connections between frame members necessary.

2.5 GALVANIZED-STEEL SHEET FINISHES

A. Finish louvers after assembly.

B. Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating compatible with the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas and repair according to ASTM A 780.

C. Baked-Enamel or Powder-Coat Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry film thickness of 2 mils.

1. Color and Gloss: As selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and openings, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 PREPARATION

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

A. Locate and place louvers level, plumb, and at indicated alignment with adjacent work.

B. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

C. Form closely fitted joints with exposed connections accurately located and secured.

D. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

E. Protect unpainted galvanized and nonferrous-metal surfaces that are in contact with concrete, masonry, or dissimilar metals from corrosion and galvanic action by applying a heavy coating of bituminous paint or by separating surfaces with waterproof gaskets or nonmetallic flashing.

F. Install concealed gaskets, flashings, joint fillers, and insulation as louver installation progresses, where weathertight louver joints are required. Comply with Section 07 9200 "Joint Sealants" for sealants applied during louver installation.

3.4 ADJUSTING AND CLEANING

A. Clean exposed louver surfaces that are not protected by temporary covering, to remove fingerprints and soil during construction period. Do not let soil accumulate during construction period.

B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

C. Restore louvers damaged during installation and construction so no evidence remains of corrective work. If results of restoration are unsuccessful, as determined by Architect, remove damaged units and replace with new units.

1. Touch up minor abrasions in finishes with air-dried coating that matches color and gloss of, and is compatible with, factory-applied finish coating.

END OF SECTION 08 9119
SECTION 09 2216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior gypsum board assemblies.
2. Suspension systems for interior gypsum ceilings, soffits, and grid systems.

B. Related Requirements:

1. Section 05 4000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; roof rafters and ceiling joists; and roof trusses.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

A. Framing Members, General: Comply with ASTM C 754 for conditions indicated.

1. Steel Sheet Components: Comply with ASTM C 645 requirements for metal unless otherwise indicated.

B. Studs and Runners: ASTM C 645.

1. Steel Studs and Runners:

   a. Minimum Base-Metal Thickness: 0.033 inch.
   b. Depth: As indicated on Drawings.

C. Slip-Type Head Joints: Where indicated, provide one of the following:

1. Single Long-Leg Runner System: ASTM C 645 top runner with 2-inch-deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top runner and with continuous bridging located within 12 inches of the top of studs to provide lateral bracing.
2. Double-Runner System: ASTM C 645 top runners, inside runner with 2-inch-deep flanges in thickness not less than indicated for studs and fastened to studs, and outer runner sized to friction fit inside runner.

3. Deflection Track: Steel sheet top runner manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.

D. Partial wall framing to floor: Equal to Clark Dietrich Pony Wall Framing Supports.

E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
   1. Minimum Base-Metal Thickness: 0.033 inch.

F. Cold-Rolled Channel Bridging: Steel, 0.053-inch minimum base-metal thickness, with minimum 1/2-inch-wide flanges.
   1. Depth: As indicated on Drawings.
   2. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch-thick, galvanized steel.

   1. Minimum Base-Metal Thickness: 0.033 inch.
   2. Depth: As indicated on Drawings.

H. Cold-Rolled Furring Channels: 0.053-inch uncoated-steel thickness, with minimum 1/2-inch-wide flanges.
   1. Depth: As indicated on Drawings.
   2. Furring Brackets: Adjustable, corrugated-edge type of steel sheet with minimum uncoated-steel thickness of 0.033 inch.
   3. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

I. Z-Shaped Furring: With slotted or nonslotted web, face flange of 1-1/4 inches, wall attachment flange of 7/8 inch, minimum uncoated-metal thickness of 0.018 inch, and depth required to fit insulation thickness indicated.

2.2 SUSPENSION SYSTEMS

A. Tie Wire: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.062-inch-diameter wire, or double strand of 0.048-inch-diameter wire.

B. Wire Hangers: ASTM A 641/A 641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

C. Flat Hangers: Steel sheet, 1 by 3/16 inch by length indicated.

D. Carrying Channels: Cold-rolled, commercial-steel sheet with a base-metal thickness of 0.053 inch and minimum 1/2-inch-wide flanges.
   1. Depth: 1-1/2 inches.

E. Grid Suspension System for Gypsum Board Ceilings: ASTM C 645, direct-hung system composed of main beams and cross-furring members that interlock.
   1. Products: Subject to compliance with requirements, provide one of the following:
2.3 AUXILIARY MATERIALS

A. General: Provide auxiliary materials that comply with referenced installation standards.

1. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

B. Isolation Strip at Exterior Walls: Provide one of the following:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), nonperforated.
2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.

1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 INSTALLATION, GENERAL

A. Installation Standard: ASTM C 754.

1. Gypsum Board Assemblies: Also comply with requirements in ASTM C 840 that apply to framing installation.

B. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.

C. Install bracing at terminations in assemblies.

D. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.
3.4 INSTALLING FRAMED ASSEMBLIES

A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Single-Layer Application: 16 inches o.c. unless otherwise indicated.
2. Multilayer Application: 16 inches o.c. unless otherwise indicated.
3. Tile Backing Panels: 16 inches o.c. unless otherwise indicated.

B. Install studs so flanges within framing system point in same direction.

C. Install tracks (runners) at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts penetrating partitions above ceiling.

1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install runner track section (for cripple studs) at head and secure to jamb studs.
   a. Install two studs at each jamb unless otherwise indicated.
   b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
   c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.

3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.

4. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

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.

3.5 INSTALLING SUSPENSION SYSTEMS

A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.

1. Hangers: 48 inches o.c.
2. Carrying Channels (Main Runners): 48 inches o.c.

B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.

C. Suspend hangers from building structure as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
   a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

   a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.

3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.

4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.

5. Do not attach hangers to steel roof deck.

6. Do not connect or suspend steel framing from ducts, pipes, or conduit.

D. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.

E. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 09 2216
SECTION 09 2900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Interior gypsum board.
   2. Tile backing panels.

B. Related Requirements:
   1. Section 06 1600 "Sheathing" for gypsum sheathing for exterior walls.
   2. Section 09 2216 "Non-Structural Metal Framing" for non-structural framing and suspension systems that support gypsum board panels.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 DELIVERY, STORAGE AND HANDLING

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

1.5 FIELD CONDITIONS

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

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

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

2.1 PERFORMANCE REQUIREMENTS

A. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.3 INTERIOR GYPSUM BOARD

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

1. CertainTeed Corporation; ProRoc Type X.
2. Georgia-Pacific Gypsum LLC.
4. Temple-Inland Building Products by Georgia-Pacific; Type X Gypsum Board Fire-resistant panels.
5. USG Corporation.

B. Gypsum Board, Type X: ASTM C 1396/C 1396M.

1. Thickness: 5/8 inch.
2. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

C. Gypsum Ceiling Board: ASTM C 1396/C 1396M.

1. Thickness: 1/2 inch.
2. Long Edges: Tapered.

2.4 SPECIALTY GYPSUM BOARD

A. Glass-Mat Interior Gypsum Board: ASTM C 1658/C 1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.

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

   a. Continental Building Products, LLC; Weather Defense Platinum Interior Type X.
   b. Georgia-Pacific Gypsum LLC; DensArmour Plus.
   c. National Gypsum Company; Gold Bond® eXP® Interior Extreme® Gypsum Panel.
   d. Temple-Inland Building Products by Georgia-Pacific; Green Glass Interior Gypsum Board.

2. Core: 5/8 inch, Type X.
4. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
2.5 TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Board: ASTM C 1178/C 1178M, with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. CertainTeed Corporation; GlasRoc Tile Backer.
   b. Georgia-Pacific Gypsum LLC; DensShield Tile Backer.
   c. National Gypsum Company; Gold Bond® eXP® Tile Backer.
   d. Temple-Inland Building Products by Georgia-Pacific; Green Glass Tilebacker.

2. Core: 5/8 inch, Type X.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

2.6 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:
   a. Cornerbead.
   b. LC-Bead: J-shaped; exposed long flange receives joint compound.
   c. L-Bead: L-shaped; exposed long flange receives joint compound.
   d. Expansion (control) joint.

B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Fry Reglet Corporation.
   b. Gordon, Inc.
   c. Pittcon Industries.

2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221, Alloy 6063-T5.

2.7 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475/C 475M.

B. Joint Tape:

1. Interior Gypsum Board: Paper.
2. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
3. Tile Backing Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Board: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
   a. Use setting-type compound for installing paper-faced metal trim accessories.
3. Fill Coat: For second coat, use setting-type, sandable topping compound.
4. Finish Coat: For third coat, use setting-type, sandable topping compound.
5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

2.8 AUXILIARY MATERIALS
A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.
B. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
   1. Use screws complying with ASTM C 954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
   2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
C. Sound Attenuation Blankets: ASTM C 665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
D. Acoustical Joint Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine areas and substrates including welded hollow-metal frames and framing, with Installer present, for compliance with requirements and other conditions affecting performance.
B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL
A. Comply with ASTM C 840.
B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch of open space between panels. Do not force into place.

D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.

E. Form control and expansion joints with space between edges of adjoining gypsum panels.

F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
   1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. in area.
   2. Fit gypsum panels around ducts, pipes, and conduits.
   3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow 1/4- to 3/8-inch-wide joints to install sealant.

G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch-wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

H. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C 919 and with manufacturer's written recommendations for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.

I. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

### 3.3 APPLYING INTERIOR GYPSUM BOARD

A. Install interior gypsum board in the following locations:
   1. Type X: Vertical surfaces unless otherwise indicated.
   2. Ceiling Type: Ceiling surfaces.
   3. Glass-Mat Interior Type: All exterior walls and wet walls which do not have tile backer..

B. Single-Layer Application:
   1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
   2. On partitions/walls, apply gypsum panels horizontally (perpendicular to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
      a. Stagger abutting end joints not less than one framing member in alternate courses of panels.
      b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
   3. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
3.4 APPLYING TILE BACKING PANELS

A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at locations indicated to receive tile. Install with 1/4-inch gap where panels abut other construction or penetrations.

B. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.5 INSTALLING TRIM ACCESSORIES

A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Interior Trim: Install in the following locations:
   1. Cornerbead: Use at outside corners unless otherwise indicated.
   2. LC-Bead: Use at exposed panel edges.
   3. L-Bead: Use where required.

C. Aluminum Trim: Install in locations indicated on Drawings.

3.6 FINISHING GYPSUM BOARD

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C 840:
   1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
   2. Level 2: Panels that are substrate for tile.
   3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
      a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."
   4. Level 5: where walls are taller than 10'-0" tall (Lobby).
      a. Primer and its application to surfaces are specified in Section 09 9123 "Interior Painting."

3.7 PROTECTION

A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.

C. Remove and replace panels that are wet, moisture damaged, and mold damaged.

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

END OF SECTION 09 2900
SECTION 09 3013 - CERAMIC TILING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Porcelain tile.
2. Waterproof membrane.
3. Crack isolation membrane.
4. Metal edge strips.

B. Related Requirements:

1. Section 07 9200 "Joint Sealants" for sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Section 09 2900 "Gypsum Board" for cementitious backer units.
3. Section 09 3023 "Glass Tiling."

1.3 DEFINITIONS

A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.1 apply to Work of this Section unless otherwise specified.


C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review requirements in ANSI A108.01 for substrates and for preparation by other trades.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.
B. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required.
   2. Full-size units of each type of trim and accessory for each color and finish required.
   3. Metal edge strips in 6-inch lengths.

1.6 MAINTENANCE MATERIAL SUBMITTALS
A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
   2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.7 DELIVERY, STORAGE, AND HANDLING
A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.1 for labeling tile packages.
B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
C. Store aggregates where grading and other required characteristics can be maintained, and contamination can be avoided.
D. Store liquid materials in unopened containers and protected from freezing.

1.8 FIELD CONDITIONS
A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Source Limitations for Tile: Obtain tile of each type and color or finish from single source or producer.
   1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
   1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
2. Obtain waterproof membrane and crack isolation membrane, except for sheet products, from manufacturer of setting and grouting materials.

C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:

1. Waterproof membrane.
2. Crack isolation membrane.
3. Metal edge strips.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

2.3 TILE PRODUCTS

A. Ceramic Tile Type: Unglazed porcelain tile. (WT-1)

1. **Basis-of-Design Product:** Subject to compliance with requirements, provide As listed in Appendix A in Specifications or comparable product by one of the following:
   
   a. American Olean
   b. Daltile
   c. Crossville

2. Certification: Tile certified by the Porcelain Tile Certification Agency.

3. Face Size: 12”x24”.


5. Tile Color, Glaze, and Pattern: As listed in Appendix A in Specifications.


2.4 WATERPROOF MEMBRANE

A. General: Manufacturer’s standard product that complies with ANSI A118.10 and is recommended by the manufacturer for the application indicated. Include reinforcement and accessories recommended by manufacturer.

B. Fluid-Applied Membrane: Liquid-latex rubber or elastomeric polymer.

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

   b. MAPEI Corporation; Mapelastic AquaDefense.
   c. TEC, H.B. Buller Construction Products Inc.: HydraFlex - Waterproofing Crack Isolation Membrane
2.5 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4.
   1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
   2. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

B. Medium-Bed, Latex-Portland Cement Mortar: Comply with requirements in ANSI A118.4. Provide product that is approved by manufacturer for application thickness of 5/8 inch.
   1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
   2. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.

2.6 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.
   1. Basis-of-Design: Subject to compliance with requirements, provide products by the following: As Listed in Appendix A 'Interior Finish Legend' or comparable product by one of the following:
      a. TEC
      b. Bostik
      c. Mapai
   2. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

2.7 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Vapor-Retarder Membrane: Polyethylene sheeting, ASTM D 4397, 4.0 mils thick.

C. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness, metallic or combination of metal and PVC or neoprene base, designed specifically for flooring applications; nickel silver exposed-edge material.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. As Listed in Appendix A "Interior Finish Legend" in Specifications

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.
2.8 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that concrete substrates for tile floors installed with bonded mortar bed comply with surface finish requirements in ANSI A108.01 for installations indicated.
   a. Verify that surfaces that received a steel trowel finish have been mechanically scarified.
   b. Verify that protrusions, bumps, and ridges have been removed by sanding or grinding.

3. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.

4. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

3.2 PREPARATION

A. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 CERAMIC TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
1. For the following installations, follow procedures in the ANSI A108 series of tile installation standards for providing 95 percent mortar coverage:
   a. Tile floors in wet areas.
   b. Tile floors consisting of tiles 8 by 8 inches or larger.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.

E. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

F. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
   1. Where adjoining tiles on floor, base, walls, or trim are specified or indicated to be same size, align joints.
   2. Where tiles are specified or indicated to be whole integer multiples of adjoining tiles on floor, base, walls, or trim, align joints unless otherwise indicated.

G. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
   1. Mosaic Tile* 1/16 inch

H. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

I. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
   1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.

J. Metal Edge Strips: Install at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove and replace tile that is damaged or that does not match adjoining tile. Provide new matching units, installed as specified and in a manner to eliminate evidence of replacement.

B. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
   1. Remove grout residue from tile as soon as possible.
   2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners
recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.

3.5 PROTECTION

A. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls and floors.

B. Prohibit foot and wheel traffic from tiled floors for at least seven days after grouting is completed.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.

3.6 INTERIOR CERAMIC TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Ceramic Tile Installation WT-1: TCNA W243 thinset mortar on gypsum board.
   a. Ceramic Tile Type: As listed in Appendix A ‘Interior Finish Legend’ in Specifications.

END OF SECTION 09 3013
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SECTION 09 3023 - GLASS TILING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Glass tile.

1.3 DEFINITIONS
A. General: Definitions in the ANSI A108 series of tile installation standards and in ANSI A137.2 apply to Work of this Section unless otherwise specified.


C. Module Size: Actual tile size plus joint width indicated.

D. Face Size: Actual tile size, excluding spacer lugs.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product.

B. Samples for Verification:
   1. Full-size units of each type and composition of tile and for each color and finish required. For glass mosaic tile in color blend patterns, provide full sheets of each color blend.
   2. Assembled samples mounted on a rigid panel, with grouted joints, for each type and composition of tile and for each color and finish required. Make samples at least 12 inchessquare, but not fewer than four tiles. Use grout of type and in color or colors approved for completed Work.

1.5 MAINTENANCE MATERIAL SUBMITTALS
A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering for storage and identified with labels describing contents.
1. Tile Units: Furnish quantity of full-size units equal to 3 percent of amount installed for each type, composition, color, pattern, and size indicated.
2. Grout: Furnish quantity of grout equal to 3 percent of amount installed for each type, composition, and color indicated.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirements in ANSI A137.2 for labeling tile packages.
B. Store tile and cementitious materials on elevated platforms, under cover, and in a dry location.
C. Store aggregates where grading and other required characteristics can be maintained and contamination can be avoided.
D. Store liquid materials in unopened containers and protected from freezing.

1.7 FIELD CONDITIONS
A. Environmental Limitations: Do not install tile until construction in spaces is complete and ambient temperature and humidity conditions are maintained at the levels indicated in referenced standards and manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. Source Limitations for Tile: Obtain tile of each type from single source or producer.
   1. Obtain tile of each type and color or finish from same production run and of consistent quality in appearance and physical properties for each contiguous area.
B. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from single manufacturer and each aggregate from single source or producer.
   1. Obtain setting and grouting materials, except for unmodified Portland cement and aggregate, from single manufacturer.
   2. Obtain waterproof membrane, except for sheet products, from manufacturer of setting and grouting materials.
C. Source Limitations for Other Products: Obtain each of the following products specified in this Section from a single manufacturer:
   1. Joint sealants.

2.2 PRODUCTS, GENERAL
A. ANSI Glass Tile Standard: Provide glass tile that complies with ANSI A137.2 for types and other characteristics indicated.
   1. Provide tile complying with Standard grade requirements.
B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI A108.02, ANSI standards referenced in other Part 2 articles, ANSI standards referenced by TCNA installation methods specified in tile installation schedules, and other requirements specified.

C. Factory Blending: For tile exhibiting color variations within ranges, blend tile in factory and package so tile units taken from one package show same range in colors as those taken from other packages and match approved Samples.

D. Mounting: For factory-mounted tile, provide back- or edge-mounted tile assemblies as standard with manufacturer unless otherwise indicated.
   1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for installation indicated and has a record of successful in-service performance.

2.3 TILE PRODUCTS

A. Glass Tile Type WT-2: Factory-mounted mosaic glass tile, cast.
   1. Basis-of-Design Product: Subject to compliance with requirements, provide As listed in Appendix A 'Interior Finish Legend' in Specifications or comparable product by one of the following:
      a. Daltile
      b. American Olean
      c. Crossville
   3. Tile Color and Pattern: As listed in Appendix A in Specifications.

2.4 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thinset): ANSI A118.4; white, unless otherwise indicated.
   1. Provide prepackaged, dry-mortar mix containing dry, redispersible, vinyl acetate or acrylic additive to which only water must be added at Project site.
   2. Provide prepackaged, dry-mortar mix combined with acrylic resin or styrene-butadiene-rubber liquid-latex additive at Project site.
   3. For wall applications, provide mortar that complies with requirements for nonsagging mortar in addition to the other requirements in ANSI A118.4.

2.5 GROUT MATERIALS

A. High-Performance Tile Grout: ANSI A118.7.
   1. Polymer Type: Ethylene vinyl acetate or acrylic additive, in dry, redispersible form, prepackaged with other dry ingredients.

2.6 MISCELLANEOUS MATERIALS

A. Metal Edge Strips: Angle or L-shaped, height to match tile and setting-bed thickness; stainless-steel, ASTM A 666, 300 Series exposed-edge material.
1. Manufacturers: Subject to compliance with requirements,
   a. Blanke Corporation
   b. Ceramic Tool Company Inc
   c. Schluter Systems L.P.

B. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

2.7 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

1. Verify that substrates for setting tile are firm; dry; clean; free of coatings that are incompatible with tile-setting materials, including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed.

3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust joint locations in consultation with Architect.

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

3.2 PREPARATION

A. Blending: For tile exhibiting color variations, verify that tile has been factory blended and packaged so tile units taken from one package show same range of colors as those taken from other packages and match approved Samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

3.3 GLASS TILE INSTALLATION

A. Comply with TCNA's "Handbook for Ceramic, Glass, and Stone Tile Installation" for TCNA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 series "Specifications for Installation of Ceramic Tile" that are referenced in TCNA installation
methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.

B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

D. Where accent tile differs in thickness from field tile, vary setting-bed thickness so that tiles are flush.

E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets same width as joints within tile sheets so joints between sheets are not apparent in finished work.

F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:


G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.

H. Metal Edge Strips: Install at locations indicated.

3.4 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all tile surfaces so they are free of foreign matter.

1. Remove grout residue from tile as soon as possible.
2. Clean grout smears and haze from tile according to tile and grout manufacturer's written instructions but no sooner than 10 days after installation. Use only cleaners recommended by tile and grout manufacturers and only after determining that cleaners are safe to use by testing on samples of tile and other surfaces to be cleaned. Protect metal surfaces and plumbing fixtures from effects of cleaning. Flush surfaces with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer and that is acceptable to tile and grout manufacturer. Trap and remove coating to prevent drain clogging.

B. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear. If recommended by tile manufacturer, apply coat of neutral protective cleaner to completed tile walls.

C. Before final inspection, remove protective coverings and rinse neutral protective cleaner from tile surfaces.
3.5 INTERIOR GLASS TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Wood or Metal Studs or Furring:

1. Glass Tile Installation WT-2: TCNA W244C or TCNA W244F; thinset mortar on cementitious backer units or fiber-cement backer board.

   a. Glass Tile Type: As listed in Appendix A 'Interior Finish Legend' in Specifications.

END OF SECTION 09 3023
SECTION 09 5113 - ACOUSTICAL PANEL CEILINGS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes acoustical panels and exposed suspension systems for ceilings.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS
A. Maintenance Data: For finishes to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS
A. Furnish extra materials that match products installed and that are packaged with protective
   covering for storage and identified with labels describing contents.
   1. Acoustical Ceiling Panels: Full-size panels equal to 2 percent of quantity installed.
   2. Suspension-System Components: Quantity of each exposed component equal to 2
      percent of quantity installed.
   3. Hold-Down Clips: Equal to 2 percent of quantity installed.
   4. Impact Clips: Equal to 2 percent of quantity installed.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Deliver acoustical panels, suspension-system components, and accessories to Project site in
   original, unopened packages and store them in a fully enclosed, conditioned space where they
   will be protected against damage from moisture, humidity, temperature extremes, direct
   sunlight, surface contamination, and other causes.
B. Before installing acoustical panels, permit them to reach room temperature and a stabilized
   moisture content.
C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.7 FIELD CONDITIONS
A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and
   weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and
ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Seismic Performance: Acoustical ceiling shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

   1. Flame-Spread Index: Comply with ASTM E 1264 for Class A materials.
   2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL PANELS, GENERAL

A. Source Limitations:

   1. Acoustical Ceiling Panel: Obtain each type from single source from single manufacturer.
   2. Suspension System: Obtain each type from single source from single manufacturer.

B. Source Limitations: Obtain each type of acoustical ceiling panel and supporting suspension system from single source from single manufacturer.

C. Glass-Fiber-Based Panels: Made with binder containing no urea formaldehyde.

D. Acoustical Panel Standard: Provide manufacturer’s standard panels of configuration indicated that comply with ASTM E 1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.

   1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches away from test surface according to ASTM E 795.

2.3 ACOUSTICAL PANELS: AC-1, AC-2

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

   1. Refer to Appendix A "Interior Finish Key" for type and manufacturer.

a. Armstrong Ceilings
b. USG Ceilings
c. Rokfon

B. Color: Match Architect’s sample.

C. Edge/Joint Detail: Reveal sized to fit flange of exposed suspension-system members.

D. Thickness: As indicated in a schedule.
E. Modular Size: As indicated in a schedule.

F. Broad Spectrum Antimicrobial Fungicide and Bactericide Treatment: Provide acoustical panels treated with manufacturer's standard antimicrobial formulation that inhibits fungus, mold, mildew, and gram-positive and gram-negative bacteria and showing no mold, mildew, or bacterial growth when tested according to ASTM D 3273 and evaluated according to ASTM D 3274 or ASTM G 21.

2.4 METAL SUSPENSION SYSTEMS, GENERAL

A. Metal Suspension-System Standard: Provide manufacturer's standard direct-hung metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable requirements in ASTM C 635/C 635M.

1. High-Humidity Finish: Comply with ASTM C 635/C 635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

B. Attachment Devices: Size for five times the design load indicated in ASTM C 635/C 635M, Table 1, "Direct Hung," unless otherwise indicated. Comply with seismic design requirements.

C. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:

2. Size: Select wire diameter so its stress at three times hanger design load (ASTM C 635/C 635M, Table 1, "Direct Hung") will be less than yield stress of wire, but provide not less than 0.135-inch-diameter wire.

D. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.

E. Angle Hangers: Angles with legs not less than 7/8 inch wide; formed with 0.04-inch-thick, galvanized-steel sheet complying with ASTM A 653/A 653M, G90 coating designation; with bolted connections and 5/16-inch-diameter bolts.

F. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.

G. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.

H. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical panels in place.

I. Hold-Down Clips: Where indicated, provide manufacturer's standard hold-down clips spaced 24 inches o.c. on all cross tees.

J. Impact Clips: Where indicated, provide manufacturer's standard impact-clip system designed to absorb impact forces against acoustical panels.

2.5 METAL SUSPENSION SYSTEM

A. Narrow-Face, Capped, Double-Web, Steel Suspension System: Main and cross runners roll formed from cold-rolled steel sheet; prepainted, electrostatically zinc coated, or hot-dip galvanized according to ASTM A 653/A 653M, not less than G30 coating designation; with prefinished 9/16-inch-wide metal caps on flanges.
2. End Condition of Cross Runners: Override (stepped) type.
3. Face Design: Flat, flush.
5. Cap Finish: Painted to match color of acoustical unit.

2.6 METAL EDGE MOLDINGS AND TRIM

A. Roll-Formed, Sheet-Metal Edge Moldings and Trim: Type and profile indicated or, if not indicated, manufacturer's standard moldings for edges and penetrations that comply with seismic design requirements; formed from sheet metal of same material, finish, and color as that used for exposed flanges of suspension-system runners.

1. Provide manufacturer's standard edge moldings that fit acoustical panel edge details and suspension systems indicated and that match width and configuration of exposed runners unless otherwise indicated.

2.7 ACOUSTICAL SEALANT

A. Acoustical Sealant: Manufacturer's standard sealant complying with ASTM C 834 and effective in reducing airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.


PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

B. Examine acoustical panels before installation. Reject acoustical panels that are wet, moisture damaged, or mold damaged.

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

3.2 PREPARATION

A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.
3.3 INSTALLATION

A. General: Install acoustical panel ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

B. Suspend ceiling hangers from building's structural members and as follows:

1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.
2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
4. Secure wire hangers to ceiling-suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
5. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both the structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
6. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
7. Do not attach hangers to steel deck tabs.
8. Do not attach hangers to steel roof deck. Attach hangers to structural members.
9. Space hangers not more than 48 inches o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than 8 inches from ends of each member.
10. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.

C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.

D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.

1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
2. Screw attach moldings to substrate at intervals not more than 16 inches o.c. and not more than 3 inches from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet. Miter corners accurately and connect securely.
3. Do not use exposed fasteners, including pop rivets, on moldings and trim.

E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.

F. Install acoustical panels with undamaged edges and fit accurately into suspension-system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.

1. Arrange directionally patterned acoustical panels as follows:
a. As indicated on reflected ceiling plans.

2. For reveal-edged panels on suspension-system runners, install panels with bottom of reveal in firm contact with top surface of runner flanges.

3. Paint cut edges of panel remaining exposed after installation; match color of exposed panel surfaces using coating recommended in writing for this purpose by acoustical panel manufacturer.

4. Install hold-down clips in areas indicated, in areas required by authorities having jurisdiction, and for fire-resistance ratings; space as recommended by panel manufacturer’s written instructions unless otherwise indicated.

5. Install clean-room gasket system in areas indicated, sealing each panel and fixture as recommended by panel manufacturer’s written instructions.

3.4 CLEANING

A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension-system members. Comply with manufacturer’s written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

END OF SECTION 09 5113
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Work Included: Provide ARCHITECTURAL COMPONENTS GROUP, INC. Suspension System Series 7 SS7 ceiling where shown on architectural drawings, and as specified in this specification or approved equal.

1.2 QUALITY ASSURANCE

A. ARCHITECTURAL COMPONENTS GROUP Suspension System Series 7 ceiling products for this project shall maintain the quality as instituted by the architect or A.W.I.

B. Design Criteria: Manufacture of Suspension System SS7-4896-C shall be installed true and plumb to within manufacturing tolerance of 1/8" within 8' of length.

C. Product Construction: Wood shall be kiln dried to 10%. Cracking, checking and warpage of members will not be acceptable.

1.3 SUBMITTALS

A. Technical Data: Submit manufacturer’s data and installation instructions.

B. Shop Drawings: Submit shop drawings showing all areas involved, attachment conditions and perimeter circumstances.

C. Submittal Samples: Submit 1 product sample for approval by architect.

1.4 DELIVERY, STORAGE AND HANDLING

A. Material must be stored and installed only in secured ambient environment (humidity min. 25% - max. 55%, temperature not to exceed 86 deg.)

B. Windows, Doors and all wet-work must be completed before un-packaging and installation. Handle carefully to avoid damaging.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURER

A. ARCHITECTURAL COMPONENTS GROUP, INC., 521 George Street, Marshfield, MO 65706 Phone (417) 869-6777 Fax (417) 869-7888

B. Other manufacturer’s will be considered including the following:

1. Rulon International; flat veneer panels

2. USG, Inc.; wood ceilings
2.2 PRODUCT TYPE

A. Product: Suspension System Series 7 wood ceiling shall be product: SS7-4896-C

Nomenclature for SS7-4896-C:
SS7 = Suspension System Series 7
4896 = a panel 48" x 96"
C = 3/4" thick substrate

B. Size: Suspension System Series 7 Flat Panels shall be provided in a panel size of: 48" x 96" and 3/4" thick.

C. System shall consist of plastic laminate veneer.

D. Perforations: Panels shall have perforations. If perforations, then 0.5526 mm holes 2 mm O.C. with perforation pattern offset.

E. Fixture areas: Fixture cut-outs will be field cut.

F. Fire Rating: Wood panels shall achieve a Class III(C) fire rating.

G. Finish: Plastic Laminate to match architect sample.

H. Panels shall have vertical perimeter trim 2" high as per architectural drawings.

I. Panel edges shall be edge-banded as required. Panels shall be spaced 3/8" apart from the adjoining panel with an optional neoprene gasket field-applied supplied by ACGI.

J. Suspension System: Suspension System Series 7 wood ceiling shall be suspended according to manufacturer’s suggested method of suspension as per the design details provided in the plans. Panels suspend from contractor supplied and installed grid using ACGI Supplied torsion springs and saddle grid clips or ACGI supplied aluminum grid and hardware.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Suspension System wood ceiling shall be handled and installed with care in order to prevent surface and structure damage. Field cutting shall be kept to a minimum and performed as recommended by manufacturer.

B. The contractor shall follow the manufacturer’s installation instructions as provided by ACGI.

PART 4 - WARRANTY

4.1 PRODUCT WARRANTY

A. Architectural Components Group, Inc. shall warranty the Suspension System Series 7 wood ceiling against manufacturer's defects up to one year. Changes in finish or dimensions due to ultraviolet light, excessive temperature or humidity conditions [see 1.4.A above] and/or abuse of any kind shall void any warranties from ACGI.
B. Install conditions for the area should remain for the proper occupied conditions of humidity and temperature (humidity min. 25% - max. 55%, temperature not to exceed 86 degrees).

C. The contractor shall warranty for one year all work from final acceptance of completed work.

END OF SECTION 07 7100
PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Resilient base.
   2. Resilient molding accessories.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Samples: For each exposed product and for each color and texture specified, not less than 12 inches long.
C. Samples for Verification: For each type of product indicated and for each color, texture, and pattern required in manufacturer's standard-size Samples, but not less than 12 inches long.
D. Product Schedule: For resilient base and accessory products. Use same designations indicated on Drawings.

1.4 MAINTENANCE MATERIAL SUBMITTALS
A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Furnish not less than 10 linear feet for every 500 linear feet or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 QUALITY ASSURANCE
A. Mockups: Build mockups to verify selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
   1. Coordinate mockups in this Section with mockups specified in other Sections.

1.6 DELIVERY, STORAGE, AND HANDLING
A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.
1.7 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 THERMOPLASTIC-RUBBER BASE: RB-1

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Johnsonite
2. Roppe
3. Burke

B. Product Standard: ASTM F 1861, Type TP (rubber, thermoplastic).

2. Style and Location:
   a. Style A, Straight: As listed in Appendix A in Specifications.

C. Thickness: 0.125 inch.

D. Height: As listed in Appendix A in Specifications.

E. Lengths: Coils in manufacturer’s standard length.

F. Outside Corners: Job formed.

G. Inside Corners: Job formed.

H. Colors: As listed in Appendix A in Specifications.

2.2 RUBBER MOLDING ACCESSORY: TR-

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Johnsonite
2. Roppe
3. Burke
B. Description: Rubber cap for cove resilient flooring reducer strip for resilient flooring joiner for tile and carpet transition strips.

C. Profile and Dimensions: As listed in Appendix A in Specifications.

D. Locations: As listed in Appendix A in Specifications.

E. Colors and Patterns: As listed in Appendix A in Specifications.

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient-product manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by resilient-product manufacturer for resilient products and substrate conditions indicated.

C. Metal Edge Strips: Extruded aluminum with mill finish of width shown, of height required to protect exposed edges of flooring, and in maximum available lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.

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

1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

C. Do not install resilient products until they are the same temperature as the space where they are to be installed.

1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.

D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.
3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base.

B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.

D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

E. Do not stretch resilient base during installation.

F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.

G. Job-Formed Corners:
   1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
      a. Form without producing discoloration (whitening) at bends.
   2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
      a. Cope corners to minimize open joints.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient accessories.

B. Resilient Molding Accessories: Butt to adjacent materials and tightly adhere to substrates throughout length of each piece. Install reducer strips at edges of floor covering that would otherwise be exposed.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.

B. Perform the following operations immediately after completing resilient-product installation:
   1. Remove adhesive and other blemishes from exposed surfaces.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 09 6513
SECTION 09 6516 - RESILIENT SHEET FLOORING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes vinyl sheet flooring.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Samples for Verification: In manufacturer's standard size, but not less than 6-by-9-inch sections of each different color and pattern of resilient sheet flooring required.
   1. For heat-welding bead, manufacturer's standard-size Samples, but not less than 9 inches long, of each color required.
C. Welded-Seam Samples: For seamless-installation technique indicated and for each resilient sheet flooring product, color, and pattern required; with seam running lengthwise and in center of 6-by-9-inch Sample applied to a rigid backing and prepared by Installer for this Project.
D. Product Schedule: For resilient sheet flooring. Use same designations indicated on Drawings.
E. As listed in Appendix A in Specifications

1.4 CLOSEOUT SUBMITTALS
A. Maintenance Data: For each type of resilient sheet flooring to include in maintenance manuals.

1.5 DELIVERY, STORAGE, AND HANDLING
A. Store resilient sheet flooring and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F. Store rolls upright.

1.6 FIELD CONDITIONS
A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 85 deg F, in spaces to receive resilient sheet flooring during the following time periods:
   1. 48 hours before installation.
   2. During installation.
3. 48 hours after installation.

B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.

C. Close spaces to traffic during resilient sheet flooring installation.

D. Close spaces to traffic for 48 hours after resilient sheet flooring installation.

E. Install resilient sheet flooring after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For resilient sheet flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 VINYL SHEET FLOORING WITH BACKING: SV-1, SV-2, SV-3

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

1. As listed in Appendix A 'Interior Finish Legend' in Specifications
   a. Teknoflor (SV-1)
   b. Mannington (SV-2 and SV-3)
   c. Johnsonite


1. Type (Binder Content): Type I, minimum binder content of 90 percent.
2. Wear-Layer Thickness: Grade 1.
3. Overall Thickness: As standard with manufacturer.

C. Wearing Surface: Smooth.

D. Sheet Width: 6 feet.


F. Colors and Patterns: As listed in Appendix A 'Interior Finish Legend' in Specifications

2.3 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by resilient sheet flooring manufacturer for applications indicated.
B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit resilient sheet flooring and substrate conditions indicated.

C. Seamless-Installation Accessories:
      a. Color: As listed in Appendix A ‘Interior Finish Legend’ in Specifications
   2. Chemical-Bonding Compound: Manufacturer's product for chemically bonding seams.
      a. Bonding compound shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

D. Integral-Flash-Cove-Base Accessories: (SVB-1)
   1. Cove Strip: 1-inch radius provided or approved by resilient sheet flooring manufacturer.
   2. Cap Strip: Tapered vinyl or metal cap provided or approved by resilient sheet flooring manufacturer.
   3. Corners: Metal inside and outside corners and end stops provided or approved by resilient sheet flooring manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
   1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient sheet flooring.

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

3.2 PREPARATION

A. Prepare substrates according to resilient sheet flooring manufacturer's written instructions to ensure adhesion of resilient sheet flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.
   1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
   2. Remove substrate coatings and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by resilient sheet flooring manufacturer. Do not use solvents.
   3. Alkalinity and Adhesion Testing: Perform tests recommended by resilient sheet flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
   4. Moisture Testing: Proceed with installation only after substrates pass testing according to resilient sheet flooring manufacturer's written recommendations, but not less stringent than the following:
a. Perform anhydrous calcium chloride test according to ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. in 24 hours.

b. Perform relative humidity test using in situ probes according to ASTM F 2170. Proceed with installation only after substrates have a maximum 75 percent relative humidity level.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient sheet flooring until it is the same temperature as the space where it is to be installed.

1. At least 48 hours in advance of installation, move flooring and installation materials into spaces where they will be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient sheet flooring.

3.3 RESILIENT SHEET FLOORING INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient sheet flooring.

B. Unroll resilient sheet flooring and allow it to stabilize before cutting and fitting.

C. Lay out resilient sheet flooring as follows:

1. Maintain uniformity of flooring direction.
2. Minimize number of seams; place seams in inconspicuous and low-traffic areas, at least 6 inches away from parallel joints in flooring substrates.
3. Match edges of flooring for color shading at seams.
4. Avoid cross seams.

D. Scribe and cut resilient sheet flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, and door frames.

E. Extend resilient sheet flooring into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on resilient sheet flooring as marked on substrates. Use chalk or other nonpermanent marking device.

G. Install resilient sheet flooring on covers for telephone and electrical ducts and similar items in installation areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.

H. Adhere resilient sheet flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Seamless Installation:

1. Heat-Welded Seams: Comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless flooring. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.

1. Install metal corners at inside and outside corners.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer’s written instructions for cleaning and protecting resilient sheet flooring.

B. Perform the following operations immediately after completing resilient sheet flooring installation:

1. Remove adhesive and other blemishes from surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient sheet flooring from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient sheet flooring until Substantial Completion.

END OF SECTION 09 6516
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SECTION 09 6813 - TILE CARPETING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes modular, Tip-Sheared Patterned Loop carpet tile.

B. Related Requirements:
   1. Section 02 4119 "Selective Demolition" for removing existing floor coverings.
   2. Section 09 6513 "Resilient Base and Accessories" for resilient wall base and accessories installed with carpet tile.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
   2. Include installation recommendations for each type of substrate.

B. Shop Drawings: Show the following:
   1. Carpet tile type, color, and dye lot.
   2. Pattern type, location, and direction.
   3. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.
   2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch-long Samples.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Sample Warranty: For special warranty.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet tiles to include in maintenance manuals. Include the following:
1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer’s recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

1.6 MAINTENANCE MATERIAL SUBMITTALS
A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
   1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd.

1.7 QUALITY ASSURANCE
A. Installer Qualifications: An experienced installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II certification level.
B. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Comply with CRI 104.

1.9 FIELD CONDITIONS
A. Comply with CRI 104 for temperature, humidity, and ventilation limitations.
B. Environmental Limitations: Do not deliver or install carpet tiles until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.
C. Do not install carpet tiles over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.
D. Where demountable partitions or other items are indicated for installation on top of carpet tiles, install carpet tiles before installing these items.

1.10 WARRANTY
A. Special Warranty for Carpet Tiles: Manufacturer agrees to repair or replace components of carpet tile installation that fail in materials or workmanship within specified warranty period.
   1. Warranty does not include deterioration or failure of carpet tile due to unusual traffic, failure of substrate, vandalism, or abuse.
   2. Failures include, but are not limited to, more than 10 percent edge raveling, snags, runs, loss of tuft bind strength, loss of face fiber, and delamination.
   3. Warranty Period: Limited Lifetime years from date of Substantial Completion.
PART 2 - PRODUCTS

2.1 CARPET TILE: CT-1, WCT-1

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

1. Mannington.
2. Mohawk
3. Tandus

B. Color: Refer to Appendix A "Interior Finish Key" in Specifications.

C. Pattern: Refer to Appendix A "Interior Finish Key" in Specifications.

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining, pressure-sensitive type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and is recommended by carpet tile manufacturer for releasable installation.

C. Metal Edge/Transition Strips: Extruded aluminum with Refer to Appendix A "Interior Finish Key" in Specifications for manufacturer, color and style finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Examine carpet tile for type, color, pattern, and potential defects.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F 710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests recommended by carpet tile manufacturer.
2. Subfloor finishes comply with requirements specified in Section 03 3000 "Cast-in-Place Concrete" for slabs receiving carpet tile.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

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

A. General: Comply with CRI 104, Section 6.2, “Site Conditions: Floor Preparation,” and with carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch wide or wider and protrusions more than 1/32 inch unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Clean metal substrates of grease, oil, soil and rust, and prime if directed by adhesive manufacturer. Rough sand painted metal surfaces and remove loose paint. Sand aluminum surfaces, to remove metal oxides, immediately before applying adhesive.

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile.

3.3 INSTALLATION

A. General: Comply with CRI 104, Section 14, "Carpet Modules," and with carpet tile manufacturer's written installation instructions.

B. Installation Method: Glue down; install every tile with full-spread, releasable, pressure-sensitive adhesive.

C. Maintain dye lot integrity. Do not mix dye lots in same area.

D. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

E. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

G. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.

B. Protect installed carpet tile to comply with CRI 104, Section 16, "Protecting Indoor Installations."
C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 6813
SECTION 09 7200 - WALL COVERINGS

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Vinyl wall covering.

1.3 ACTION SUBMITTALS
   A. Product Data: For each type of product.
      1. Include data on physical characteristics, durability, fade resistance, and fire-test-response characteristics.
   B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, seams and termination points.
   C. Samples for Initial Selection: For each type of wall covering.
   D. Samples for Verification: For each type of wall covering and for each color, pattern, texture, and finish specified, full width by 36-inch- long in size.
      1. Wall-Covering Sample: From same production run to be used for the Work, with specified treatments applied. Show complete pattern repeat.
   E. Product Schedule: For wall coverings. Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS
   A. Qualification Data: For testing agency.
   B. Product Test Reports: For each wall covering, for tests performed by a qualified testing agency.

1.5 CLOSEOUT SUBMITTALS
   A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.6 FIELD CONDITIONS
   A. Environmental Limitations: Do not deliver or install wall coverings until spaces are enclosed and weathertight, wet work in spaces is complete and dry, work above ceilings is complete, and
temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at levels intended for occupants after Project completion during the remainder of the construction period.

1. Wood-Veneer Wall Coverings: Condition spaces for not less than 48 hours before installation.

B. Lighting: Do not install wall covering until lighting that matches conditions intended for occupants after Project completion is provided on the surfaces to receive wall covering.

C. Ventilation: Provide continuous ventilation during installation and for not less than the time recommended by wall-covering manufacturer for full drying or curing.

PART 2 - PRODUCTS

2.1 VINYL WALL COVERING: WC-1, WC-2, WC-3

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

B. Basis-of-Design Product: Subject to compliance with requirements, provide As Listed in Appendix A ‘Interior Finish Legend’ in Specifications:

1. D. L. Couch; Wallcovering Source. (WC-2, WC-3)
2. MDC Wallcoverings.

C. Description: Provide mildew-resistant products in rolls from same production run and complying with the following:

1. FS CCC-W-408D and CFFA-W-101-D for Type II, Medium-Duty products.

D. Total Weight: 20 oz/lyd, excluding coatings.

E. Width: 54 inches.


G. Repeat: Random Reversible.

H. Colors, Textures, and Patterns: As selected by Architect from manufacturer’s full range.

1. As listed in Appendix A ‘Interior Finish Legend’ in Specifications

2.2 ACCESSORIES

A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application indicated and as recommended in writing by wall-covering manufacturer.
PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine substrates and conditions, with Installer present, for compliance with requirements for levelness, wall plumbness, maximum moisture content, and other conditions affecting performance of the Work.
B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION
A. Comply with manufacturer's written instructions for surface preparation.
B. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
C. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
   1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
   2. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.

3.3 WALL-COVERING INSTALLATION
A. Comply with wall-covering manufacturers' written installation instructions applicable to products and applications indicated.
B. Cut wall-covering strips in roll number sequence. Change the roll numbers at partition breaks and corners.
C. Install strips in same order as cut from roll.
   1. For solid-color, even-texture, or random-match wall coverings, reverse every other strip.
D. Install wall covering without lifted or curling edges and without visible shrinkage.
E. Match pattern 72 inches above the finish floor.
F. Install seams vertical and plumb at least 6 inches from outside corners and 6 inches from inside corners unless a change of pattern or color exists at corner. Horizontal seams are not permitted.
G. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without overlaps or gaps between strips.
H. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

3.4 CLEANING
A. Remove excess adhesive at seams, perimeter edges, and adjacent surfaces.
B. Use cleaning methods recommended in writing by wall-covering manufacturer.

C. Replace strips that cannot be cleaned.

D. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 09 7200
PART 1 - GENERAL

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

1.2 SUMMARY
A. Related Requirements:
   1. Section 05 5213 "Pipe and Tube Railings" for shop priming painting pipe and tube railings.

1.3 DEFINITIONS
A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.
B. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.
C. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.
D. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.
E. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.
F. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
   2. Indicate VOC content.
   3. Label each coat of each Sample with the IPS- # that coordinates with the Appendix B - Exterior Finish Key
B. Samples for Verification: For each type of paint system and each color and gloss of topcoat.
   1. Submit Samples on rigid backing, 8 inches square.
   2. Step coats on Samples to show each coat required for system.
   3. Label each coat of each Sample.
   4. Label each Sample for location and application area.
C. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

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

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

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS
A. **Basis-of-Design Product**: Subject to compliance with requirements, provide product indicated in Exterior Painting Schedule or comparable product by one of the following:
   1. Sherwin - Williams Company
   2. Benjamin Moore and Co
   3. PPG Architectural Finishes Inc
B. Products: Subject to compliance with requirements, provide product listed in the Exterior Painting Schedule for the paint category indicated.

2.2 PAINT, GENERAL
A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its “MPI Approved Products Lists.”
B. Material Compatibility:
   1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction.

D. Colors: As listed in Appendix B ‘Exterior Finish Legend’ in Specifications.

1. Ten percent of surface area will be painted with deep tones.

2.3 SOURCE QUALITY CONTROL

A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:

1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.

2. Testing agency will perform tests for compliance with product requirements.

3. Owner may direct Contractor to stop applying paints if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Concrete: 12 percent.
2. Fiber-Cement Board: 12 percent.
3. Masonry (Clay and CMUs): 12 percent.
5. Portland Cement Plaster: 12 percent.
6. Gypsum Board: 12 percent.

C. Portland Cement Plaster Substrates: Verify that plaster is fully cured.

D. Exterior Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

E. Verify suitability of substrates, including surface conditions and compatibility, with existing finishes and primers.

F. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.
3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:
   1. SSPC-SP 2.
   2. SSPC-SP 3.
   3. SSPC-SP 7/NACE No. 4.
   4. SSPC-SP 11.

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.

3.3 APPLICATION

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

   1. Use applicators and techniques suited for paint and substrate indicated.
   2. Paint surfaces behind movable items same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed items with prime coat only.
   3. Paint both sides and edges of exterior doors and entire exposed surface of exterior door frames.
   4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
   5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint undercoats same color as topcoat, but tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.
3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.

1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 EXTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System MPI EXT 3.1A:
   a. Prime Coat: Primer, alkali resistant, water based, MPI #3.
   d. Topcoat: Latex, exterior, semi-gloss (MPI Gloss Level 5), MPI #11.

B. Steel and Iron Substrates:

1. Alkyd System MPI EXT 5.1D:
   a. Prime Coat: Primer, alkyd, anticorrosive, for metal, MPI #79.
   b. Prime Coat: Shop primer specified in Section where substrate is specified.
   c. Prime Coat: Primer, metal, surface tolerant, MPI #23.
   e. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

C. Galvanized-Metal Substrates:

1. Alkyd System MPI EXT 5.3B:


c. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

D. Stainless-Steel Substrates:

1. Alkyd System MPI EXT 5.6A:

   a. Prime Coat: Vinyl wash primer, MPI #80.


   c. Topcoat: Alkyd, exterior, semi-gloss (MPI Gloss Level 5), MPI #94.

END OF SECTION 09 9113
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on interior substrates.
   1. Steel and iron.
   2. Gypsum board.

1.3 DEFINITIONS

A. MPI Gloss Level 1: Not more than five units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. MPI Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. MPI Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

D. MPI Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523.

E. MPI Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

F. MPI Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

G. MPI Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product. Include preparation requirements and application instructions.
   1. Include Printout of current "MPI Approved Products List" for each product category specified, with the proposed product highlighted.
   2. Indicate VOC content.

B. Samples for Initial Selection: For each type of topcoat product.

C. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
   1. Submit Samples on rigid backing, 8 inches square.
   2. Step coats on Samples to show each coat required for system.
3. Label each coat of each Sample with the IPS - # that coordinates with the Appendix A - Interior Finish Key
4. Label each Sample for location and application area.

D. Product List: Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules. Include color designations.

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. of each material and color applied.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F.

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F.

B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Products: Subject to compliance with requirements, provide products indicated in Interior Painting Schedule or comparable product by one of the following:

1. Sherwin-Williams Company
2. Benjamin Moore and Co.
3. PPG Architectural Finishes Inc.

2.2 PAINT, GENERAL

A. MPI Standards: Products shall comply with MPI standards indicated and shall be listed in its "MPI Approved Products Lists."

B. Material Compatibility:

1. Materials for use within each paint system shall be compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, products shall be recommended in writing by topcoat manufacturers for use in paint system and on substrate indicated.

C. Colors: As Listed in Appendix A 'Interior Finish Legend' in Specifications.

   1. Ten percent of surface area will be painted with deep tones.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

   1. Gypsum Board: 12 percent.

C. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.

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

E. Proceed with coating application only after unsatisfactory conditions have been corrected.

   1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates and paint systems indicated.

B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.

   1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.

C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

   1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.

D. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer but not less than the following:

   1. SSPC-SP 2.
   2. SSPC-SP 3.
   3. SSPC-SP 7/NACE No. 4.
   4. SSPC-SP 11.
E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and areas where shop paint is abraded. Paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

3.3 APPLICATION

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

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.

E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:

1. Paint the following work where exposed in equipment rooms:
   a. Equipment, including panelboards.

2. Paint the following work where exposed in occupied spaces:
   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Pipe hangers and supports.
   d. Metal conduit.
   e. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   f. Other items as directed by Architect.

3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
1. Contractor shall touch up and restore painted surfaces damaged by testing.
2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Steel Substrates: Alkyd System MPI INT 5.1E: IPS-5A

1. Prime Coat: Primer, alkyd, quick dry, for metal, MPI #76.
2. Prime Coat: Primer, alkyd, anti-corrosive, for metal, MPI #79.
3. Prime Coat: Shop primer specified in Section where substrate is specified.
5. Topcoat: Alkyd, interior, semi-gloss (MPI Gloss Level 5), MPI #47.

B. Gypsum Board Substrates: IPS-1A, IPS-1B, IPS-1C, IPS-1D, IPS-1E, IPS-1F, IPS-1G and IPS-2A

1. High-Performance Architectural Latex System MPI INT 9.2B:

   a. Prime Coat: Primer sealer, latex, interior, MPI #50.
   c. Topcoat: Latex, interior, high performance architectural, flat (MPI Gloss Level 2), MPI #138. (IPS-2A)
   d. Topcoat: Latex, interior, high performance architectural, Eggshell (MPI Gloss Level 3), MPI #139. (IPS-1A through IPS-1G)

END OF SECTION 09 9123
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SECTION 10 1419 - DIMENSIONAL LETTER SIGNAGE

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Illuminated, fabricated channel dimensional characters.

1.3 DEFINITIONS
A. Illuminated: Illuminated by lighting source integrally constructed as part of the sign unit.

1.4 COORDINATION
A. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS
A. Product Data: For each type of product.
B. Shop Drawings: For dimensional letter signs.
   1. Include fabrication and installation details and attachments to other work.
   2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
   3. Show message list, typestyles, graphic elements, and layout for each sign at least half size.
   4. Show locations of electrical service connections.
   5. Include diagrams for power, signal, and control wiring.
C. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
   1. Include representative Samples of available typestyles and graphic symbols.
D. Samples for Verification: For each type of sign assembly showing all components and with the required finish(es), in manufacturer’s standard size unless otherwise indicated and as follows:
   1. Exposed Accessories: Full-size Sample of each accessory type.
1.6 CLOSEOUT SUBMITTALS

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

1.7 FIELD CONDITIONS

A. Field Measurements: Verify locations of electrical service embedded in permanent construction by other installers by field measurements before fabrication, and indicate measurements on Shop Drawings.

1.8 WARRANTY

A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

   a. Deterioration of finishes beyond normal weathering.
   b. Separation or delamination of sheet materials and components.

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

PART 2 - PRODUCTS

2.1 DIMENSIONAL CHARACTERS

A. Fabricated Channel Characters: Metal face and side returns, formed free from warp and distortion; with uniform faces, sharp corners, and precisely formed lines and profiles; internally braced for stability and for securing fasteners; and as follows.

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

   b. ASI Sign Systems, Inc.
   c. Gemini Incorporated.

2. Illuminated Characters: Backlighted character construction with LED lighting including transformers, insulators, and other accessories for operability, with provision for servicing and concealing connections to building electrical system. Use tight or sealed joint construction to prevent unintentional light leakage. Space lamps apart from each other and away from character surfaces as needed to illuminate evenly.

   a. Power: 120 V, 60 Hz, 1 phase, 15 A.
   b. Weeps: Provide weep holes to drain water at lowest part of exterior characters.

3. Character Material: Sheet or plate aluminum.
4. Material Thickness: Manufacturer's standard for size and design of character.
5. Character Height: As indicated.
6. Character Depth: As indicated.
7. Finishes:
a. Baked-Enamel or Powder-Coat Finish: Manufacturer's standard, in color as selected by Architect from manufacturer's full range.

8. Mounting: Manufacturer's standard for size and design of character.
  a. Hold characters at distance as selected by Architect from wall surface.

9. Typeface: To be determined during submittal process.

2.2 DIMENSIONAL CHARACTER MATERIALS

A. Aluminum Sheet and Plate: ASTM B 209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

B. Aluminum Extrusions: ASTM B 221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

C. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.3 ACCESSORIES

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

1. Use concealed fasteners and anchors unless indicated to be exposed.
2. For exterior exposure, furnish, stainless-steel devices unless otherwise indicated.
3. Exposed Metal-Fastener Components, General:
   a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.

2.4 FABRICATION

A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.

1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
3. Comply with AWS for recommended practices in welding and brazing. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
4. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
5. Internally brace signs for stability and for securing fasteners.
6. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
B. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.

1. Stainless-Steel Brackets: Factory finish brackets to match sign background finish unless otherwise indicated.

2.5 GENERAL FINISH REQUIREMENTS

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

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

C. Organic, Anodic, and Chemically Produced Finishes: Apply to formed metal after fabrication but before applying contrasting polished finishes on raised features unless otherwise indicated.

2.6 ALUMINUM FINISHES

A. Baked-Enamel or Powder-Coat Finish: AAMA 2603 except with a minimum dry film thickness of 1.5 mils. Comply with coating manufacturer's written instructions for cleaning, conversion coating, and applying and baking finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of signage work.

B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise indicated.

C. Verify that electrical service is correctly sized and located to accommodate signs.

D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.

2. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

3. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.
B. Mounting Methods:

1. Back Bar and Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.

3.3 ADJUSTING AND CLEANING

A. Remove and replace damaged or deformed characters and signs that do not comply with specified requirements. Replace characters with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.

B. Remove temporary protective coverings and strippable films as signs are installed.

C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 10 1419
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SECTION 10 2113 - TOILET COMPARTMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Solid-polymer toilet compartments configured as toilet enclosures and urinal screens.

B. Related Sections:
   1. Section 10 2800 "Toilet, Bath, and Laundry Accessories" for toilet tissue dispensers, grab bars, shelves, and similar accessories.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: For toilet compartments. Include plans, elevations, sections, details, and attachments to other work.
   1. Show locations of cutouts for compartment-mounted toilet accessories.
   2. Show locations of reinforcements for compartment-mounted grab bars.
   3. Show locations of centerlines of toilet fixtures.

C. Samples for Initial Selection: For each type of unit indicated. Include Samples of hardware and accessories involving material and color selection.

D. Samples for Verification: For the following products, in manufacturer’s standard sizes unless otherwise indicated:
   1. Each type of material, color, and finish required for units, prepared on 6-inch-square Samples of same thickness and material indicated for Work.
   2. Each type of hardware and accessory.

1.4 INFORMATIONAL SUBMITTALS

A. Product Certificates: For each type of toilet compartment, from manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments to include in maintenance manuals.
1.6 QUALITY ASSURANCE


B. Surface-Burning Characteristics: As determined by testing identical products according to ASTM E 84, or another standard acceptable to authorities having jurisdiction, by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
   1. Flame-Spread Index: 75 or less.
   2. Smoke-Developed Index: 450 or less.

C. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board’s “Americans with Disabilities Act (ADA) and Architectural Barriers Act (ABA) Accessibility Guidelines for Buildings and Facilities” and ICC/ANSI A117.1 for toilet compartments designated as accessible.

1.7 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221.

C. Brass Castings: ASTM B 584.

D. Brass Extrusions: ASTM B 455.

E. Steel Sheet: Commercial steel sheet for exposed applications; mill phosphatized and selected for smoothness.
   1. Electrolytically Zinc Coated: ASTM A 879/A 879M, 01Z.

F. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

G. Stainless-Steel Castings: ASTM A 743/A 743M.

H. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.2 SOLID-POLYMER UNITS (HDPE-1)

A. Manufacturers: Subject to compliance with requirements, provide products by the following:
   1. Refer to Appendix A "Interior Finish Key" for manufacturer, color and texture.

B. Toilet-Enclosure Style: Overhead braced.
C. Urinal-Screen Style: Wall hung.

D. Door, Panel, and Pilaster Construction: Solid, high-density polyethylene (HDPE) panel material, not less than 1 inch thick, seamless, with eased edges, and with homogenous color and pattern throughout thickness of material.
   1. Integral Hinges: Configure doors and pilasters to receive integral hinges.
   2. Heat-Sink Strip: Manufacturer's standard continuous, extruded-aluminum or stainless-steel strip fastened to exposed bottom edges of solid-polymer components to prevent burning.
   3. Color and Pattern: One color and pattern in each room as indicated by manufacturer's designations.

E. Pilaster Shoes and Sleeves (Caps): Manufacturer's standard design; stainless steel.

F. Brackets (Fittings):
   1. Full-Height (Continuous) Type: Manufacturer's standard design; stainless steel.

2.3 ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard design, heavy-duty operating hardware and accessories.
   2. Hinges: Manufacturer's standard integral hinge for solid-polymer doors.
   3. Latch and Keeper: Manufacturer's standard recessed latch unit designed for emergency access and with combination rubber-faced door strike and keeper. Provide units that comply with regulatory requirements for accessibility at compartments designated as accessible.
   4. Coat Hook: Manufacturer's standard combination hook and rubber-tipped bumper, sized to prevent in-swinging door from hitting compartment-mounted accessories.
   5. Door Bumper: Manufacturer's standard rubber-tipped bumper at out-swinging doors.
   6. Door Pull: Manufacturer's standard unit at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel or chrome-plated steel or brass, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless steel, hot-dip galvanized steel, or other rust-resistant, protective-coated steel.

2.4 FABRICATION

A. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

B. Door Size and Swings: Unless otherwise indicated, provide 24-inch-wide, in-swinging doors for standard toilet compartments and 36-inch-wide, out-swinging doors with a minimum 32-inch-wide, clear opening for compartments designated as accessible.
PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Comply with manufacturer’s written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer’s recommended anchoring devices.

1. Maximum Clearances:
   a. Pilasters and Panels: 1/2 inch.
   b. Panels and Walls: 1 inch.

B. Overhead-Braced Units: Secure pilasters to floor and level, plumb, and tighten. Set pilasters with anchors penetrating not less than 1-3/4 inches into structural floor unless otherwise indicated in manufacturer’s written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

3.2 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer’s written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors to return doors to fully closed position.

END OF SECTION 10 2113
SECTION 10 2600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Corner guards.
   2. Abuse-resistant wall coverings.

B. Related Requirements:
   1. Section 08 7100 "Door Hardware" for metal protective trim units, according to BHMA A156.6, used for armor, kick, mop, and push plates.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.
   1. Include construction details, material descriptions, impact strength, dimensions of individual components and profiles, and finishes.

B. Shop Drawings: For each type of wall and door protection showing locations and extent.
   1. Include plans, elevations, sections, and attachment details.

C. Samples for Verification: For each type of exposed finish on the following products, prepared on Samples of size indicated below:
   1. Corner Guards: 12 inches long. Include example top caps.
   2. Abuse-Resistant Wall Covering: 6 by 6 inches square.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store wall and door protection in original undamaged packages and containers inside well-ventilated area protected from weather, moisture, soiling, extreme temperatures, and humidity.
   1. Maintain room temperature within storage area at not less than 70 deg F during the period plastic materials are stored.
   2. Keep plastic materials out of direct sunlight.
   3. Store plastic wall- and door-protection components for a minimum of 72 hours, or until plastic material attains a minimum room temperature of 70 deg F.
      a. Store corner-guard covers in a vertical position.
PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain wall- and door-protection products of each type from single source from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

A. Surface Burning Characteristics: Comply with ASTM E 84 or UL 723; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

2.3 WALL GUARDS

A. Crash Rail (CR-1): Heavy-Duty assembly consisting of continuous snap-on plastic cover installed over concealed retainer system: designed to withstand impacts

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Construction Specialties, Inc.
   b. Korogard Wall Protection Systems
   c. InPro Corporation

2. Cover: Extruded rigid plastic, minimum 0.100-inch wall thickness: as follows:
   a. Profile: Flat
      1) Dimension: Nominal 8 inch high by 1 inch deep.
      2) Surface: Uniform
   b. Color and Texture: As Listed in Appendix A “Interior Finish Legend” in Specifications

2.4 CORNER GUARDS

A. Surface-Mounted, Plastic-Cover Corner Guards(CG-2, CG-3): Manufacturer’s standard assembly consisting of snap-on, resilient plastic cover installed over retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.

1. Basis-of-Design Product ct to compliance with requirements, provide As Listed in Appendix A ‘Interior Finish Legend’ in Specifications or comparable product by one of the following:
   a. CS Acrovy
   b. InPro - IPC
   c. Koroseal

2. Cover: Extruded rigid plastic, minimum 0.100-inch wall thickness; in dimensions and profiles indicated on Drawings.
a. Profile: Nominal 2-inch-long leg and 1/4-inch corner radius.
b. Height: As Listed in Appendix A 'Interior Finish Legend' in Specifications.
c. Color and Texture: As Listed in Appendix A 'Interior Finish Legend' in Specifications.

3. Continuous Retainer: Minimum 0.060-inch-thick, one-piece, extruded aluminum.
4. Retainer Clips: Manufacturer's standard impact-absorbing clips.
5. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

2.5 ABUSE-RESISTANT WALL COVERINGS: (ARWC-1 and FRP-1)

A. Abuse-Resistant Sheet Wall Covering: Fabricated from semirigid, plastic sheet wall-covering material.

1. Basis-of-Design Product to comply with requirements, provide As Listed in Appendix A 'Interior Finish Legend' in Specifications or comparable product by one of the following:
   a. Panolam (FRP-1)
   b. CS Acrovy (ARWC-1)
   c. InPro

2. Size: As Listed in Appendix A 'Interior Finish Legend' in Specifications.
5. Height: As indicated.
6. Trim and Joint Moldings: Extruded rigid plastic that matches wall-covering color.

2.6 MATERIALS

A. Plastic Materials: Chemical- and stain-resistant, high-impact-resistant plastic with integral color throughout; extruded and sheet material as required, thickness as indicated.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

C. Adhesive: As recommended by protection-product manufacturer and with a VOC content of 70 g/L or less.

2.7 FABRICATION

A. Fabricate wall and door protection according to requirements indicated for design, performance, dimensions, and member sizes, including thicknesses of components.

B. Factory Assembly: Assemble components in factory to greatest extent possible to minimize field assembly. Disassemble only as necessary for shipping and handling.

C. Quality: Fabricate components with uniformly tight seams and joints and with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.
2.8 FINISHES

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

B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Examine walls to which wall and door protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

   1. For wall and door protection attached with adhesive, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

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

3.2 PREPARATION

A. Complete finishing operations, including painting, before installing wall and door protection.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. Installation Quality: Install wall and door protection according to manufacturer’s written instructions, level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

B. Abuse-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard ammonia-based household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 2600
SECTION 10 2613 - FRP PANELS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. RFP Panels and trim.

1.3 SUBMITTALS
A. Product Data: Include construction details, material descriptions, impact strength, fire-test-response characteristics, dimensions of individual components and profiles, and finishes for each impact-resistant wall protection unit.
B. Samples for Initial Selection: For each type of impact-resistant wall protection unit indicated.
   1. Include similar Samples of accent strips and accessories involving color selection.

1.4 QUALITY ASSURANCE
A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
B. Source Limitations: Obtain impact-resistant wall protection units from single source from single manufacturer.
C. Product Options: Drawings indicate size, profiles, and dimensional requirements of impact-resistant wall protection units and are based on the specific system indicated.
   1. Do not modify intended aesthetic effects, as judged solely by Architect, except with Architect's approval. If modifications are proposed, submit comprehensive explanatory data to Architect for review.
D. Surface-Burning Characteristics: Provide impact-resistant, plastic wall protection units with surface-burning characteristics as determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

PART 2 - PRODUCTS
2.1 MATERIALS

A. PVC Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout; sheet material, thickness as indicated.

1. Chemical and Stain Resistance: Tested according to ASTM D 543
2. Self-extinguishing when tested according to ASTM D 635.
3. Flame-Spread Index: 25 or less.
4. Smoke-Developed Index: 450 or less.

B. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

2.2 FRP PANELS

A. RFP Panels: Fabricated from plastic sheet material.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Panolam, .090” thick, Textured Wall Panels or comparable product by another manufacturer.
2. Sheet Thickness: 0.090 inch minimum.
3. Color and Texture: Refer to Appendix A “Interior Finish Key”.
4. Height: Full wall.
5. Trim and Joint Moldings: Extruded rigid plastic that matches sheet wall covering color.

2.3 FABRICATION

A. Fabricate FRP wall protection units to comply with requirements indicated for design, dimensions, and member sizes, including thicknesses of components.

B. Fabricate components with tight seams and joints with exposed edges rolled. Provide surfaces free of wrinkles, chips, dents, uneven coloration, and other imperfections. Fabricate members and fittings to produce flush, smooth, and rigid hairline joints.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and wall areas, with Installer present, for compliance with requirements for installation tolerances, fire rating, and other conditions affecting performance of work.

B. Examine walls to which impact-resistant wall protection will be attached for blocking, grounds, and other solid backing that have been installed in the locations required for secure attachment of support fasteners.

1. For impact-resistant wall protection units attached with adhesive or foam tape, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.

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

A. Complete finishing operations, including painting, before installing impact-resistant wall protection system components.

B. Before installation, clean substrate to remove dust, debris, and loose particles.

3.3 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.
   a. Provide anchoring devices to withstand imposed loads.
   b. Where splices occur in horizontal runs of more than 20 feet, splice aluminum retainers and plastic covers at different locations along the run, but no closer than 12 inches.
   c. Adjust end and top caps as required to ensure tight seams.

B. Impact-Resistant Wall Covering: Install top and edge moldings, corners, and divider bars as required for a complete installation.

3.4 CLEANING

A. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

B. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 10 2613
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PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Decorative protection panels.

B. Related Requirements:
   1. Section 06 4116 Plastic Laminate Faced Architectural Casework.
   2. Section 12 3623.16 Plastic Laminate-Clad Countertops.

1.2 REFERENCES

A. Reference Standards: In addition to requirements, comply with applicable provisions of following for design, materials, fabrication, and installation of component parts:
   1. ANSI / NEMA LD-3: High Pressure Decorative Laminates.
   4. SEFA 8.1 approved.
   5. ASTM G 22 Bacterial Growth Resistance.
   6. Architectural Woodwork Quality Standards

1.3 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1.4 ACTION SUBMITTALS

A. Product Data:
   1. Product data for each specified product. Include manufacturer’s technical data sheets and published instructions.

B. Shop Drawings: Each installation.
   1. Anchorages to other construction, including requirements for concealed supports.
   2. Use same unit designations used on Drawings.

C. Verification Samples: Not less than 5 by 7 inches (127 by 177.8 mm), for each type, color, pattern, and surface finish. Provide actual color samples. Electronic color samples will not be accepted.
1.5 INFORMATIONAL SUBMITTALS
A. Qualification Data: For fabricator and installer.
B. Product Certificates: For the following:
   1. Decorative protection panels.

1.6 CLOSEOUT SUBMITTALS
A. Maintenance Data: Manufacturer’s written maintenance instructions.
B. Manufacturer warranties transferrable to Owner.

1.7 QUALITY ASSURANCE
A. Installer Qualifications: Company specializing in fabricating and installing decorative plastic laminate finished work with a minimum 3 years experience.
B. Fabricator Qualifications: Shop that employs skilled workers who custom fabricate products similar to those required for this Project and whose products have a record of successful in-service performance with a minimum 3 years experience.
C. Mock-Ups:
   1. Build mockups to verify selections made under submittals and to demonstrate aesthetic effects, set quality for materials and construction, set quality standard for fabrication and installation.
   2. Acceptable mock-ups may remain as part of the Work if undamaged at time of Substantial Completion.
   3. Acceptable mock-ups shall be comparison standard for remaining Work.

1.8 DELIVERY, STORAGE, AND HANDLING
A. Package and ready materials according to manufacturer’s instructions.
B. Do not deliver components until Project is fully enclosed.
C. Store products inside building protected from light, heat and moisture and never store in contact with floor or outside wall surfaces. Do not expose to continuous direct sunlight.
   1. Store horizontally.
   2. Sheets must be handled by two people.
   3. Stored at a temperature per Formica Corporation technical guide requirements.
D. Provide protective coverings of suitable material. Take special precautions at corners.

1.9 PROJECT CONDITIONS
A. Coordinate sizes and locations of cut-outs and other related Work specified in other Sections to ensure that interior laminate construction can be supported and installed as indicated.
PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: Provide decorative protection panels with the following surface burning characteristics as determined by testing identical products per ASTM E 84 by UL or another testing and inspecting agency acceptable to authorities having jurisdiction:

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 450 or less.

B. Source Limitations: Obtain decorative protection panels materials through one source from a single manufacturer.

2.2 MANUFACTURER

A. Manufacturer:


2. Other manufacturers will be considered including:
   b. Laminart
   c. Wilsonart

B. Decorative Protection Panels

1. Description: Decorative protection panels.
   a. Impact resistant panels.

3. Laminate Grade:
   a. Grade H1, 0.0677 Inches - 0.0827 Inches (1.72mm-2.1mm).

4. Laminate Color(s):
   a. Refer to appendix A “Interior Finish Schedule” for color and texture.

5. Laminate Finish:
   a. Match Architect’s samples.

6. Laminate Application(s):
   a. Wall panels.

2.3 ACCESSORY MATERIALS

A. Aluminum Trim Profiles for Seam Treatments:
1. Thicknesses:
   a. All trims 0.055-inch.
   b. Corner guard trim 0.065-inch.

2. Profile Types:
   a. Inside corners.
   b. Outside corners.
   c. Division bars.
   d. End caps.

3. Colors, Finish and Patterns:
   a. Lear anodized.

B. Adhesives:

C. Sealant:
   1. Color Coordinated Sealant: 100% silicone or acrylic caulk material by Color-Rite Incorporated as recommended by Formica Corporation.

2.4 FABRICATION

A. Conform to Formica Corporation standard practices, procedures, conditions including preconditioning, material recommendations, machining, equipment and workmanship.

B. Router base should be clean and free of burrs and debris. Table saws should be clean, flat, and free of burrs.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install decorative protection panels in accordance with manufacturer’s installation instructions, approved submittals.

B. Provide templates and rough-in measurements.

C. Accessory Materials: Install in accordance with manufacturer’s written installation instructions.

3.2 CLEANING AND PROTECTING

A. Cleaning:
   1. Clean decorative protection panels and aluminum trims in accordance with manufacturer’s instructions.

B. Protection:
1. Do not permit construction near unprotected surfaces.

END OF SECTION 10 2623.11
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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
3. Warm-air dryers.
4. Childcare accessories.
5. Custodial accessories.

B. Owner-Furnished and contractor installed Material:

1. Soap Dispensers.
2. Soap Dispensers
3. Alcohol Dispensers, Hand Sanitizer Dispensers.
4. Sharps Disposals unit.
5. Glove Dispensers.
6. Paper Towel Dispensers.
7. Multiple Coat Hooks as indicated on drawings.
8. Marker boards/Tack boards/Patient boards
9. TV and Monitor Mounting Brackets
10. Clocks

C. Related Sections:

1. Section 08 8300 “Mirrors” for frameless mirrors.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include the following:

1. Construction details and dimensions.
2. Anchoring and mounting requirements, including requirements for cutouts in other work and substrate preparation.
3. Material and finish descriptions.
4. Features that will be included for Project.
5. Manufacturer's warranty.

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.
1.4 **INFORMATIONAL SUBMITTALS**

A. Warranty: Sample of special warranty.

1.5 **CLOSEOUT SUBMITTALS**

A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.6 **QUALITY ASSURANCE**

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

1.7 **COORDINATION**

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

B. Deliver inserts and anchoring devices set into concrete or masonry as required to prevent delaying the Work.

1.8 **WARRANTY**

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

**PART 2 - PRODUCTS**

2.1 **MATERIALS**

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch minimum nominal thickness unless otherwise indicated.

B. Brass: ASTM B 19, flat products; ASTM B 16/B 16M, rods, shapes, forgings, and flat products with finished edges; or ASTM B 30, castings.

C. Steel Sheet: ASTM A 1008/A 1008M, Designation CS (cold rolled, commercial steel), 0.036-inch minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 hot-dip zinc coating.


F. Fasteners: Screws, bolts, and other devices of same material as accessory unit and tamper-and-theft resistant where exposed, and of galvanized steel where concealed.

G. Chrome Plating: ASTM B 456, Service Condition Number SC 2 (moderate service).
H. Mirrors: ASTM C 1503, Mirror Glazing Quality, clear-glass mirrors, nominal 6.0 mm thick.

2.2 PUBLIC-USE WASHROOM ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. AJW Architectural Products.
   2. American Specialties, Inc.

B. Toilet Tissue (Roll) Dispenser TP-1:
   2. Description: Double-roll dispenser.
   5. Capacity: Designed for 5-inch-diameter tissue rolls.

C. Grab Bar GB:
   3. Material: Stainless steel, 0.05 inch thick.
      a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.
   5. Configuration and Length: As indicated on Drawings.

D. Vendor NV:
   2. Type: Sanitary napkin and tampon.
   3. Mounting: Fully recessed, designed for 4-inch wall depth.
   4. Operation: Two coin (50 cents).
   5. Exposed Material and Finish: Stainless steel, No. 4 finish (satin).
   6. Lockset: Tumbler type with separate lock and key for coin box.

E. Sanitary-Napkin Disposal Unit SND:
   3. Door or Cover: Self-closing, disposal-opening cover.
   5. Material and Finish: Stainless steel, No. 4 finish (satin).

F. Seat-Cover Dispenser TSC:
   5. Lockset: Tumbler type.
G. Shelf:

H. Mirror Unit MR:
   2. Frame: Stainless-steel angle, 0.05 inch thick.
      a. Corners: Manufacturer's standard.
      a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
      b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.
   4. Size: As indicated on Drawings.

2.3 HEALTHCARE ACCESSORIES

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated below or comparable product by one of the following:
   1. A & J Washroom Accessories, Inc.
   2. American Specialties, Inc.
   4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
   5. Tubular Specialties Manufacturing, Inc.

B. Specimen Pass-Through Box (SPT-1):
   1. Basis-of-Design Product: Carr Corporation, SPT-12D.
   2. Description: With minimum 12-inch-square x 7 ¼" deep with doors on both sides for insertion and retrieval.
   3. Nominal Wall Opening: 12” x 12” nominal.

C. Specimen Pass-Through Box (SPT-2):
   1. Basis-of-Design Product: Carr Corporation, SPT-12DD.
   2. Description: With minimum 12-inch-square x 11 ¼” deep with doors on both sides for insertion and retrieval.
   3. Nominal Wall Opening: 12” x 12” nominal.

2.4 CHILDCARE ACCESSORIES

A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   1. American Specialties, Inc.
   2. Brocar Products, Inc.
3. Diaper Deck & Company, Inc.
4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
5. SSC, Inc.
6. Tubular Specialties Manufacturing, Inc.

B. Diaper-Changing Station (DCS):

1. Basis-of-Design Product: Koala Kare; KB110SSRE.
2. Description: Horizontal unit that opens by folding down from stored position and with child-protection strap.
   a. Engineered to support a minimum of 250-lb static load when opened.
3. Mounting: Semirecessed, with unit projecting not more than 1 inch from wall when closed.
5. Material and Finish: Stainless steel, No. 4 finish (satin), with replaceable insulated polystyrene tray liner and rounded plastic corners.

C. Child Protection Seat (CPS):

1. Basis-of-Design Product: Bobrick KB102-00
2. Mounting: Surface

### 2.5 Custodial Accessories

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

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
4. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
5. Tubular Specialties Manufacturing, Inc.

B. Mop and Broom Holder (MBH):

1. Basis-of-Design Product: Bobrick; B-239.
2. Description: Unit with shelf, hooks, holders, and rod suspended beneath shelf.
3. Length: 34 inches.
5. Mop/Broom Holders: Three, spring-loaded, rubber hat, cam type.
   a. Shelf: Not less than nominal 0.05-inch thick stainless steel.
   b. Rod: Approximately 1/4-inch diameter stainless steel.

### 2.6 Fabrication

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.
2.7 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner’s representative.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units’ level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf, when tested according to ASTM F 446.

3.2 ADJUSTING AND CLEANING

A. Adjust accessories for unencumbered, smooth operation. Replace damaged or defective items.

B. Remove temporary labels and protective coatings.

C. Clean and polish exposed surfaces according to manufacturer’s written recommendations.

END OF SECTION 10 2800
SECTION 10 4413 - FIRE PROTECTION CABINETS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Fire-protection cabinets for the following:
      a. Portable fire extinguishers, 10 lbs. furnished by Owner.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing recessed-, semirecessed-, or surface-mounting method and relationships of box and trim to surrounding construction.
B. Product Schedule: For fire-protection cabinets. Indicate whether recessed, semirecessed, or surface mounted. Coordinate final fire-protection cabinet schedule with fire-extinguisher schedule to ensure proper fit and function.

1.4 CLOSEOUT SUBMITTALS
A. Maintenance Data: For fire-protection cabinets to include in maintenance manuals.

1.5 COORDINATION
A. Coordinate size of fire-protection cabinets to ensure that type and capacity of fire extinguishers indicated are accommodated.
B. Coordinate sizes and locations of fire-protection cabinets with wall depths.

PART 2 - PRODUCTS

2.1 FIRE-PROTECTION CABINET FC-1
A. Cabinet Type: Suitable for fire extinguisher.
   1. Products: Subject to compliance with requirements, provide one of the following:
      a. JL Industries, Inc.; a division of the Activar Construction Products Group.
      b. Larsens Manufacturing Company.
c. Nystrom.
d. Potter Roemer LLC.

B. Cabinet Construction: Nonrated.

C. Cabinet Material: Cold-rolled steel sheet.

D. Semirecessed Cabinet: One-piece combination trim and perimeter door frame overlapping surrounding wall surface with exposed trim face and wall return at outer edge (backbend).
   1. Rolled-Edge Trim: 2-1/2-inch backbend depth.

E. Cabinet Trim Material: Stainless-steel sheet.

F. Door Material: Stainless-steel sheet.

G. Door Style: Vertical duo panel with frame.

H. Door Glazing: Tempered float glass (clear).

I. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
   1. Provide manufacturer's standard.
   2. Provide manufacturer's standard hinge permitting door to open 180 degrees.

J. Accessories:
   1. Mounting Bracket: Manufacturer's standard steel, designed to secure fire extinguisher to fire-protection cabinet, of sizes required for types and capacities of fire extinguishers indicated, with plated or baked-enamel finish.
   2. Lettered Door Handle: One-piece, cast-iron door handle with the word "FIRE" embossed into face.
   3. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as directed by Architect.
      a. Identify fire extinguisher in fire-protection cabinet with the words "FIRE EXTINGUISHER."
         1) Location: Applied to cabinet door.
         2) Application Process: Pressure-sensitive vinyl letters.
         3) Lettering Color: Red.
         4) Orientation: Vertical.

K. Materials:
   1. Cold-Rolled Steel: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B.
      a. Finish: Baked enamel or powder coat.
      b. Color: As selected by Architect from full range of industry colors and color densities.
   
   2. Stainless Steel: ASTM A 666, Type 304.
      a. Finish: No. 4 directional satin finish.
3. Tempered Float Glass: ASTM C 1048, Kind FT, Condition A, Type I, Quality q3, 3 mm thick, Class 1 (clear).

2.2 FABRICATION

A. Fire-Protection Cabinets: Provide manufacturer's standard box (tub) with trim, frame, door, and hardware to suit cabinet type, trim style, and door style indicated.

1. Weld joints and grind smooth.
2. Provide factory-drilled mounting holes.
3. Prepare doors and frames to receive locks.

B. Cabinet Doors: Fabricate doors according to manufacturer's standards, from materials indicated and coordinated with cabinet types and trim styles.

1. Fabricate door frames with tubular stiles and rails and hollow-metal design, minimum 1/2 inch thick.
2. Fabricate door frames of one-piece construction with edges flanged.
3. Miter and weld perimeter door frames.

C. Cabinet Trim: Fabricate cabinet trim in one piece with corners mitered, welded, and ground smooth.

2.3 GENERAL FINISH REQUIREMENTS


B. Protect mechanical finishes on exposed surfaces of fire-protection cabinets from damage by applying a strippable, temporary protective covering before shipping.

C. Finish fire-protection cabinets after assembly.

D. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine walls and partitions for suitable framing depth and blocking where semirecessed cabinets will be installed.

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

3.2 PREPARATION

A. Prepare recesses for semirecessed fire-protection cabinets as required by type and size of cabinet and trim style.
3.3 INSTALLATION

A. General: Install fire-protection cabinets in locations and at mounting heights indicated or, if not indicated, at heights indicated below:

1. Fire-Protection Cabinets: 54 inches above finished floor to top of cabinet.

B. Fire-Protection Cabinets: Fasten cabinets to structure, square and plumb.

1. Unless otherwise indicated, provide recessed fire-protection cabinets. If wall thickness is inadequate for recessed cabinets, provide semirecessed fire-protection cabinets.
2. Provide inside latch and lock for break-glass panels.
3. Fasten mounting brackets to inside surface of fire-protection cabinets, square and plumb.

C. Identification: Apply vinyl lettering at locations indicated.

3.4 ADJUSTING AND CLEANING

A. Remove temporary protective coverings and strippable films, if any, as fire-protection cabinets are installed unless otherwise indicated in manufacturer's written installation instructions.

B. Adjust fire-protection cabinet doors to operate easily without binding. Verify that integral locking devices operate properly.

C. On completion of fire-protection cabinet installation, clean interior and exterior surfaces as recommended by manufacturer.

D. Touch up marred finishes, or replace fire-protection cabinets that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by fire-protection cabinet and mounting bracket manufacturers.

E. Replace fire-protection cabinets that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 10 4413
PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes solid phenolic lockers.

1.3 SUBMITTALS
A. Product Data: For each type of solid phenolic locker.
   1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of locker.
B. Shop Drawings: For solid phenolic lockers.
   1. Include plans, elevations, sections, details, and attachments to other work.
   2. Show details full size.
   3. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcement specified in other Sections.
   4. Show locations and sizes of cutouts and holes for items installed in lockers.
   5. Show locker fillers, trim, base, sloping tops, and accessories.
   6. Show locker numbering sequence.
C. Samples for Initial Selection: For the following:
   1. Solid Phenolic Samples

1.4 DELIVERY, STORAGE, AND HANDLING
A. Do not deliver lockers until painting and similar operations that could damage lockers have been completed in installation areas. If lockers must be stored in other-than-installation areas, store only in areas where environmental conditions are the same as those in final installation location, and comply with requirements specified in "Field Conditions" Article.
B. Deliver combination control charts to Owner.

1.5 FIELD CONDITIONS
A. Environmental Limitations: Do not deliver or install lockers until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and 90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.
B. Field Measurements: Where lockers are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Locate concealed framing, blocking, and reinforcements that support lockers by field measurements before being enclosed and indicate measurements on Shop Drawings.

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

1.6 COORDINATION

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

B. Hardware Coordination: Distribute copies of approved hardware schedule specified in Section 08 7100 "Door Hardware" to fabricator of lockers; coordinate Shop Drawings and fabrication with hardware requirements.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Accessibility Requirements: For lockers indicated to be accessible, comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board’s ADA-ABA Accessibility Guidelines and ICC A117.1.

2.2 SOLID PHENOLIC LOCKERS

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

1. Accu tec Mfg. Inc.
2. Columbia PSISC, Columbia, SC
3. Per Mar LTD, Germantown, Wisconsin
4. Spec-Rite Designs

B. Construction Style: Flush overlay.

C. Locker Fabricated from solid phenolic-core panels covered on both sides with thermoset decorative overlay.

1. Exposed edges: Straight profile; eased edges to remove sharpness; machine polished and free from tooling imperfections.
2. Bottoms and intermediate shelves: 1/2” (13mm) thick solid phenolic composite material with ventilation holes.
3. Locker backs: 1/4” (6 mm) thick solid phenolic composite material.
4. Locker sides: 3/8” (10 mm) thick solid phenolic composite material.
5. Doors: 1/2” (13mm) thick solid phenolic composite material.
   a. Corners: Rounded.
b. Edges: Crescent profile; machine polished and free from tooling imperfections.
c. Door Fastening: Blind Fixing

D. Continuously Sloping Tops: Solid phenolic, 3/4-inch thick panel that matches door faces for installation over lockers with separate flat tops. Fabricate tops in lengths as long as practical, without visible fasteners at splice locations. Provide fasteners, supports, and closures, as follows:

1. Sloping-top corner fillers, mitered.

E. Solid phenolic Colors, Patterns, and Finishes:

1. As selected by Architect from manufacturer's full range of colors and patterns.

### 2.3 MATERIALS

A. Panel material is composed of melamine-impregnated decorative surface papers that are fused under extreme heat and pressure with a wide ranging number of phenolic resin saturated draft core papers.

B. Fire-Retardant-Treated Materials: Where fire-retardant-treated materials are indicated, use materials impregnated with fire-retardant chemical formulations indicated by a pressure process or other means acceptable to authorities having jurisdiction to produce products with fire-test-response characteristics specified.

1. Do not use treated material that does not comply with requirements of referenced material standards or material that is warped, discolored, or otherwise defective.
2. Use fire-retardant-treatment formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

C. Furring, Blocking, Shims, and Hanging Strips: Fire-retardant-treated softwood lumber, kiln dried to less than 15 percent moisture content.

D. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous-metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

### 2.4 HARDWARE

A. General: Provide manufacturer's standard locker hardware complying with the requirements in this Section.

B. Built-in Combination Locks: Key-controlled, three-number dialing combination locks; capable of at least five combination changes made automatically with a control key. Locking System: Hasp preparation for Owner furnished padlock.


1. Provide two hinges for doors 36 inches high and less.

D. Cup style handles.

E. Exposed Hardware Finishes: Satin chrome unless otherwise indicated.
F. Exposed Hardware Finishes: Unless otherwise indicated, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

2.5 ACCESSORIES

A. Number Plates: 1-1/2-inch- diameter, etched, embossed, or stamped, aluminum plates with black numbers and letters at least 1/2 inch high.

2.6 FABRICATION

A. Fabricate each locker with shelves, an individual door and frame, an individual top, a bottom, and a back, and with common intermediate uprights separating compartments.

1. Fabricate lockers to dimensions, profiles, and details indicated.
2. Ease edges of corners of solid-wood members to 1/16-inch radius.

B. Fabricate components square, rigid, without warp, and with finished faces flat and free of scratches and chips. Accurately factory machine components for attachments. Make joints tight and true.

1. Fabricate lockers using manufacturer’s standard construction, with joints made with dowels, dados, or rabbets. Dado side panels to receive shelving except where indicated to be adjustable.

C. Accessible Lockers: Fabricate as follows:

1. Locate bottom shelf no lower than 15 inches above the floor.

D. Venting: Fabricate lockers with space between doors and locker assembly of not less than 1/4 inch, with painted metal security screen attached to each shelf between doors.

E. Number Plates: Inlay number plates flush in each locker door, near top, centered.

F. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended, and check measurements of assemblies against field measurements indicated on Shop Drawings before disassembling for shipment.

G. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 EXAMINATION
A. Examine walls, floors, and support bases, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.

B. Verify that furring is attached to concrete and masonry walls that are to receive lockers.

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

3.2 PREPARATION

A. Condition lockers to average prevailing humidity conditions in installation areas before installation.

B. Before installing lockers, examine factory-fabricated work for completeness and complete work as required, including removal of packing.

3.3 INSTALLATION

A. Assemble knocked-down lockers with manufacturer's standard fasteners, with no exposed fasteners on face frames.

B. Install lockers level, plumb, and true; use concealed shims.

C. Connect groups of lockers together with manufacturer's standard brass-finished fasteners, through predrilled holes, with no exposed fasteners on face frames. Fit lockers accurately together to form flush, tight, hairline joints.

D. Install lockers without distortion so doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings, providing unencumbered operation. Complete installation of hardware and accessory items as indicated.

1. Installation Tolerance: No more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line. Shim as required with concealed shims.

E. Scribe and cut corner and filler panels to fit adjoining work using fasteners concealed where practical. Repair damaged finish at cuts.

F. Attach sloping-top units to lockers, with end panels covering exposed ends.

G. Install number plates after lockers are in place.

3.4 ADJUSTING, CLEANING, AND PROTECTION

A. Protect lockers from damage, abuse, dust, dirt, stain, or paint. Do not permit use during construction.

B. Touch up marred finishes, or replace lockers that cannot be restored to factory-finished appearance. Use only materials and procedures recommended or furnished by locker manufacturer.

END OF SECTION 10 5129
PART 1 - GENERAL

1.1 DESCRIPTION OF WORK
A. Work in this section includes furnishing and installation of extruded aluminum overhead hanger rod style canopies.
B. Related Sections:
   1. Section 07 7100 – Roof Specialties for flashing.

1.2 FIELD MEASUREMENT
A. Confirm dimensions prior to preparation of shop drawings when possible.
B. If requested, supply manufacturer’s standard literature and specifications for canopies.
C. Submit shop drawings showing structural component locations/positions, material dimensions and details of construction and assembly.

1.3 PERFORMANCE REQUIREMENTS
A. Canopy must conform to local building codes, 2018 IBC.
B. PE Stamped calculations are required and must be signed and sealed by an engineer licensed within the state canopy is installed.

1.4 SUBMITTALS
A. Product Data: For each type of product
   1. Include construction details, material descriptions, dimensions of individual component and profiles, and finishes for each type of panel and accessory.
B. Shop Drawings:
   1. Include fabrication and installation layouts of canopy; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
C. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches.
   1. Retain "Samples for Initial Selection" and "Samples for Verification" paragraphs below for two-stage Samples.
D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.
1. Include Samples of trim and accessories involving color selection.

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

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

1.5 DELIVER, STORAGE, HANDLING

A. Deliver and store all canopy components in protected areas.

PART 2 - Products

2.1 BASIS-OF-DESIGN PRODUCT:

A. Mapes Canopies, Super Lumideck, rod supported or comparable product by one of the following:

1. Architectural Shade Products
2. Awnex, Inc.
3. Superior Canopy Corporation

2.2 MATERIALS

A. Decking shall consist of 3" extruded flat soffit .078 decking.

B. Intermediate framing members shall be extruded aluminum, alloy 6063-T6, in profile and thickness shown.

C. Hanger rods and attachment hardware shall be powder coated.

D. Fascia shall be standard 8" extruded G style.

2.3 ALUMINUM FINISHES

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

2.4 FABRICATION

A. Ship canopies in preassembled sections for ease of installation.

B. All connections shall be mechanically assembled utilizing 3/16 fasteners with a minimum shear stress of 350 lb. Pre-welded or factory-welded connections are not acceptable.

C. Decking shall be designed with interlocking roll-formed aluminum members.

D. Concealed drainage. Water shall drain from covered surfaces into intermediate trough and be directed to Downspout from Rear Gutter.
PART 3 - Execution

3.1 INSPECTION

A. Confirm that surrounding area is ready for the canopy installation.

B. Installer shall confirm dimensions and elevations to be as shown on drawings.

C. Erection shall be performed by an approved installer and scheduled after all concrete, masonry and roofing in the area is completed.

3.2 INSTALLATION

A. Installation shall be in strict accordance with manufacturer’s shop drawings. Particular attention should be given to protecting the finish during handling and erection.

B. After installation, entire system shall be left in a clean condition.

END OF SECTION 10 5300
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SECTION 11 5126 – PHARMACY SHELVING SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Free standing tubular shelving system.
2. Wall mounted tubular shelving system.
3. Shelving system accessories.

B. Related Requirements:

2. Section 12 3661 “Simulated Stone Countertops”.

1.3 SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for pharmacy shelving system and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Detail fabrication and installation of pharmacy shelving system including methods of anchoring to building structure at locations recommended by manufacturer.

C. Samples for Verification: For the following products, one of each, in manufacturer’s standard size and finish:

1. One three-position shelf.

D. Warranty: For manufacturer's special warranty.

1.4 QUALITY ASSURANCE

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

1.5 WARRANTY
A. Special Warranty: Manufacturer agrees to repair or replace components of pharmacy shelving system that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Deterioration of metals, metal finishes, and other materials beyond normal wear.
   b. Plastic laminate delamination.

2. Warranty Period: Five (5) years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 TUBULAR SHELVING SYSTEM

A. Gondola Upright and Wall Upright Units: designed for pharmacy use and consisting of all components for stable, complete installation.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Tubular Pharmacy Shelving and accessories by Madix, Inc. or comparable product.

B. Gondola Upright Units: Open back shelving units that allow for merchandise on both sides of run with lock-together structural components.

1. Standard Height: 7'-0”.
2. Uprights: 1” x 1-1/2” tubular steel with slotting on both sides.
3. Shoes: welded to upright and designed to receive and fit snugly around uprights, extending from both faces of double-faced units or one face of single-faced units.
5. Bay Stretcher: two (2) per vertical section, one at top and bottom of each section to connect one upright section to another.
   a. Finish: Satin Black.
   b. Widths to match sections.

7. Aisle Stretcher: used overhead to stabilize freestanding bays.
   a. Lock into uprights on opposite runs.

8. Diagonal Stabilizer: required for stability where back panels are not used.
   a. One per gondola run.

9. End Panels: Provide double bay panel at end of each range.
   a. Double bay.
   b. Finish: custom high pressure decorative laminate as indicated on drawings.

10. Finish: ‘Snow White’ on all components not specified as other finish.

C. Adjustable Shelves:

1. Three-position shelf with integral brackets.
   a. Flat position.
b. 12 degree down tilt position.
c. Upside-down position.

2. Size: 8” deep by lengths as indicated on drawings.
   a. Nominal sizes: sixteen inch, thirty-two inch, forty-eight inch.

3. Weight capacity: 30lbs.
4. Quantity: seven (7) shelves per vertical section (both sides).
5. Locations: at free standing gondola upright units

D. Wall Upright Units: allows for merchandise on one side of run with lock-together structural components.
   1. Uprights: 1” x 1-1/2” tubular steel with slotting on both sides.
   2. Shoes: welded to upright and designed to receive and fit snugly around uprights, extending from one face of single-faced units.
      a. Finish: Satin Black.
      b. Widths to match sections.
   5. End Panels: Provide single bay panel at end of each range.
      a. Single bay.
      b. Finish: custom high pressure decorative laminate as indicated on drawings Finish: ‘Snow White’ on all components not specified as other finish.

E. Upright System Accessories:
   1. Shelf dividers:
      a. Depth to match shelf.
      b. Finish to match shelf.
      c. Quantity: 80
   2. Will Call Bar:
      a. Extension: six inches from face of wall upright.
      b. Nominal sizes: sixteen inch, thirty-two inch, forty-eight inch.
         1) Widths to match sections.
      c. Location:
         1) On Wall Upright system: Refer to Pharmacy interior elevations for quantity and widths.

2.2 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
2.3 STEEL FINISHES

A. Baked-Enamel or Powder-Coat Finish: Manufacturer’s standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat to achieve a minimum dry film thickness of 2 mils.

1. Color and Gloss:
   a. All shelving and support components: Equal to Madix ‘Snow White’
   b. Kick plates: Equal to Madix ‘Satin Black’

2.4 ACCESSORIES

A. Floor Anchors: As required by manufacture’s installation requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas, with Installer present, for compliance with requirements for installation tolerances, location of framing and reinforcements, and other conditions affecting performance of pharmacy shelving systems.

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

3.2 PREPARATION

A. Vacuum finished floor over which shelving is to be installed.

3.3 INSTALLATION

A. Install shelving systems at locations indicated on Drawings and according to manufacturer’s written instructions.

B. Starter/Adder Units: Connect groups together with standard fasteners according to manufacturer’s written instructions, using concealed fasteners where possible.

C. Enclosure Panels: Install end panels with concealed fasteners.

D. Level and plumb shelving units to a tolerance of 1/8 inch in 96 inches.

E. Install type of shelves at locations indicated and at spacing indicated or, if not indicated, at equal spacing in each unit.

3.4 ANCHORAGE

A. Shelving Anchorage: Install shelving using floor anchors, wall anchors, or top bracing in locations recommended by manufacturer and as indicated on Shop Drawings.

3.5 CLEANING AND PROTECTING
A. Repair or remove and replace defective work as directed on completion of installation.

B. Clean finished surfaces, touch up as required, and remove or refinish damaged or soiled areas to match original factory finish, as approved by Owner’s Representative.

C. Protect installed products from damage during remainder of the construction period.

END OF SECTION 11 5126
SECTION 12 2413 - ROLLER WINDOW SHADES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manually operated roller shades with single rollers.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include styles, material descriptions, construction details, dimensions of individual components and profiles, features, finishes, and operating instructions for roller shades.

B. Shop Drawings: Show fabrication and installation details for roller shades, including shadeband materials, their orientation to rollers, and their seam and batten locations.

C. Samples for Verification: For each type of roller shade.

1. Shadeband Material: Not less than 10 inches square. Mark inside face of material if applicable.
2. Roller Shade: Full-size operating unit, not less than 16 inches wide by 36 inches long for each type of roller shade indicated.
3. Installation Accessories: Full-size unit, not less than 10 inches long.

D. Roller-Shade Schedule: Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For roller shades to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Fabricator of products.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver roller shades in factory packages, marked with manufacturer, product name, and location of installation using same designations indicated on Drawings.
1.7 FIELD CONDITIONS

A. Environmental Limitations: Do not install roller shades until construction and finish work in spaces, including painting, is complete and dry and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

B. Field Measurements: Where roller shades are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Allow clearances for operating hardware of operable glazed units through entire operating range. Notify Architect of installation conditions that vary from Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis-of-Design Product: Subject to compliance with requirements, provide As Listed in Appendix A 'Interior Finish Legend' in Specifications or comparable product by one of the following:

1. Draper Inc.
2. MechoShade Systems, Inc.
3. Hunter Douglas

B. Source Limitations: Obtain roller shades from single source from single manufacturer.

2.2 MANUALLY OPERATED SHADES WITH SINGLE ROLLERS

A. Chain-and-Clutch Operating Mechanisms: With continuous-loop bead chain and clutch that stops shade movement when bead chain is released; permanently adjusted and lubricated.

1. Bead Chains: Manufacturer's standard.
   a. Loop Length: Full length of roller shade.
   b. Limit Stops: Provide upper and lower ball stops.
   c. Chain-Retainer Type: Chain tensioner, jamb mounted.

B. Crank-and-Gear Operating Mechanisms: Sealed gearbox drive system controlled by crank handle.

1. Crank-Handle Type: Detachable.
2. Crank-Handle Length: Manufacturer's standard.

C. Rollers: Corrosion-resistant steel or extruded-aluminum tubes of diameters and wall thicknesses required to accommodate operating mechanisms and weights and widths of shadebands indicated without deflection. Provide with permanently lubricated drive-end assemblies and idle-end assemblies designed to facilitate removal of shadebands for service.

1. Roller Drive-End Location: Right side of inside face of shade.
2. Direction of Shadeband Roll: Regular, from back of roller.
D. Mounting Hardware: Brackets or endcaps, corrosion resistant and compatible with roller assembly, operating mechanism, installation accessories, and mounting location and conditions indicated.

E. Shadebands:

2. Shadeband Bottom (Hem) Bar: Steel or extruded aluminum.

F. Installation Accessories:

1. Front Fascia: Aluminum extrusion that conceals front and underside of roller and operating mechanism and attaches to roller endcaps without exposed fasteners.
   a. Shape: L-shaped.
   b. Height: Manufacturer's standard height required to conceal roller and shadeband when shade is fully open, but not less than 4 inches.
2. Installation Accessories Color and Finish: As Listed in Appendix A 'Interior Finish Legend' in Specifications.

2.3 SHADEBAND MATERIALS: RS-1 and RS-2

A. Shadeband Material Flame-Resistance Rating: Comply with NFPA 701. Testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

B. Light-Filtering Fabric: Woven fabric, stain and fade resistant.

2. Type: PVC-coated polyester.
4. Orientation on Shadeband: Up the bolt.
5. Openness Factor: As Listed in Appendix A 'Interior Finish Legend' in Specifications percent.


2. Type: As Listed in Appendix A 'Interior Finish Legend' in Specifications.
3. Roll Width: As shown in drawings.
4. Orientation on Shadeband: Up the bolt.

2.4 ROLLER-SHADE FABRICATION

A. Product Safety Standard: Fabricate roller shades to comply with WCMA A 100.1, including requirements for flexible, chain-loop devices; lead content of components; and warning labels.

B. Unit Sizes: Fabricate units in sizes to fill window and other openings as follows, measured at 74 deg F:

1. Between (Inside) Jamb Installation: Width equal to jamb-to-jamb dimension of opening in which shade is installed less 1/4 inch per side or 1/2-inch total, plus or minus 1/8 inch. Length equal to head-to-sill or -floor dimension of opening in which shade is installed less 1/4 inch, plus or minus 1/8 inch.
2. Outside of Jamb Installation: Width and length as indicated, with terminations between shades of end-to-end installations at centerlines of mullion or other defined vertical separations between openings.

C. Shadeband Fabrication: Fabricate shadebands without battens or seams to extent possible except as follows:

1. Vertical Shades: Where width-to-length ratio of shadeband is equal to or greater than 1:4, provide battens and seams at uniform spacings along shadeband length to ensure shadeband tracking and alignment through its full range of movement without distortion of the material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, operational clearances, and other conditions affecting performance of the Work.

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

3.2 ROLLER-SHADE INSTALLATION

A. Install roller shades level, plumb, and aligned with adjacent units according to manufacturer's written instructions.

1. Opaque Shadebands: Located so shadeband is not closer than 2 inches to interior face of glass. Allow clearances for window operation hardware.

3.3 ADJUSTING

A. Adjust and balance roller shades to operate smoothly, easily, safely, and free from binding or malfunction throughout entire operational range.

3.4 CLEANING AND PROTECTION

A. Clean roller-shade surfaces after installation, according to manufacturer's written instructions.

B. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure that roller shades are without damage or deterioration at time of Substantial Completion.

C. Replace damaged roller shades that cannot be repaired, in a manner approved by Architect, before time of Substantial Completion.

END OF SECTION 12 2413
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Slatwall merchandising and display panels for use at perimeter walls.
2. Free standing floor display units.

1.3 RELATED SECTIONS

A. Section 06 4116 – Plastic Laminate Faced Architectural Cabinets.
B. Section 06 4219 – Plastic Laminate Faced Wood Paneling.

1.4 SUBMITTALS

A. Product Data: Manufacturer's printed product data for each product indicated in this section.
B. Shop Drawings: Manufacturer’s detailed drawings showing product dimensions and features.

1. Edge details for wall and H-Unit display.
3. Attachment details for wall panels.
4. Elevations and connection details for H-Unit displays.
C. Manufacturer’s installation instructions: printed installation instruction outlining recommended procedures.
D. Product Samples:

E. Samples for verification:

1. Slatwall panel: 12 by 12 inches, showing color, pattern, and surface finish, applied to core material and specified edge material applied to one edge. Groove spacing and finish as specified.
2. Six inch piece of aluminum edge trim.

1.5 DELIVERY, STORAGE AND HANDLING
A. Inspect shipments upon receipt. Notify manufacturer if there are any problems with the order. Check to make sure you have the right number of pieces (as stated on the delivery receipt). Check for any outside damage to crates, boxes, or panels. If you find “hidden damage,” call the manufacturer. Take photographs of any damaged goods. Save all packing materials.

B. Store panels in a dry environment. Keep away from outside exposure.

C. Keep panels off the ground. Store units with spacer sticks underneath.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install paneling until building is enclosed, wet work is complete, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where paneling is indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

   1. Locate concealed framing, blocking, and reinforcements that support paneling by field measurements before being enclosed and indicate measurements on Shop Drawings.

C. Established Dimensions: Where paneling is indicated to fit to other construction, establish dimensions for areas where woodwork is to fit. Provide allowance for trimming at site, and coordinate construction to ensure that actual dimensions correspond to established dimensions.

1.7 COORDINATION

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

1.8 WARRANTY

A. Manufacturer warrants the shipment of products - the same type, size and quantity as originally ordered.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Basis of Design: Wind Mill Woodworking, Inc., 200 Balsam Road, Sheboygan Falls, Wisconsin 53085 • 920.467.2402 • FAX 920.467.6114 • email: info@windmillslatwall.com website: www.windmillslatwall.com.

B. Comparable product by one of the following:

   1. Marlite
   2. Spacewall International
   3. Palay Display
2.2 MATERIALS

A. Slatwall display wall panels: MDF (medium density fiberboard) with cut grooves to accept standard slatwall accessories for merchandising displays.

1. Standard panel size: ¾” (19.05 mm) x 48” (1220 mm) x 96” (2438 mm) +/- .0625” (1.6mm) on squareness, or +/- .125 (3mm) as measured diagonally across the boards.
2. Board properties: 48 lb. (769 kgs) density with an internal bond strength of 110 lbs (758 kgs) per square inch. MDF has a linear expansion of .30% and a moisture content of 6-8%. The screw holding capacity for the face is 350 lbs (159 kgs) and 275 lbs (125 kgs) for the edge.
3. Groove spacing: Slatwall groove spacing are: 3” oc (on-center)(75 mm)
4. Groove measurements: Opening: 3/8” (9.525 mm), lip: ¼” (6.350 mm), groove: ¼” (6.350 mm), back ¼” (6.350 mm).
5. Surface finish: High pressure laminate, cabinet grade thickness. .020” (0.51 mm) thick, bonded with a vinyl acetate copolymer glue to MDF via cold press laminating line.
7. Edge trim: extruded clear anodized aluminum all exposed edges.
8. Finish: As indicated on Appendix A – Interior Finishes Key.
9. Locations: Pharmacy Retail, as indicated on Drawings.

B. Free-standing Slatwall floor display units:

1. Configuration: H-Unit.
2. Display unit size: 48” W x 24” D x 54” H with a 6” tall Base.
   a. Center slatwall panels: 48”W x 48”H.
   b. Side slatwall panels: 24” W x 48” H.
3. Slatwall panel properties: match all properties of wall panels listed above.
4. Groove properties and spacing to match wall panels listed above.
5. Edge trim: extruded clear anodized aluminum all exposed edges.
6. Finish: As indicated on Appendix A – Interior Finishes Key.
7. Locations: Pharmacy Retail, as indicated on Drawings.

2.3 INSTALLATION MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber, kiln dried to less than 15 percent moisture content.

2.4 FABRICATION

A. Complete fabrication, including assembly, to maximum extent possible, before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Shop cut openings, to maximum extent possible, to receive hardware, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

PART 3 - EXECUTION

3.1 PREPARATION
A. Before installation, condition paneling to average prevailing humidity conditions in installation areas.

B. Before installing paneling, examine shop-fabricated work for completion and complete work as required, including removal of packing.

### 3.2 INSTALLATION

A. Install paneling level, plumb, true, and straight with no distortions. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches. Install with no more than 1/16 inch in 96-inch vertical cup or bow and 1/8 inch in 96-inch horizontal variation from a true plane.

B. Anchor paneling to supporting substrate with blind nailing and/or adhesively. Do not use face fastening unless otherwise indicated.

C. Install over wall-board directly onto studs (wood, or metal).

D. Panel adhesive is recommended for permanent installations.

E. Drywall screws of the proper length work well. Note: Other wood screws with the proper sized head can work, as well.

F. Drive screws through the center of the back of the grooves. Take care not to damage the grooves lips during installation.

G. Cutting to size should be done so the saw blade enters the grooved side of the panel (to avoid chip-out). Always check the direction of the saw blade prior to cutting. Note: Table saw blades and portable circular saw blades often spin in opposite directions.

H. Follow mounting instructions located on the stickers adhered to the backs of the panel. Note: Mounting instruction stickers indicate the “fence side of the panel during the machining process. "Installing the panels keeping all the “fence sides" congruent will afford the optimum groove alignment.

I. During installation, avoid damaging the panel’s surface with adhesives or other installation tools, or materials.

### 3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective paneling and display units, where possible, to eliminate defects; where not possible to repair, replace paneling or display unit. Adjust for uniform appearance.

B. Clean paneling and display units on exposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

C. Protect any necessary surrounding surfaces from damage during installation.

### 3.4 CLEAN UP

A. Do not use harsh abrasives, or cleaning solvents - they may damage the surface finish.
B. Soft cloth rags and gentle cleaning solvents work best.

END OF SECTION 12 3500
SECTION 12 3623.13 - PLASTIC-LAMINATE-CLAD COUNTERTOPS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes plastic-laminate countertops.

1.3 ACTION SUBMITTALS
A. Product Data: For each type of product, including, panel products, and high-pressure decorative laminate.
   1. Include data for fire-retardant treatment from chemical-treatment manufacturer and certification by treating plant that treated materials comply with requirements.
B. Shop Drawings: Show location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.
   1. Show locations and sizes of cutouts and holes for plumbing fixtures installed in plastic-laminate countertops.
C. Samples for Initial Selection:
   1. Plastic laminates.
D. Samples for Verification:
   1. Plastic laminates, 12 by 12 inches, for each type, color, pattern, and surface finish and specified edge material applied to one edge.
   2. Wood-grain plastic laminates, 24 by 24 inches, for each type, pattern and surface finish and specified edge material applied to one edge.

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

1.5 FIELD CONDITIONS
A. Environmental Limitations: Do not deliver or install countertops until building is enclosed, wet work is complete, and HVAC system is operating and maintaining temperature between 60 and...
90 deg F and relative humidity between 25 and 55 percent during the remainder of the construction period.

B. Field Measurements: Where countertops are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication, and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

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

PART 2 - PRODUCTS

2.1 PLASTIC-LAMINATE COUNTERTOPS

A. Quality Standard: Unless otherwise indicated, comply with the "Architectural Woodwork Standards" for grades indicated for construction, installation, and other requirements.

B. Grade: Premium.

C. High-Pressure Decorative Laminate: NEMA LD 3, Grade HGS.
   1. Manufacturers: Subject to compliance with requirements, provide products by the following:
      a. Refer to Appendix A "Interior Finish Key" for manufacturer, color and texture.

D. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
   2. Grain Direction: Parallel to cabinet fronts.

E. Edge Treatment: 3-mm PVC edging.

F. Core Material: Particleboard or medium-density fiberboard.

G. Core Material at Sinks: medium-density fiberboard made with exterior glue or exterior-grade plywood.

H. Core Thickness: 3/4 inch.
   1. Build up countertop thickness to 1-1/2 inches at front, back, and ends with additional layers of core material laminated to top.

I. Backer Sheet: Provide plastic-laminate backer sheet, NEMA LD 3, Grade BKL, on underside of countertop substrate.


K. Support Brackets:
   1. Metal Support Brackets as listed in Appendix A 'Interior Finish Legend'
2.2 **WOOD MATERIALS**

A. Wood Products: Provide materials that comply with requirements of referenced quality standard unless otherwise indicated.

1. Wood Moisture Content: 5 to 10 percent.

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

1. Particleboard: ANSI A208.1, Grade M-2, made with binder containing no urea formaldehyde.

2.3 **ACCESSORIES**

A. Grommets for Cable Passage through Countertops: 2-inch OD, black, molded-plastic grommets and matching plastic caps with slot for wire passage.

1. Product: Subject to compliance with requirements, provide "OG series" by Doug Mockett & Company, Inc.

2.4 **FABRICATION**

A. Fabricate countertops to dimensions, profiles, and details indicated. Provide front and end overhang of 1 inch over base cabinets. Ease edges to radius indicated for the following:

1. Solid-Wood (Lumber) Members: 1/16 inch unless otherwise indicated.

B. Complete fabrication, including assembly, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Notify Architect seven days in advance of the dates and times woodwork fabrication will be complete.
2. Trial fit assemblies at fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements before disassembling for shipment.

C. Shop cut openings to maximum extent possible to receive appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

1. Seal edges of openings in countertops with a coat of varnish.
PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition countertops to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

A. Grade: Install countertops to comply with same grade as item to be installed.

B. Assemble countertops and complete fabrication at Project site to the extent that it was not completed in the shop.

1. Provide cutouts for appliances, plumbing fixtures, electrical work, and similar items.
2. Seal edges of cutouts by saturating with varnish.

C. Field Jointing: Where possible, make in the same manner as shop jointing, using dowels, splines, adhesives, and fasteners recommended by manufacturer. Prepare edges to be joined in shop so Project-site processing of top and edge surfaces is not required. Locate field joints where shown on Shop Drawings.

1. Secure field joints in plastic-laminate countertops with concealed clamping devices located within 6 inches of front and back edges and at intervals not exceeding 24 inches. Tighten according to manufacturer’s written instructions to exert a constant, heavy-clamping pressure at joints.

D. Install countertops level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches.

E. Scribe and cut countertops to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

F. Countertops: Anchor securely by screwing through corner blocks of base cabinets or other supports into underside of countertop.

1. Install countertops with no more than 1/8 inch in 96-inch sag, bow, or other variation from a straight line.
2. Secure backsplashes to walls with adhesive.
3. Seal junctures of tops, splashes, and walls with mildew-resistant silicone sealant or another permanently elastic sealing compound recommended by countertop material manufacturer.

3.3 ADJUSTING AND CLEANING

A. Repair damaged and defective countertops, where possible, to eliminate functional and visual defects; where not possible to repair, replace woodwork. Adjust joinery for uniform appearance.

B. Clean countertops on exposed and semiexposed surfaces. Touch up shop-applied finishes to restore damaged or soiled areas.

END OF SECTION 12 3623.13
SECTION 12 3661 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Solid-surface-material countertops and backsplashes.
   2. Quartz agglomerate countertops and backsplashes.

1.3 ACTION SUBMITTALS
A. Product Data: For countertop materials and sinks.
B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.
C. Samples for Initial Selection: For each type of material exposed to view.
D. Samples for Verification: For the following products:
   1. Countertop material, 6 inches square.
   2. One full-size solid-surface-material countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.
   3. One full-size quartz agglomerate countertop, with front edge and backsplash, 8 by 10 inches, of construction and in configuration specified.

1.4 PROJECT CONDITIONS
A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.5 COORDINATION
A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 SOLID-SURFACE-MATERIAL COUNTERTOPS (SS-1, SS-2, SS-3, SS-4)
A. Configuration: Provide countertops with the following front and backsplash style:
1. Front: Straight, slightly eased at top.
2. Backsplash: Straight, slightly eased at corner.

B. Countertops: 3/4-inch- thick, solid surface material with front edge built up with same material.

C. Backsplashes: 3/4-inch- thick, solid surface material.

D. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes unless otherwise indicated. Comply with solid-surface-material manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
   1. Fabricate with loose backsplashes for field assembly.
   2. Install integral sink bowls in countertops in the shop.
   3. Metal Support Brackets as listed in Appendix A 'Interior Finish Legend'.

2.2 QUARTZ AGGLOMERATE COUNTERTOPS

A. Configuration: Provide countertops with the following front and backsplash style:
   1. Front: Straight, slightly eased at top.
   2. Backsplash: Straight, slightly eased at corner.
   4. Metal Support Brackets as listed in Appendix A 'Interior Finish Legend'.

B. Countertops: 3/4-inch- thick, quartz agglomerate with front edge built up with same material.

C. Backsplashes: 3/4-inch- thick, quartz agglomerate.

D. Fabrication: Fabricate tops in one piece with shop-applied edges and backsplashes unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
   1. Fabricate with loose backsplashes for field assembly.
   2. Install integral sink bowls in countertops in the shop.

2.3 COUNTERTOP MATERIALS

A. Solid Surface Material: Homogeneous solid sheets of filled plastic resin complying with ANSI SS1.
   1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
      a. Refer to Appendix A "Interior Finish Key" for manufacturer, color and texture.
   2. Type: Provide Standard Type unless Special Purpose Type is indicated.
   3. Integral Sink Bowls: Comply with ISSFA-2 and ANSI Z124.3, Type 5 or Type 6, without a precoated finish.

B. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with the "Physical Characteristics of Materials" Article of ANSI SS1.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. Refer to Appendix A "Interior Finish Key" for manufacturer, color and texture.

2. Colors and Patterns: Match Architect's samples.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install countertops level to a tolerance of 1/8 inch in 8 feet

B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.

1. Install backsplashes and endsplashes to comply with manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.

END OF SECTION 12 3661
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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Bicycle racks.

B. Related Requirements:
   1. Section 03 3000 "Cast-in-Place Concrete" for installing pipe sleeves cast in concrete footings.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

PART 2 - PRODUCTS

2.1 BICYCLE RACKS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Brandir International, Inc.; Ribbon Bike Rack or a compatible product by one of the following:
   2. Landscape Forms.
   3. Landscape Structures Inc.
   4. Wausau Tile, Inc.

B. Bicycle Rack Construction:
   1. Frame: Stainless steel.
      b. Locking Bars: Solid round bar, not less than 1 inch in diameter.
      a. Overall Height: 35 ¼".
b. Overall Width: As indicated.
c. Overall Depth: As indicated.
d. Capacity: Designed to accommodate no fewer than twelve bikes at each location.


C. Stainless-Steel Finish: No. 4.

2.2 MATERIALS

A. Stainless Steel: Free of surface blemishes and complying with the following:
   1. Sheet, Strip, Plate, and Flat Bars: ASTM A 666.
   2. Pipe: Schedule 40 steel pipe complying with ASTM A 312/A 312M.
   3. Tubing: ASTM A 554.

B. Anchors, Fasteners, Fittings, and Hardware: Stainless steel; commercial quality, tamperproof, vandal and theft resistant.

2.3 FABRICATION

A. Metal Components: Form to required shapes and sizes with true, consistent curves, lines, and angles. Separate metals from dissimilar materials to prevent electrolytic action.

B. Welded Connections: Weld connections continuously. Weld solid members with full-length, full-penetration welds and hollow members with full-circumference welds. At exposed connections, finish surfaces smooth and blended so no roughness or unevenness shows after finishing and welded surface matches contours of adjoining surfaces.

C. Pipes and Tubes: Form simple and compound curves by bending members in jigs to produce uniform curvature for each repetitive configuration required; maintain cylindrical cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of handrail and railing components.

D. Exposed Surfaces: Polished, sanded, or otherwise finished; all surfaces smooth, free of burrs, barbs, splinters, and sharpness; all edges and ends rolled, rounded, or capped.

E. Factory Assembly: Assemble components in the factory to greatest extent possible to minimize field assembly. Clearly mark units for assembly in the field.

2.4 GENERAL FINISH REQUIREMENTS

A. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

2.5 STAINLESS-STEEL FINISHES

A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.

B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
   1. Directional Satin Finish: No 4.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for correct and level finished grade, mounting surfaces, installation tolerances, and other conditions affecting performance of the Work.

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

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written installation instructions unless more stringent requirements are indicated. Complete field assembly of site furnishings where required.

B. Unless otherwise indicated, install site furnishings after landscaping and paving have been completed.

C. Install site furnishings level, plumb, true, and securely anchored at locations indicated on Drawings.

D. Post Setting: Set cast-in support posts in concrete footing with smooth top, shaped to shed water. Protect portion of posts above footing from concrete splatter. Verify that posts are set plumb or at correct angle and are aligned and at correct height and spacing. Hold posts in position during placement and finishing operations until concrete is sufficiently cured.

END OF SECTION 12 9300
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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Lead sheet, strip, and plate.
2. Lead-lined gypsum board.
3. Lead glass.
4. Lead-lined, hollow-metal door frames.
5. Lead-lined flush wood doors.
7. Informational signs.

1.3 DEFINITIONS

A. Lead Equivalence: The thickness of lead that provides the same attenuation (reduction of radiation passing through) as the material in question under the specified conditions.

1. Lead equivalence specified for materials used in diagnostic x-ray rooms is as measured at 100 kV unless otherwise indicated.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show layout of radiation-protected areas. Indicate lead thickness or lead equivalence of components. Show components and installation conditions not fully dimensioned or detailed in product data.

1. Show ducts, pipes, conduit, and other objects that penetrate radiation protection; include details of penetrations.

C. Product Schedule: For observation windows, doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings. Coordinate with final door hardware schedule.

1.5 INFORMATIONAL SUBMITTALS

A. Sample Warranty: For warranty.
1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For neutron-shielding doors to include in operation and maintenance manuals.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Lead-Lined Gypsum Panels: Neatly stack panels flat to prevent deformation.

B. Lead-Lined, Hollow-Metal Doors and Frames: Comply with requirements in Section 08 1113 "Hollow Metal Doors and Frames" for delivery, storage, and handling.

C. Lead-Lined Flush Wood Doors: Comply with manufacturer’s written instructions and requirements in WDMA I.S.1-A.
   1. Mark each door on top and bottom rail with opening number used on Shop Drawings.

1.8 FIELD CONDITIONS

A. Environmental Limitations: Do not deliver or install radiation protection until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and temporary HVAC system is operating and maintaining ambient temperature and humidity conditions at occupancy levels during the remainder of the construction period.

1.9 WARRANTY

A. Warranty for Lead-Lined Flush Wood Doors: Comply with requirements in Section 08 1416 "Flush Wood Doors."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Provide materials and workmanship, including joints and fasteners, that maintain continuity of radiation protection at all points and in all directions equivalent to materials specified in thicknesses and locations indicated.
   1. Materials, thicknesses, and configurations indicated are based on radiation protection design prepared by Owner’s radiation health physicist. This design is available to Contractor on request.

B. Lead-Lined Assemblies: Unless otherwise indicated, provide lead thickness in doors, door frames, window frames, penetration shielding, joint strips, film transfer cabinets, and other items located in lead-lined assemblies not less than that indicated for assemblies in which they are installed.

C. Lead Glazing: Unless otherwise indicated, provide lead equivalence not less than that indicated for assembly in which glazing is installed.
2.2 **MANUFACTURERS**

A. Source Limitations: Obtain each type of radiation protection product from single source from single manufacturer.

2.3 **MATERIALS**


B. Grout: ASTM C 476, with a slump of 8 to 11 inches as measured according to ASTM C 143/C 143M.

C. Lead-Lined Gypsum Board: 5/8-inch-thick gypsum board complying with Section 09 2900 "Gypsum Board," of width and length required for support spacing and to prevent cracking during handling, and with a single sheet of lead laminated to the back of the board.

1. Lead Sheet Lining: Full width and length of board.
2. Furnish 3-inch-wide lead strips for wrapping metal stud flanges.
3. Furnish 2-inch-wide lead strips for backing joints.
5. Furnish finishing materials, accessories, and trim for lead-lined gypsum board complying with Section 09 2900 "Gypsum Board."

D. Lead Glass: Lead-barium, polished glass containing not less than 60 percent heavy metal oxides, including not less than 48 percent lead oxide by weight.

   a. Outer Ply: Clear float glass.
   b. Interlayer: Clear polyvinyl butyral.
   c. Inner Ply: Lead glass; thickness as needed to provide lead equivalence indicated.

E. Glazing Compounds, Gaskets, and Accessories: Comply with requirements in Section 08 8000 "Glazing."

F. Accessories and Fasteners: Manufacturer’s standard fasteners and accessories as required for installation, maintaining same lead equivalence as rest of system.

G. Asphalt Coating: Cold-applied asphalt emulsion complying with ASTM D 1187/D 1187M.

H. Asphalt Felt: ASTM D 226/D 226M.

2.4 **LEAD-LINED, HOLLOW-METAL DOOR FRAMES**

A. General: Steel door frames complying with NAAMM-HMMA 861, except 0.0667 inch thick, lined with lead sheet of thickness not less than that required for doors and walls where frames are used.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. same manufacturer as other doors on project.
2. Furnish with additional reinforcements and internal supports to adequately carry the weight of lead-lined doors. Install reinforcements and supports before installing lead lining.

3. Form lead sheet to match frame contour, continuous in each jamb and across the head, lapping the stops. Form lead shields around areas prepared to receive hardware. Fabricate lead lining wide enough to maintain an effective lap with lead of adjacent shielding.

4. Finish: Apply manufacturer's standard primer immediately after cleaning and pretreating.

2.5 LEAD-LINED FLUSH WOOD DOORS

A. Lead-Lined Flush Wood Doors: Solid-core wood doors with lead lining, thickness not less than that required for partition in which door is installed.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. same manufacturer as other doors on project.

2. Door Construction: Veneer face, five ply, bonded particleboard core.

3. Lead Lining: One or more continuous sheets of lead extending from top to bottom and edge to edge, constructed either in the core or between the core and faces, at manufacturer's option.

4. Comply with Section 08 1416 "Flush Wood Doors" for grade, faces, veneer matching, performance grade, fabrication, finishing, and other requirements unless otherwise indicated.

B. Quality Standard: In addition to requirements specified, comply with WDMA I.S.1-A, "Architectural Wood Flush Doors."

1. Grade: Premium.

2. Face Veneer Species and Cut: Select White Birch, plain sliced.
   b. Factory finish with stain and transparent finish to match remained of doors.

C. WDMA I.S.1-A Performance Grade: Extra Heavy Duty.

D. Factory fit doors to suit frame openings indicated with 1/16-inch clearance at heads and jambs and minimum clearance at bottom. Factory machine doors for hardware not surface applied.

2.6 LEAD-LINED, OBSERVATION-WINDOW FRAMES

A. General: Fabricate from 0.043-inch-thick, formed-steel sheet or 0.064-inch-thick aluminum extrusions with mitered corners, welded or bolted with concealed fasteners.

1. Line with lead sheet formed to match frame contour, continuous in each jamb and across head and sill, lapping the stops, and fabricated wide enough to maintain an effective lap with lead of adjoining assemblies.

2. Construct so lead lining overlaps glazing material perimeter by at least 3/8 inch and furnish removable stops.

3. Form sill with an opening for sound transmission. Offset sound passage to make opening lightproof and to maintain required lead equivalence at all points and in all directions.
2.7 INFORMATIONAL SIGNS

A. Informational Signs: High-pressure-laminate engraving stock with contrasting face and core, machine engraved from master templates for accurately formed letters, numbers, and symbols.

1. Color: As selected by Architect from manufacturer's full range of colors.
2. Provide copy indicated or as directed.
3. Indicate lead equivalence in millimeters and heights of radiation protection in inches.

B. Rooms Where the Level of Protection Is Uniform Throughout: Provide one sign for each room indicating lead equivalence of partitions, ceilings, floors, doors, and other portions of radiation protection enclosure. Indicate height of radiation protection above floor or indicate that partitions are radiation protected to full height.

C. Rooms Where Some Partitions Are without Radiation Protection: Provide one sign for each partition that contains radiation protection and indicate its lead equivalence. Indicate height of radiation protection above floor or indicate that partitions are radiation protected to full height.

2.8 DOOR AND DOOR FRAME FABRICATION

A. Hardware Preparation: Factory prepare doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to the Door Hardware Schedule and templates furnished as specified in Section 08 7100 "Door Hardware."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates in areas to receive radiation protection, with Installer present, for compliance with requirements, installation tolerances, and other conditions affecting performance of radiation protection.

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

3.2 INSTALLATION OF LEAD-LINED GYPSUM BOARD

A. Install with long edge parallel to supports and lead lining facing supports. Provide blocking at end joints. Install using construction adhesive and supplementary fasteners.

B. Fastening to Metal Supports: Use steel drill screws spaced as recommended in writing by gypsum board manufacturer.

1. Install lead strips covering face of framing and wrap around flange to cover points of screws. Where possible, install lead-lined gypsum board before installing gypsum board on other side of partition, and do not fold lead strips back over inside of flange until after lead-lined gypsum board is applied. Apply lead disks recessed flush with surface of board over heads of screws securing trim.

2. Install lead strips, 2 inches wide and same thickness as lead lining, to face of supports and blocking where joints occur. Secure lead strips with construction adhesive. Provide shims at face of supports and blocking where joints do not occur.

C. Fastening to Metal Supports: Use steel drill screws spaced as recommended in writing by gypsum board manufacturer.
1. Install lead strips, 2 inches wide and same thickness as lead lining, to face of supports and blocking where joints occur. Secure lead strips with construction adhesive. Provide shims at face of supports and blocking where joints do not occur.

2. Apply lead disks recessed flush with surface of board over heads of screws securing gypsum board and trim.

D. Openings: Extend lead-lined gypsum board into frames of openings, lapping lead lining with lead frames or frame linings at least 1 inch. Arrange board around openings so neither horizontal nor vertical joints occur at corners of openings.

E. Install control and expansion joints where indicated, with appropriate trim accessories. Install lead strip on face of framing, extending across joint, and lap with lead lining of gypsum board.

F. Finish lead-lined gypsum base to comply with Section 09 2613 "Gypsum Veneer Plastering."

G. Finish lead-lined gypsum board to comply with Section 09 2900 "Gypsum Board."

3.3 INSTALLATION OF LEAD-LINED DOORS AND DOOR FRAMES

A. Install lead-lined steel door frames according to Section 08 1113 "Hollow Metal Doors and Frames."

B. Install lead-lined wood doors according to Section 08 1416 "Flush Wood Doors."

C. Frames: Comply with HMMA 840 unless otherwise indicated. Except for frames located in existing walls or partitions, place frames before constructing walls. Set frames accurately in position, plumb, and brace securely until permanent anchors are set.

1. Provide three anchors per jamb, located adjacent to hinge on hinge jamb and at corresponding heights on strike jamb.

2. In metal stud construction, use wall anchors attached to studs with screws.

D. Lap lead lining of frames over lining in walls at least 1 inch.

E. Lead Lining of Frames: Line inside of frames with lead of thickness not less than that required in doors and walls where frames are used. Form lead to match frame contour, continuous in each jamb and across the head, lapping the stops. Form lead shields around areas prepared to receive hardware. Lap lining over lining in walls at least 1 inch.

F. Install doors in frames level and plumb, aligned with frames and with uniform clearance at each edge.

G. Hardware: Line covers, escutcheons, and plates to provide effective shielding at cutouts and penetrations of frames and doors. See Section 08 7100 "Door Hardware" for other installation requirements.

H. Touch up damaged finishes with compatible coating after sanding smooth.

I. Operation: Rehang or replace doors that do not swing or operate freely. Check and readjust operating hardware items, leaving doors and frames undamaged and in proper operating condition.

3.4 INSTALLATION OF LEAD-LINED OBSERVATION WINDOWS

A. Install observation windows according to manufacturer’s written installation instructions.
1. Apply a coat of asphalt mastic or paint to lead lining in frames where lead comes in contact with masonry or grout.

B. Install windows level, plumb, square, true to line, and anchored securely in place to structural support.

C. Install leaded side of frame on radiation side of wall. Lap lead lining of frames over lining in walls at least 1 inch.

D. Glazing: Comply with installation requirements in Section 08 8000 "Glazing" and with manufacturer's written instructions.

3.5 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections after radiology equipment has been installed and placed in operating condition.

B. Correct deficiencies in or remove and replace radiation protection that inspection reports indicate does not comply with specified requirements.

C. Prepare test and inspection reports.

3.6 PROTECTION

A. Lock radiation-protected rooms once doors and locks are installed, and limit access to only those persons performing work in the rooms.

END OF SECTION 13 4900
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20 00 00 BASIC MECHANICAL CONDITIONS

20 00 01 GENERAL

A. This Section includes procedural requirements for the Work of Divisions 20 – 29 to supplement the requirements specified in Division 1.

B. The organization of the Specifications into Divisions, Sections and Subsections, and the arrangement of the Plans shall not in and of itself divide the Work among the Contractors and Subcontractors nor establish the Work to be performed by any trade.

C. The “Scope of Work” and “Work Included” under each respective sectional heading, nevertheless, attempts to segregate the Work by known contracting activities. In the final analysis, the General Contractor shall be responsible for scoping the work for each trade based on local practice to include all the Work of a given type in the related proposal, regardless of where and how identified in the Bid Documents.

20 00 02 SCOPE OF WORK

A. This project is for a new Primary Care Clinic for University of Missouri Health Care located at 7115 East St. Charles Road, Columbia, MO 65202. The design, defined by the Project Documents, provides for Primary Care Clinic.

B. The Mechanical Work for this project shall include all material, labor and services necessary for and incidental to providing the following systems (respective Sections of the Specifications are noted in the right hand column):

1. Basic Mechanical Materials and Methods 20
2. Insulation Work 20
3. Fire Protection System 21
4. Plumbing Work 22
5. HVAC Piping and Equipment 23
6. Air Distribution 24
7. Temperature Control Systems 25

20 00 03 REFERENCES

A. The Plans, the general provisions of the Contract, including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Divisions 20 – 29 of the Specifications.

B. All provisions and conditions cited in this Section shall apply to Work for all other sections of Divisions 20 – 29 of these Specifications.

20 00 04 REFERENCES, REGULATORY REQUIREMENTS

A. All material and equipment shall be listed, labeled or certified by Underwriters Laboratories, Inc., where relevant standards have been established (see also Paragraph 20 00 60). Material and equipment, which are not covered by UL Standards, will be acceptable provided they meet safety requirements of a nationally recognized testing laboratory. Products which no nationally recognized testing laboratory accepts, lists, labels, certifies or determines to be safe will be
considered if inspected or tested in accordance with national industrial standards such as NEMA or ANSI. Evidence of compliance shall include test reports and definitive submittals.

B. Pressure vessels and pressure retaining safety devices shall be certified in accordance with applicable requirements of the ASME Boiler Code.

C. Definitions:

1. “Listed”: A product is “listed” if of a kind mentioned in a list which: Is published by a nationally recognized laboratory which makes periodic inspections of such production. States that such product meets nationally recognized standards or has been tested and found safe for use in a specified manner.

2. “Labeled”: The product is “labeled” if: It embodies a valid label or other identifying mark of a nationally recognized testing laboratory such as UL, Inc. Production is inspected periodically by a nationally recognized testing laboratory. The labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.

3. “Certified”: The product is “certified” if: The product has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in specific manner. Production is inspected periodically by a nationally recognized testing laboratory. The product bears a label, tag or other record of certification.

20 00 05 DEFINITIONS

A. The term “unfinished space” as used in Division 20 - 25 of the Specifications shall be a mechanical or electrical equipment room. These are rooms that are generally unpainted and accessible only to building maintenance personnel.

B. The term “finished space” as used in Division 20 - 25 of the Specifications shall mean any space not defined as “unfinished space” (i.e. occupied rooms, corridors, stairways, closets, etc.).

C. The term “exterior” or “outdoors” as used in Division 20 - 25 of the Specifications shall mean exposed to atmospheric weather conditions.

D. The term “interior” or “indoors” as used in Division 20 - 25 of the Specifications shall mean not exposed to atmospheric weather conditions.

E. The term “concealed” as used in Division 20 - 25 of the Specifications shall mean anything that is not visible in a “finished space”.

F. The term “inaccessible” as used in Division 20 - 25 of the Specifications shall mean located within walls or above non-lay-in ceiling (i.e., drywall, plaster).

G. The term “packaged” as used in Division 20 - 25 of the Specifications shall be construed to be a factory manufactured piece of equipment for which all components are totally assembled, prepped and prewired within its own structure and ready to operate when connected to proper external mechanical and electrical services.

H. The term “cold piping system” as used in Division 20 - 25 of the Specifications shall be a piping system containing media at or below 79 degrees F temperature.
I. The term “ambient piping system” as used in Division 20 - 25 of the Specifications shall be a piping system containing media which is neither heated nor chilled and remains at a temperature range between 80 and 109 degrees F temperature.

J. The term “hot piping system” as used in Division 20 - 25 of the Specifications shall be a piping system containing media at or above 110 degrees temperature.

20 00 06 CODES, STANDARDS, ETC.

A. The material, workmanship and systems for Work of this Division shall comply with all applicable codes, standards, regulations and laws of the legal governmental jurisdiction at the project site.

B. Should the Contractor perform any work that does not comply with the requirements of the applicable codes, standards, regulations, statutes, laws, acts, or which does not receive the approval of the responsible inspection authority, Contractor shall bear all costs arising in correcting the deficiencies.

C. Applicable requirements of the current and accepted edition of the following industry standards, codes and specifications shall apply to the Work for Divisions 20 - 29:

<table>
<thead>
<tr>
<th>Code</th>
<th>Standard Name</th>
<th>Edition</th>
</tr>
</thead>
<tbody>
<tr>
<td>AGA</td>
<td>American Gas Association</td>
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</tr>
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<td>AMCA</td>
<td>Air Moving and Conditioning Association</td>
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<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
<td>20 10 00</td>
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<tr>
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<td>CISPI</td>
<td>Cast Iron Soil Pipe Institution</td>
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<tr>
<td>IEEE</td>
<td>Institute of Electrical &amp; Electronic Engineers</td>
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<td>IPCEA</td>
<td>Insulated Power Cable Engineers Association</td>
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<td>MSS</td>
<td>Manufacturers Standardization Society of Valve and Fitting Industry</td>
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<td>NIST</td>
<td>Institute of Science and Technology</td>
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<td>National Electric Code, including amendments by local authority having jurisdiction</td>
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<td>National Fire Protection Association</td>
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<td>NSF</td>
<td>National Sanitation Foundation</td>
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<tr>
<td>NIOSH</td>
<td>National Institute of Occupational Safety and Health</td>
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<td>Sheet Metal and Air Conditioning Contractors National Association</td>
<td>24 00 00</td>
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<tr>
<td>UL</td>
<td>Underwriters Laboratory, Inc.</td>
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</tbody>
</table>

END OF SECTION
20 10 00 BASIC MECHANICAL MATERIALS and METHODS

20 10 01 GENERAL

A. This Section describes and specifies basic mechanical materials and methods to be utilized in the Work included in other sections of Divisions 20 - 25.

B. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Divisions 20 - 25 of the Specifications.

C. Provisions and conditions cited in this Section shall apply, where and when relevant, to Work of other sections of Divisions 20 - 25 of these Specifications.

20 10 02 REGULATORY REQUIREMENTS

A. Work for this section of the Specifications shall be performed in accordance with the Codes, Standards, etc. as identified in Division 20.

20 10 03 RELATED SECTIONS of the SPECIFICATIONS

A. Requirements of the following Section(s) of the Specifications apply to Work of this Section:

B. Division 20 - Basic Mechanical Conditions

C. Requirements of this Section of the Specifications shall apply to Work of the following sections of Divisions 20 - 29:

1. Division 20 - Insulation Work
2. Division 21 - Fire Protection System
3. Division 22 - Plumbing Work
4. Division 23 - HVAC Piping and Equipment
5. Division 24 - Air Distribution System
6. Division 25 - Temperature Control System

20 10 04 WORK INCLUDED

A. Furnish material, labor and services necessary for and incidental to the installation of the following work where shown on the Plans and as hereinafter specified. Include all necessary work in related sections of the Specifications (sub-section 20 10 03) to perform the Work completely.

B. Identification of piping and equipment for the work of Divisions 20 - 25.

C. Testing, adjusting and balancing of systems for the work of Divisions 20 - 25.

D. Cleaning of piping and equipment for the work of Divisions 20 - 25.

E. Excavation, trenching and backfilling for the work of Divisions 20 - 25.

F. Painting of piping and equipment for the work of Divisions 20 - 25.

G. Demolition for the work of Divisions 20 - 25.
20 10 05 WORK NOT INCLUDED

A. Materials and methods are specified in this section for the work of Divisions 20 - 25. The Work, itself, is specified in the respective sections of Divisions 20 - 25 of the Specifications.

20 10 06 SUBMITTALS

A. The Contractor shall submit materials for the Work of Divisions 20 - 25 for approval in accordance with Section 20 00 43. The requirements are enumerated in the respective sections of Divisions 20 - 25 of the Specifications.

B. Single and multiple manufacturers are cited in this Sub-section as acceptable sources of piping material. While “or equivalent” is not included, the intent of this Section is to permit substitution as defined in Sub-section 20 00 51, EQUIPMENT MANUFACTURERS, unless “no substitution allowed” is noted.

C. The following shall be submitted under this section of the specification:
   1. Firestop schedule and product data, see Section 20 10 20 for specific requirements.
   2. Coordination drawings, see Section 20 10 53 for specific requirements.
   3. Testing and Balancing, see Section 20 10 80 for specific requirements.
   4. Identification, see Section 20 10 90 for specific requirements.
   5. Commissioning, see Section 152300 for specific requirements.

20 10 07 SPECIAL REQUIREMENTS

A. Special requirements for work shall be specified in the respective sections of Divisions 20 - 25 of the Specifications.
20 10 10  BASIC PIPING MATERIALS

A. General:

1. The intent of sub-sections 20 10 11, 20 10 12, and 20 10 13 is to identify materials that may be utilized for Divisions 20 - 25 Work as specified for each specific piping system.

2. Respective piping materials shall be manufactured, fabricated and/or provided in accordance with the ANSI, ASTM, ASME or other accepted industry standard as specified herein.

20 10 11  PIPE AND TUBE

A. General:

1. All pipe and tube material shall be uncoated, unless specified otherwise.

2. Manufacturer's mill reports and applicable documents to certify the validity of procured piping materials shall be on file at the Contractor's office.

B. Steel pipe:

1. Steel pipe shall be specified by finish, size by nominal diameter, ASTM specification number, manufacturing process, wall thickness (by schedule number or decimal dimension) and end preparation as follows:

2.

<table>
<thead>
<tr>
<th>ASTM finish</th>
<th>mfr.</th>
<th>wall method</th>
<th>size range</th>
<th>end thickness</th>
<th>prep</th>
</tr>
</thead>
<tbody>
<tr>
<td>black</td>
<td>A-53</td>
<td>CW/ERW</td>
<td>Sch 40, 80</td>
<td>2&quot; and smaller</td>
<td>T&amp;C</td>
</tr>
<tr>
<td>black</td>
<td>A-53</td>
<td>SMLS</td>
<td>Std, Sch 40, 80</td>
<td>all</td>
<td>PE/T&amp;C</td>
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<tr>
<td>black</td>
<td>A-106</td>
<td>SMLS Grade A</td>
<td>Std, Sch 40, 80</td>
<td>all</td>
<td>PE/T&amp;C</td>
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<tr>
<td>galv</td>
<td>A-53</td>
<td>SMLS Grade A</td>
<td>Std, Sch 40, 80</td>
<td>all</td>
<td>PE/T&amp;C</td>
</tr>
</tbody>
</table>

a. Per ANSI B36.10, schedule 40 is standard weight pipe for 10" pipe size and smaller.

b. Schedule 80 in this pipe size range is extra strong pipe.

c. Standard weight pipe for all sizes 12" and larger is 0.375" wall thickness and are generally not referred to by schedule number.

d. Outside diameters of pipe sizes 14" and larger are even whole numbers (e.g. - 18" O.D., 20" O.D., etc.)

CW = continuous weld
ERW = electric resistance weld
SMLS = seamless
PE = plain end
T&C = threaded and coupled

3. All steel pipe shall be mill coated and rust free.

C. Copper tube:

1. Type K, L, and M copper tube shall be in accordance with ASTM B88. Tubing is available in various finished products and wall thickness, which must be called out as well as sizes being either "nominal" or "outside diameter" (O.D.) since there are overlaps in smaller sizes.

2. size annealed type range hard soft application
K ¼”-2” x heaviest wall, underground water (ASTM B-88)
L ¼”-8” x general use, HVAC, refrig., plumbing (ASTM B-88)
M ¼”-8” x lightest, gravity drains and vents (ASTM B-88)
DWV 1-1/4”-6” x plumbing drains and vents (ASTM B-306)
Refr./ACR 1/8”-4-1/8” x O.D. tube, refrigeration (ASTM B-280)

D. Cast iron pipe:
1. Hub and spigot soil pipe shall be accordance with ASTM A-74. Available in service weight and extra heavy, both with coal tar coating, 5 foot and 10 foot lengths, single and double hub ends, range 2” - 15” diameter.

2. No-hub soil pipe shall be in accordance with ASTM A-888, CISPI 301. Available with coal tar coating, 5 foot and 10 foot lengths, range 1-1/2” - 10” diameter.

E. Plastic pipe:
1. PVC pressure rated schedule 40 (white) and schedule 80 (gray) pipe shall be in conformance with ASTM D-1785.
2. CPVC pressure rated Schedule 40 and Schedule 80 pipe shall be in conformance with ASTM F-441.
3. PVC DWV pipe for non-pressure applications shall be schedule 40 pipe in conformance with ASTM D-1785.
4. SDR PVC sewer pipe outside of building shall be in conformance with ASTM D-3034 and ASTM F-477.

F. Ductile iron pipe:
1. Ductile iron pipe shall meet requirements of ANSI/AWWA C150/A21.5. Thickness class shall be in accordance to the pressure class, installed depth, and laying condition and meet requirements of ANSI/AWWA C151/A21.51.
2. Pipe shall be cement mortar lined with bituminous seal coat for ductile iron pipe and shall meet ANSI/AWWA C104/A21.4.
3. Pipe shall be exterior coated with bituminous for ductile iron pipe and shall meet ANSI/AWWA C106.

G. Polyethylene:
1. Material used for the manufacture of high density polyethylene pipe and fittings shall be categorized as extra high molecular weight and meet all requirements for a grade PE24. The high density polyethylene material shall be a cell class of 234343E per ASTM D3350 and shall be assigned a Plastics Pipe Institute (PPI) recommended designation of PE2406 and a 60°C Hydrostatic Design Basis (HBD). Pipe manufacturer shall be a member in good standing of the Plastic Pipe Institute.
2. Pipe and fittings shall be manufactured from material meeting the requirements of above, and all appropriate requirements of Part 192 of the Federal Minimum Safety Standards. The manufacturer shall certify that samples of the manufacturer’s production product have been tested in-house in accordance with ASTM D2837, and validated in accordance
with the latest revision of PPI TR-3. IPS dimensional, markings, and performance characteristics shall conform to the requirements of ASTM D2513.

3. Both pipe and fittings shall carry the same pressure rating. All fittings shall be pressure rated to match the system piping to which they are joined. Socket type fittings shall comply with ASTM D2683. Butt fusion fittings shall comply with ASTM D3261. The manufacturer of the pipe shall be the same manufacturer of the fabricated fittings and other fabrications. The manufacturer shall certify that the materials used to manufacture pipe and fittings meet the requirements of this specification.

4. The pipe shall have product traceability. This shall be accomplished by the inclusion of a product code into the printline of all products. This shall note the manufacturer, the date of manufacture, the lot and supplier of raw material, the location of manufacturer, and the production shift on which the product was produced.

5. Pipe and fittings shall be butt fusible according to the manufacturer recommended procedures. The socket or sidewall fittings shall also be to manufacturer’s recommended procedures. Pipe and fittings may also be joined with flanged adapters.


7. The pipe and fittings shall be PE2708 as manufactured by Isco Industries, JE Eagle, Performance Pipe or approved equivalent.

H. Fiber Reinforced Plastic Pipe

1. Red Thread Type
   a. Fiber reinforced plastic pipe (FRP) shall meet a maximum water service temperature of 210°F and maximum static pressure of 450 psi (4" pipe). Operating parameters shall meet 210°F at 150 psi cyclic (2" - 16" pipe).
   b. FRP pipe shall meet requirements of ASTM D2996 designation code RTRP-11AF1-2111 and testing methods as per ASTM D2992, D1599, D2105, D2412.
   c. Manufacturer of FRP piping system shall be Smith Fibercast Red Thread II or equivalent by Bondstrand.

2. Green Thread Type
   a. Fiber reinforced plastic pipe (FRP) shall meet a maximum water service temperature of 225°F and maximum static pressure of 300 psi (3" pipe). Operating parameters shall meet 225°F at 150 psi cyclic (1" - 16" pipe).
   b. FRP pipe shall meet requirements of ASTM D2996 designation code RTRP-11FF1-3112 and testing methods as per ASTM D2992, D1599, D2105, D2412.
   c. Manufacturer of FRP piping system shall be Smith Fibercast Green Thread or equivalent by Bondstrand.

3. Fiber Reinforced Plastic Insulated Piping System
   a. Carrier pipe shall be FRP as listed above and per the service use.
   b. Insulation shall be polyurethane foam with minimum characteristics of K factor = .13, density 2 pcf, closed cell content - 90-95% in conformance with MIL-I-24172 and ASTM C-591 completely filling the annular space between carrier pipe and jacketing.
   c. Jacketing Material shall be high impact, seamless polyvinylchloride (PVC) Class 12454-B conforming to ASTM 1784, Type 1 Grade 1.
   d. Each length of pre-insulated pipe shall be fitted with watertight mastic end seal at jacket and pipe surfaces. All field cuts shall be sealed with a field applied end seal.

4. Fittings Shall Be Preinsulated
a. All joints shall have field applied insulation, jacket sleeve and field applied shrink material over jacket sleeve.
b. Manufacturer of insulated FRP piping system shall be Rovanco Piping Systems, Inc. or equivalent by Perma-Pipe/Ricwil, Thermacor Process, Inc.

5. Fiber Reinforced Plastic Pipe
   a. Fiber reinforced plastic pipe fittings shall be either compression molding or spray-up/contact molding methods with same type materials as FRP pipe.
   b. Fittings shall be adhesive bonded matched tapered bell and spigot.
   c. Flanges shall be in accordance with ASTM D4024 and have ANSI B16.5 Class 150 bolt hole patterns.

20 10 12  FITTINGS

A. Cast iron:
   1. Screwed fittings and flange unions: 125# standard and 250# extra heavy threaded in accordance with ANSI B16.4 (except plugs and bushings which are ANSI B16.14). Available in black or galvanized, range ¼” - 8”.
   2. Flanged fittings and flanges: 125# standard, flat faced in accordance with ANSI B16.1. 250# extra heavy, raised face in accordance with ANSI B16.2. Flange facing and drilling shall be in accordance with ANSI B16.5. Available black and limited galvanized, range 1-1/2” - 12”.
   3. Flanged elbows shall be long radius (1.5 x diameter), short radius elbow are not permitted, unless specifically noted.
   4. Drainage fittings: recessed pitched threads for non-pressurized applications. Available in standard black uncoated, coated or galvanized, range 1-1/4” - 8”.
   5. Soil pipe hub and spigot and no-hub fittings shall be accordance with ASTM A-74, ANSI A-112.5.1, CISPI std #301 and HS-82. Hub and spigot fittings available in service weight and extra heavy, coal tar coating, range 2” - 15” diameter. No-hub fittings with coal tar coating, range 1-1/2” - 10”.

B. Malleable iron:
   1. Fittings: 150# Sat. steam (300 WOG), 300# Sat. steam (600 WOG), in accordance with ANSI B16.3. Available in black and galvanized, range 1/8” – 6”.
   2. Unions: 150# Sat. steam (300 WOG), 250# Sat. steam (500 WOG), 300# Sat. steam (600 WOG), threads in accordance to ANSI B2.1, hexagonal stock ASTM A197, ground joint type bronze-to-iron, range 1/8” – 3”.

C. Forged steel:
   1. Fittings: 2000#, 3000# and 6000# threaded in accordance with MSS SP49 - SP50. 3000# and 6000# socket weld in accordance with ANSI B16.11/MSS SP79. Available black and electro zinc plated; socket weld for schedule 80 bore. Range 1/8” - 4”.
   2. Unions: 3000# threaded and socket weld, steel to steel and brass to steel: 6000# threaded and socket weld, steel to steel only all in accordance with MSS SP83. Available 3000# black and electro zinc plated, 6000# black only, range 1/8” - 4”.
   3. “Weldolets, Threadolets, Sockolets and Elbolets”: In accordance with ANSI B36.10/ASTM A216, except Elbolets which are ANSI B16.11. Weldolets available standard and extra strong, black only, range 1/8” - 24”. Others available 3000# and 6000#, black only, range 1/8” - 4” (limited). Source: Bonney Forge.
D. Butt weld:
   1. Butt welding fittings shall be in accordance with ASTM A-234 and ANSI B16.9. End preparation of butt welding fittings shall be in accordance with ANSI B16.25.
   2. Elbows shall be long radius (1.5 x diameter), short radius elbows, and 180-degree returns are not permitted, unless specifically noted.

E. Forged steel flanges:
   1. 150# and 300# forged steel flanges shall be manufactured to the requirements of ASTM A-181 with dimension in accordance to ANSI B16.5. Flange faces shall be flat or raised face as required.
   2. Forged steel flanges shall be furnished as weld neck pattern. Slip-on, lightweight slip-on (drilled to 125# ANSI standards) and orifice flanges shall be provided only where specified and/or noted.

F. Copper (alloy and bronze) shall be in conformance with the following ANSI specifications:
   1. Cast bronze threaded fittings: ANSI B16.15
   2. Cast copper alloy solder fittings: ANSI B16.18
   3. Wrought copper pressure solder fittings: ANSI B16.22
   4. Cast copper DWV solder fittings: ANSI B16.23
   6. Cast copper alloy for flared tubing: ANSI B16.26
   7. Wrought copper DWV solder fittings: ANSI B16.29
   8. Short radius 90 degrees elbows and 180 degree returns are not permitted, unless specified and/or specifically noted.

G. Grooved:
   1. All grooved components shall be of one manufacturer made in accordance with ANSI B-31.1, B-31.9. Fittings shall be ANSI 150#, 300# cast of ductile iron in accordance with ASTM A-536, Grade 65-45-12. Fittings shall have an enamel finish. Segmentally welded fittings are not acceptable.
   2. Only the following fittings will be accepted: Long radius (1.5 x diameter) 90° and 45° elbows, tee, reducing tee, concentric/eccentric reducers, and flange adapter nipples. Flange rings, reducing couplings, saddle tee, and others not listed above are not acceptable.

H. Ductile iron:
   1. Ductile iron fittings shall meet requirements of ANSI/AWWA C110/A21.10 with thickness equal to Class 54 ductile iron pipe in accordance with ANSI/AWWA C151/A21.51.
   2. Ductile iron fittings shall be cement mortar lined with bituminous seal coat and shall meet the requirements of ANSI/AWWA C104/A21.4.
   3. Ductile iron fitting shall be exterior coated with bituminous and shall meet the requirements of ANSI/AWWA C106.

I. Miscellaneous
   1. Dielectric flanges and unions:
2. Dielectric unions and flange unions shall be required in piping systems where an electrically insulated connection is needed to separate dissimilar metals from producing galvanic or electrolytic action. Unions shall be rated for 250#; flange unions for 175#. Range: unions ½” - 2”; flange unions 1-1/2” - 12”.

3. Steel threaded nipples:

4. General use: Made from ASTM A-120 pipe in standard (schedule 40) and extra strong (schedule 80). Available black and galvanized, range 1/8” - 6” pipe diameters.

5. High-pressure application: Made from ASTM A-53 seamless pipe and ASTM A106 seamless pressure tube in standard (schedule 40) and extra strong (schedule 80). Available black only, range 2” - 6” pipe diameters.

6. Close nipples are not permitted.

20 10 13 VALVES

A. General:

1. It is indented that valves specifications are for high quality HVAC / Plumbing applications, not lesser quality “Contractor / Value / Economy” series. Valves produced internationally shall be from the Manufacturer’s owned facilities. Valves shall not be manufactured by third party OEM suppliers. Valve submittal shall indicate where the valve is assembled and tested.

2. When two or more valves of the same type are to be used in the same service, all valves of this type shall be of the same manufacturer.

3. Only general valve series are specified. Valves shall have all options, trim, seat material, and accessories as specified whether or not listed as a prefix, suffix or valve number.

4. All valve manufacturers and models listed shall be considered as “acceptable manufacturers” and may be submitted without concern from subsection 20 00 62

5. All valves for use in “cold” piping shall have stem or neck extensions allowing proper insulation and a continuous vapor barrier.

6. No asbestos packing allowed.

B. Ball Valve:

1. 2” and smaller: Bronze ASTM B584 (or low lead bronze for lead-free), 2-piece body, 600 psi WOG, quarter turn lever handle, blow-out proof stem, stem extension (for “cold” applications), full port, virgin TFE seats, all stainless steel trim, threaded or soldered ends. Nibco S-585-70-66, Apollo 77-240, Watts Series B-6081, Hammond 8311 or approved equivalent. Full port valves 2 ½” and 3” the same model numbers as the 2” and smaller valves are also acceptable.

2. 2-1/2” - 3”: Bronze ASTM B584 (or low lead bronze for lead-free), 2-piece body, 600 psi WOG, quarter turn lever handle, blow-out proof stem, stem extension (for “cold” applications), standard port, virgin TFE seats, all stainless steel trim, threaded or soldered ends. Nibco S-585-66, Apollo 70-240, Watts Series B-6001, Hammond 8511 or approved equivalent. Full port valves 2 ½” and 3” the same model numbers as the 2” and smaller valves are also acceptable.

3. Gauge cocks where not specified or specifically identified shall be ¼” bronze 2 piece body ball valves with lever handle and threaded ends per the above specification.
4. Drain valves and air vents shall be ¾” bronze 2 piece body ball valves per the above specification, with ¾” hose end adapter cap and chain. In ½” through 2” pipe, contractor may use Webstone model T-drain.

C. Butterfly:

1. 2” - 24”: Class 200 ASTM A395 ductile iron body, threaded lug type, 1/4 turn, extended neck, peroxide cured EPDM molded-in seat liner, aluminum bronze disc, 416 SS stem, lubersized bronze or Teflon bushings, and stem seals material matching the seat material. Conforms to MSS SP-67 & API 609. Bi-directional bubble tight dead end service with no downstream flange required rated at 200 psi for 2-12”, or 150psi 14” and larger. Valve body shall an integrally cast top plate for direct flush mounting of manual or power actuators without the use of brackets or adapters.
   a. Refer to subsequent paragraphs for operator type based on size and service.
   b. Valves shall be chemically compatible with: up to 4ppm of Chloramines (NH₂Cl, NHCl₂, NCl₃) 40°F-200°F, propylene glycol 0°F-200°F; and NSF-61 rated 40°F-180°F.
   c. Where used in potable water valve shall be “lead free” per 2011 Reduction of Lead in Drinking Water Act.
   d. Valve submittal shall indicate where the valve is assembled and tested.
   e. Valves shall be NIBCO figure LD 2000, Milwaukee ML-133E, Hammond 6411, Bray 31H, Apollo LD-145, Watts DBF-03, or approved equivalent. The following valves are NOT equivalent NIBCO N200, Milwaukee CL series, Hammond 5000 series, Apollo LC series, Watts BF series, or Crane 200 series.

2. Service valves 6” and less shall have a 10-position lever handle; balance valves shall have infinitely adjustable lever handle with memory stop locking option. Service valves and balance valves 8” and larger shall have position indicating worm gear operators with handwheel operator. Control valves shall have actuators as specified in Division 25.

3. Where valves are located above 15'-0” AFF provide gear operator with chain wheel and guide. Provide chain hoods where required, to prevent fouling of chains on equipment and to clear walkways. Terminate chains approximately 6'-3” above the floor.

D. Balancing Valves:

1. General: Balance valves shall provide positive shut-off for service and shall have adjustable memory stops to allow returning to original balanced position after servicing.

2. 3” and smaller: Body shall be bronze or Dezincification Resistant Brass rated to 300 psig. Valves shall be multi-turn, provide positive shut off; include: position indication, memory stops, integral pressure tap ports provided with “drip caps”. Quarter turn valves are not acceptable. Balance valves shall be Nibco 1810, Tour and Anderson 786/787, Apollo 59A, Armstrong CBV, Macon Balancing STV/L Series or approved equivalent.

3. 4” – 12”: Body shall be iron body rated to 300psig with 150# flanges. Valves shall be multi-turn, provide positive shut off; include: position indication, memory stops, integral pressure tap ports provided with “drip caps”. Quarter turn valves are not acceptable. Balance valves shall be Nibco F739, Tour & Anderson 788, Apollo 58A, Armstrong CBV, Macon Balancing STV, Watts CSM-91, or approved equivalent.

4. 14” - 24”: Balance valves shall be butterfly valves with memory stop. Where valve is used in conjunction with balancing a specific piece of equipment (and not general throttling in order to assist in balancing) it shall be used in conjunction with a flow-measuring device.

E. Check:
1. Check valves installed at pump discharge size 2 ½ and larger shall be Silent type, size 2” and smaller may be swing type.

2. 2’” and smaller: Class 125 (125 psi at 400°F, 200 psi at 150°F), bronze, horizontal swing, vertical up-flow, Y pattern, teflon renewable seat and disc in conformance with MSS SP80. Nibco 413, Grinnell 3300, Watts 5000, Crane 1707, Hammond IB904, Stockham B320, or approved equivalent.

3. 2” - 12”: Class 125 (125 psi at 400°F, 200 psi at 150°F), iron body, flanged, horizontal swing, vertical up-flow, bolted bonnet, renewable seat and disc in conformance with MSS SP71, type 1. Nibo 918, Grinnell 6300A, Watts 511, Crane 373, Hammond IR1124, Jenkins 624C, Stockham G931, or approved equivalent.

4. Silent Check Valve: 2-1/2” - 30”, Class 125 (125 psi at 400°F, 200 psi at 150°F), flanged, ASTM A-126 Class B, cast iron body, bronze trim, resilient seat. Nibco F-910, Grinnell Series 500, Milwaukee 125 Class, Mueller 91-AP, or approved equivalent.


6. Silent Check Valve: 2” - 30”, Class 300 (300 psi at 550°F, 600 psi at 150°F), ASTM B61 bronze body, horizontal swing, vertical up-flow, regrinding type, Y pattern renewable seat and disk in conformance with MSS SP80. Nibco T-473, Grinnell 3370, Milwaukee 507, Hammond IB949, or approved equivalent.

F. Gate:

1. Resilient Wedge Domestic/Fire Protection Valve - 2” - 12”: 250 psig non-shock cold working pressure (maximum operating temperature 160°F), ASTM A536 ductile iron body, bolted bonnet, non-rising stem, Peroxide cured EPDM coated ductile iron wedge, epoxy coated inside and outside per AWWA C550. Valves shall be “lead free” per 2011 Reduction of Lead in Drinking Water Act. Valves shall be chemically compatible with: up to 4ppm of Chloramines (NH₂Cl, NHCl₂, NCl₃) 40°F - 160°F and NSF-61 rated 40°F-160°F. Nibco F-619-RW, Mueller A-2360, or approved equivalent.

2. 2” - 12”: 250 psig non-shock cold working pressure (maximum operating temperature 160°F), ASTM A536 ductile iron body, bolted bonnet, non-rising stem, EPDM coated ductile iron wedge, epoxy coated inside and outside per AWWA C550. Nibco F-619-RW, or approved equivalent.

G. Polyethylene:

1. Ball valve: Valve shall be the same size as pipe polyethylene ball valve 150 psig, P.E. 2406 manufactured by Nordstrom.

2. Valve box shall be plastic for a Nordstrom P.E. ball valve, gas lettering, heavy duty, arched base, 6@ ID shaft as manufactured by Handley Industries.

20 10 14 STRainers

A. General:

1. When two or more strainers of the same type are to be used in the same service, all strainers of this type shall be of the same manufacturer.

2. Only general strainer series are specified. Strainers shall have all options, trim, and accessories as specified whether or not listed as a prefix, suffix or the model number.
3. All manufacturers and models listed shall be considered as “acceptable manufacturers” and may be submitted without concern from subsection 150620.

B. “Y” Strainers:

1. 2” and smaller: ANSI 125 lb. (125 psi at 353°F, 200 psi at 150°F), ASTM B62 bronze body and straight thread cap, ASTM A240 304 stainless steel perforated sheetmetal with .033” openings for steam and 1/8” diameter for water service. Mueller 351M, Keckley F-150, Armstrong F4SC, Spirax/Sarco BT, Watts 777/777S, or approved equivalent.

2. 2-1/2” through 12”: ANSI 125 lb. (125 psi at 353°F, 200 psi at 150°F), ASTM A126-B cast iron body and cover, ASTM A240 304 stainless steel perforated sheetmetal with .045” openings for steam and ¼” diameter for water service. Mueller 51, Keckley A, Armstrong A-FL-125, Spirax/Sarco F-125, Watts 77F-D, or approved equivalent.

3. 14” through 24”: ANSI 125 lb. (100 psi at 353°F, 150 psi at 150°F), ASTM A126-B Cast iron body and cover, ASTM A240 304 stainless steel perforated sheetmetal with .045” openings for steam and ¼” diameter for water service. Mueller 751, Keckley A, Spirax/Sarco F-125, or approved equivalent.
20 10 20 MISCELLANEOUS MATERIALS

20 10 21 SLEEVES (NON-WATER PROOF, NON-FIRE RATED)

A. Piping passing through non-fire rated interior walls or floors shall be neatly field cut round holes with hole saws for non-masonry/concrete, and core drill for masonry/concrete. “Beating” an opening in a gypsum or masonry wall shall not be accepted.

B. Install Schedule 40 pipe sleeves where pipes passing through floors of spaces where water could leak to the area below (i.e., mechanical rooms, janitor closets, kitchens, etc.). ID of pipe sleeve shall accommodate pipe insulation. Pipe sleeve shall extend a minimum of 4” above the finished floor, grout the annual space between the oversized core drill in the floor and the sleeve.

C. In new construction, field formed walls or floors, the contractor shall install appropriate blocking or material or pipe sleeves.

20 10 22 WATER SEALS

A. All penetrations through interior to exterior walls or floors shall be sealed water tight using the methods below.

B. In new construction, sleeves shall be hot-dipped galvanized pipe fabrication with continuously welded water stop plate. GPT Industries “Century-Line” CS model (plastic), WS model (steel or SS model “Sleeve-Sec” (modular sections) sleeves may be used at the Contractor's option.

C. The annular space between pipes/conduits and interior to exterior sleeves and sleeve penetrations for service temperatures below 250°F shall be sealed with GPT Industries “Link Seal” Model S-316 EPDM rubber with 316 stainless steel hardware. For service temperatures between 250°F-450°F and model “T” shall be used. Closure seals sizing shall be in accordance with manufacturer's data and application.

D. The Contractor shall submit a schedule of sleeves and seals to the Architect/Engineer for approval indicating the following: carrier pipe size, location, type of sleeve - fabricated with dimensional details or purchased with manufacturer’s support information, seal requirements - none, fire rated, non-fire rate or “Link Seal” with respective support data.

E. Sleeves and seals manufactured by GPT Industries/PSI, Flexicraft Industries, Advance Products & Systems, Metraflex, or equivalent.

20 10 23 FIRESTOPS AND SMOKESTOPS, FIRE RATED/SMOKE PARTITIONS.

A. All penetrations through rated assemblies, walls, shafts, floors, roofs, etc., shall be firestopped in accordance with Local Building Codes, NFPA, U.L. Fire Resistant Directory, and manufacturer's instructions.

B. Provide a FIRESTOP PRODUCT SCHEDULE consisting of the following minimum information:

1. Type – indicate the type of materials, or system.
2. Manufacturer – manufacturer’s name, product name and product number.
3. Mechanical System – indicate which Divisions 20 - 25 items the product is utilized for.
4. Rating – indicate the fire rating and UL detail numbers.
C. Submit the following with the above FIRESTOP PRODUCT SCHEDULE:

1. Manufacturer’s specifications and technical data including installation instructions.
2. Details of each proposed assembly.
3. Manufacturer’s representative who shall provide qualified engineering judgments and drawings for non-standard applications.
4. Contractor’s qualifications and related experience.

D. Materials shall be stored per the manufacturer’s recommendations and as specified for General Project storage in Division 20.

20 10 24 SEALS, NON-FIRE RATED

A. All penetrations through non-rated walls, floors, etc., shall be sealed for draft stopping with caulk, putty, etc., designed for this use.

20 10 25 ESCUTCHEONS

A. Wall, floor, and ceiling plates shall be spun brass, plain pattern, chrome plated, spring type or setscrew fastening. Provide escutcheons for all exposed piping in finished spaces.

20 10 26 FLASHINGS, CURBS, AND EQUIPMENT SUPPORTS

A. Piping and other roof penetrations shall be flashed and/or pitch pocketed by the Contractor in a manner approved by the roofing contractor and specified herein.

B. Single pipe and other round penetrations less than 12” O.D. diameter shall be flashed with Pate Pipe Seal or equal product, which consists of a spun aluminum base, a stepped rubber boot, and stainless steel adjustable clamps.

C. Multiple pipe and other round penetrations less than 12” O.D. diameter shall be flashed with Pate Pipe Curb or equal product, which consists of a galvanized roof curb, thermoplastic cover, rubber boots, and stainless steel adjustable clamps. Pipe curb shall be minimum 24” high.

D. When an irregular shaped member extends above the roof, a pitch pocket fabricated of galvanized or copper sheet metal material shall be provided. The vertical box portion shall extend a minimum of 4” beyond the contained pipe or member, have a solid bottom cut for the penetration and extend at least 6” above the finished roof. The collar portion shall extend a minimum of 9” beyond the vertical box and be fastened to the roof deck. The open space on the inside of the pitch pocket shall be filled with oakum and topped with a minimum thickness of 2” of pitch or roofing cement.

E. Supports for roof mounted equipment piping, and ductwork shall also meet the requirements listed above. All roof supports shall be anchored to the structure in a manner that will transmit all loads including seismic and wind loads from the equipment supports through the roofing to the building structure. Equipment supports shall be equal to Pate model ES-1 and be a minimum 24” high. Refrigerant pipe supports and duct supports shall be equal to Pate model PRS-1. Curbs not specified with the equipment shall be equal to Pate Curbs.
20 10 27  ACCESS DOORS

A. Access to mechanical equipment and ductwork of Divisions 20 - 29 required for testing, adjusting, inspection, maintenance or servicing shall be the responsibility of the Contractor. Doors for manufactured equipment shall be an integral feature included with the respective equipment. Access openings in ductwork shall be included with the fabrication in accordance with SMACNA practices.

B. Openings in building components for access to concealed mechanical work shall be furnished by the Contractor and installed with the building construction work. Access doors shall be located as indicated on the Plans or as strategically required for inspection, maintenance, and service. The model and style shall fit the building construction, fire rating requirements and provide adequate size and function.

C. Access doors shall be sized as shown on the drawings or shall be a minimum size of 18" x 18" and otherwise shall be large enough for purpose intended and shall be fabricated of heavy gauge steel frames and door panels with double action concealed spring hinges, 1/4 turn flush screwdriver operated cam locks and prime coat paint finish. Access doors for various applications shall be as follows:

<table>
<thead>
<tr>
<th>Building Construction</th>
<th>Milcor Access Door</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flush door in dry wall construction (walls and ceilings)</td>
<td>Style DW</td>
</tr>
<tr>
<td>Flush door in masonry or tile walls with exposed frame flange</td>
<td>Style M (steel), Style MS (stainless)</td>
</tr>
<tr>
<td>Flush door in plaster construction (walls and ceilings)</td>
<td>Style K</td>
</tr>
<tr>
<td>Recessed door in acoustical plaster ceiling</td>
<td>Style AP</td>
</tr>
<tr>
<td>Recessed door in suspended drywall ceiling</td>
<td>Style CT (aluminum - wet locations)</td>
</tr>
<tr>
<td>Flush door in suspended drywall ceiling</td>
<td>Style CF (aluminum - wet locations)</td>
</tr>
<tr>
<td>Door in suspended drywall ceiling</td>
<td>Style ATR (fire resistive door)</td>
</tr>
</tbody>
</table>

D. Access doors are not required for Work above lay-in panel ceilings.

E. Submittals shall indicate schedule of locations, sizes, types, adjacent building construction, finish, fire rating including thickness and type of insulation, conformance to UL requirements and associated labeling, metal and gauge of fabrication. Access door shall be as manufactured by Karp Associates, Milcor, or Higgins MfCO.

20 10 28  RESTRICTIONS, GENERAL FOR ALL PIPING SYSTEMS

A. Do not use gaskets or packing containing asbestos.

B. Selections of material and equipment and options for substitution shall conform to the requirements of Sub-section 20 00 60, MATERIAL and EQUIPMENT.

C. “Bull head” tee connections are not permitted, unless approved by the Engineer.

D. Close nipples and bushing reducers are not permitted.

E. Slip joints are permitted in sanitary drainage systems only, on the fixture side of traps.

F. Mitered elbows are not permitted in welded pipe construction.
G. Solder for use in joints of copper piping for domestic (sanitary) cold water, hot water, hot water recirculating and softened water shall not contain lead.

H. Unprotected, non-smoke rated plastic piping material is not permitted in above-the-ceiling spaces used as return air plenums, or exposed in any occupied space.

I. Black and galvanized pipe, fittings, nipples and specialties are not permitted in water piping systems where copper and/or brass are the basic materials.

J. Cast iron fittings are not permitted for gaseous distribution applications.

K. Cast brass/copper fittings are not permitted for gaseous applications including refrigerant lines.

L. Short radius 90-degree elbows and 180-degree returns are not permitted, unless specified and/or specifically noted.

M. The use of pipe hooks, chain and perforated band iron are not permitted for hanging or supporting piping.

N. Power driven inserts and attachments are not permitted unless approved by the Architect/Engineer on express request by the Contractor.

O. Welded attachments to the structural steel of the building are not permitted unless otherwise noted or approved by the Architect/Engineer on specific request of the Contractor.

P. Plastic pipe, fittings, valves and specialties are not permitted for gaseous distribution applications.

Q. Plastic and fiberglass piping systems shall not be tested pneumatically.
20 10 30 JOINTS AND CONNECTION METHODS

20 10 31 THREADED

A. Threads for all screwed pipe systems shall be American National Standard taper threads in accordance with ANSI B-1.201.

B. Threads shall be full, sharp, clean and free of fins and burrs. Pipe ends shall be reamed to remove internal burrs.

C. Threaded connections shall be joined using teflon sealing tape applied to the male threads only.

D. This sub-section does not apply to threads for compression, flare and sanitary drainage slip type drainage fittings.

20 10 32 WELDED

A. Welded joints shall be “V” type butt welds in accordance with ANSI B31.1.

B. The Contractor shall only use welders regularly engaged in the piping trades and certified by the National Certified Welding Bureau, using procedures set forth in ASME Boiler Construction Code, Section IX, “Welding Qualifications”.

C. Contractor shall keep a copy of welder's certification on file at Contractor's office. Upon request the Architect/Engineer may request Contractor to produce certifications. Any pipe installed by a non-certified welder shall be removed if requested by Architect/Engineer.

D. All steel piping shall be cleaned of mill scale and rust before assembly. Welds shall be chipped and hammered after each pass and joints shall be built up to at least the same thickness as that of the pipe wall. All welding shall be done in accordance with the welding procedures of the National Certified Pipe Welding Bureau conforming to the requirements of the ASA Code for Pressure Piping.

E. Architect/Engineer/Owner's Representative/Inspecting Agent shall have the authority to accept or reject the welds and require random samples of installed welds to be removed, tested and inspected.

20 10 33 GROOVED

A. Grooved joints for grooved couplings and fittings shall be in accordance with accepted manufacturer's specifications and practices.

B. Grooves may be cut or rolled in accordance with manufacturer's recommendations for type of pipe, sizes and thicknesses specified for respective systems.

C. Gaskets shall be suitable for the temperature, pressure and compatibility with the fluid contained therein. Unless specifically specified otherwise or incompatibility with the system, gaskets shall be EPDM grade E.

D. Grooved couplings shall be ASTM-A47 grooved malleable iron clamp type couplings as manufactured by Victaulic or equivalent.
E. Grooved couplings for vibration isolation or as unions at equipment connections shall be similar to Victaulic Style 77; all others shall be similar to Victaulic Style 07.

**SOLDERED AND BRAZED**

A. Soldered and brazed connections shall be made in accordance with recommendations of the current edition of the Copper Tube Handbook of the Copper Development Association or as hereinafter specified.

B. General criteria for soldered and brazed joints shall be as follows:

1. Copper tubing shall be square-end cut by varied methods at the Contractor's option. The ends of the tubing shall be reamed to remove both internal and external burrs.
2. Joints for copper piping for hydronic systems, domestic water, temperature controls, DWV systems and other applications of fluids below 250 degrees F. shall be soldered with 95-5 Tin Antimony. 50-50 Tin Lead solder shall not be used.
3. Joints in copper piping for gases, refrigerant lines and other applications operating above 250 degrees F., or where otherwise specified shall be brazed with Copper Phosphorus (BCuP Series), Silver solder (BAg Series), or other approved high temperature brazing alloy.
4. Cleaning of tubing and fittings, application of flux and heat, purging and cooling shall be in accordance with recommendations of solder and brazing alloy manufacturers for the joint type and material specified in the respective “PIPING MATERIAL SCHEDULE” in Section 155000.

C. Copper connections for refrigerant systems shall be made per the following criteria:

1. Screwed joints shall be made with teflon tape applied to the male threads.

**FLANGED**

A. Flanges shall be flat faced or raised faced as required for mating flanges of valves, specialties, equipment connections, etc.

B. Carbon steel hex head machine bolts, ASTM A307, grade 2, with heavy hex nuts shall be used for joining 125 and 150# flanged joints, unless otherwise specified.

C. Alloy steel machine bolts, studs and heavy hex nuts shall be used for joining of 250 and 300# flanged joints, unless otherwise specified.

D. Lubricate the threads of bolts and studs with an acceptable commercial product. Include data with submittal for approval for piping material.

E. Gaskets shall be 1/16" thick non-metallic type conforming to ANSI B16.21 and shall be suitable for the pressure and temperature of the fluid contained therein, shall be provided at all flange joints. Full-faced gaskets shall be used for flat face flanges; ring gaskets shall be used for raised face flanges.

**CAST IRON PIPE AND FITTINGS**

A. Joints for hub and spigot and no-hub cast iron soil pipe and fittings shall be installed in accordance with recommendations of the CISPI, unless noted otherwise.

B. Do not use joint material which has deteriorated or which does not spread easily or smoothly.
C. No-hub couplings shall be NSF Listed and conform to the requirements of CISPI 310, ASTM C1277, FM1680, IAPMO 35-89 and gaskets shall comply with ASTM C564.

1. Band, screw housing, screw, and shield shall all be stainless steel.
2. 1-1/2” through 4” couplings shall have a minimum of two clamps. 5” through 10” couplings shall have a minimum of four clamps. 12” through 15” coupling shall have a minimum of six clamps.
3. Heavy duty couplings (100 in./lbs) shall be ASTM C1540: Anaco/Husky SD-4000 or Clamp-All Hi-Torq 125, Thermafit Industries POC.

20 10 37 MECHANICAL JOINTS

A. Mechanical joints and joining material shall meet the requirements of ANSI/AWWA C111/A21.11.

B. Clean bell and plain end, and lubricate gasket as recommended by manufacturer. The joint area must be free of dirt.

C. All bolts and tie rods shall be galvanized. Tighten bolt to 75-90 ft.-lbs. torque alternating from top to bottom maintaining equal distance between face and gland during tightening.

D. Where flanged joints are used to interface with equipment or other piping materials they shall be flanged joints in accordance with ANSI B16.1. The gaskets shall be full forced, made of rubber and shall meet the requirements of ANSI B16.21.

20 10 38 PLASTIC

A. Solvent cement: Joints in PVC piping shall be made in accordance with manufacturer's guidelines and instructions for CPVC handling, joint preparation, type of primer and solvent/cement, curing time, temperature and testing.

1. PVC pressure piping and DWV - solvent cement shall conform to ASTM D-2564 and primer shall conform to ASTM F-656.
2. CPVC pressure piping - solvent cement shall conform to ASTM F-493.
3. SDR sewer pipe - ASTM D-2855.

B. Gasket: Elastomeric seals (gaskets) for joining plastic piping shall conform to the following:

1. PVC water distribution piping - AWWA C-900, ASTM D-2774 and ASTM D-3139.
2. SDR sewer piping - ASTM D-2321 and ASTM D-3034.
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20 10 40 HANGERS, SHIELDS, SUPPORTS AND ANCHORS

A. General:

1. All hanger devices (e.g. - concrete inserts, expansion anchors, clamps, pipe hangers, strut, etc.) shall be UL approved for the intended service. Material shall be applied within the load limitations prescribed by the respective manufacturer. Loads transmitted to the building shall be within the limitations of the structure.


3. This section shall not apply to Division 21 Fire Protection.

20 10 41 HANGERS

A. Piping shall be supported from the building structure, walls, and floors. Piping shall not be supported from other piping, ductwork, conduits, etc. Loads shall be within the allowable load of building component that is connected to. Piping loads shall include, but not limited to, the weight of the piping, valves, specialties, insulation, pipe covering, pipe content, pressure test media content, wind, snow, seismic, etc.

B. Where piping is indicated on common trapeze hangers, racks, stanchions or brackets, the various trade contractors involved shall agree to a mutually acceptable arrangement among themselves, but each shall be responsible for the correctness and compliance of their work.

C. Pipe hangers, supports, etc. for “cold” piping systems shall have hangers sized for the outside diameter of the insulation in order to maintain a continuous vapor barrier.

D. Pipe hangers for all “ambient” and “hot” piping systems shall be the same size as the pipe, except at roller hangers or supports where the treatment shall be the same as for “cold” piping systems.

E. Hangers, and other supports, anchors, guides, etc. in direct contact with copper piping material shall be copper plated. All others shall be electro-plated for indoor use.

F. The use of pipe hooks, chain, perforated band iron, wire, or cable are not permitted for hanging or supporting piping.

G. Singular, horizontal, suspended piping above grade shall be hung with pipe hangers per the following schedule, unless noted otherwise:

<table>
<thead>
<tr>
<th>Pipe sizes</th>
<th>Piping application</th>
<th>Anvil International type and figure number</th>
</tr>
</thead>
<tbody>
<tr>
<td>3” and smaller</td>
<td>not subject to expansion/contraction</td>
<td>adjustable ring, #69</td>
</tr>
<tr>
<td>4” and larger</td>
<td>not subject to expansion/contraction</td>
<td>adjustable clevis, #260</td>
</tr>
<tr>
<td>2-1/2” and larger</td>
<td>systems with pipe guides and anchors</td>
<td>adjustable steel yoke, #181 (2)</td>
</tr>
</tbody>
</table>
4" and smaller  copper pipe/tubing        adjustable ring, #CT-99
5" and larger  copper pipe               adjustable clevis, #260 (1)
all             vertical risers           riser clamps
                steel                        #261
                copper                        #CT-121

1. hanger to be sized for outside diameter of insulation and to be used with insulation protection shield, figure 167.
2. hanger to be sized for outside diameter of insulation and to be used with insulation protection saddle, figure #160 through figure #165.

H. Hangers, supports, etc. shall position the piping properly in the work, and provide for expansion and contraction.
I. Vertical piping shall be supported at each floor level with riser clamps bearing on the building structure or pipe sleeve.
J. Pipe stands shall be field fabricated to meet the anticipated loads. The base plate shall be spaced 1" minimum above the finished floor with concrete or grout.
K. Wall brackets shall be field fabricated to meet the anticipated loads. The minimum brace angle shall be 45° from the horizontal.

20 10 42   HANGER RODS AND HANGER SPACING

A. Where "All-thread" rod is used it shall be galvanized, cadmium or zinc electro-plated. Where plain rod is used the threads shall be a minimum of 2" in length on each end.
B. Hangers and hanger rod spacing for metallic piping shall be provided and installed in accordance with the Building Codes or the following schedule, whichever is more stringent:

<table>
<thead>
<tr>
<th>pipe size</th>
<th>rod diameter</th>
<th>max. hanger spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-1/4&quot; &amp; smaller</td>
<td>3/8&quot; diameter</td>
<td>8' on centers</td>
</tr>
<tr>
<td>1-1/2&quot; &amp; 2&quot;</td>
<td>3/8&quot;</td>
<td>10' oc</td>
</tr>
<tr>
<td>2-1/2&quot; &amp; 3&quot;</td>
<td>3/8&quot;</td>
<td>10' oc</td>
</tr>
<tr>
<td>4&quot; &amp; 5&quot;</td>
<td>5/8&quot;</td>
<td>12' oc*</td>
</tr>
<tr>
<td>6&quot; &amp; 8&quot;</td>
<td>3/4&quot;</td>
<td>12' oc*</td>
</tr>
<tr>
<td>10&quot; and 12&quot;</td>
<td>7/8&quot;</td>
<td>12' oc*</td>
</tr>
<tr>
<td>14&quot;, 16&quot; &amp; 18&quot;</td>
<td>1&quot;</td>
<td>12' oc*</td>
</tr>
</tbody>
</table>

* cast iron pipe shall have a maximum spacing of 10' oc center with the hangers located near the joint.
C. Hangers for non-metallic piping shall be spaced in accordance with the Building Codes or the following schedule, whichever is more stringent:

<table>
<thead>
<tr>
<th>pipe size</th>
<th>rod diameter</th>
<th>max. hanger spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1&quot; &amp; smaller</td>
<td>3/8&quot; diameter</td>
<td>4' oc</td>
</tr>
<tr>
<td>1-1/4&quot; - 2&quot;</td>
<td>3/8&quot;</td>
<td>5' oc</td>
</tr>
<tr>
<td>3&quot;</td>
<td>3/8&quot;</td>
<td>6' oc</td>
</tr>
<tr>
<td>4&quot;</td>
<td>5/8&quot;</td>
<td>7' oc</td>
</tr>
</tbody>
</table>
ANCHORING

A. Anchors for piping, ductwork, or equipment in new concrete construction may be suspended at the Contractor’s option, or as shown on the plans, from inserts placed in the concrete as it is poured-in-place. Mechanical equipment rooms shall have inserts placed at a maximum of 4 ft. centers.

<table>
<thead>
<tr>
<th>Hanger Rod Size</th>
<th>Grinnell Insert Figure Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/8” or smaller</td>
<td>Single - CB Universal, figure #282</td>
</tr>
<tr>
<td>7/8” or smaller</td>
<td>Multiple - 1-5/8” x 1” continuous strut, #PS 449</td>
</tr>
</tbody>
</table>

B. Anchors for piping, ductwork, or equipment in new concrete construction shall be suspended from epoxy resin set anchors, installed per the manufacturer’s recommendations set into holes drilled into the concrete. Anchors shall be UL and/or FM approved, and applied within the allowable working load ratings for the respective size. Cataloged load values shall be derated by one third for seismic allowances. Minimum embedment depth shall be 2/3 of concrete thickness. Field pullout test shall be performed when requested by the Engineer. Anchors shall be Hilti type HVA.

C. Anchors for piping, ductwork, or equipment in steel structured buildings shall be attached to the steel by bolting directly through the void in the bar joist chord or by using the appropriate cataloged type C-clamp or beam clamp. The roof deck shall not be used for supporting the piping or ductwork.

D. Welded attachments to the structural steel of the building are not permitted unless otherwise noted on the Construction Documents or where approved by the Architect/Engineer on specific request of the Contractor.

E. Anchors for piping, ductwork or equipment in “flexicore” precast construction shall be suspended from inserts placed as the panels/planks are set in place. Where attachment to the “flexicore” is needed where the continuous strut is not available then, specifically designed “toggle bolt” anchors with oversized washers may be used provided that they are placed in the center of the hollow cores located 8” on center within the planks.

<table>
<thead>
<tr>
<th>Hanger Rod Size</th>
<th>Grinnell Insert Figure Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/8” or smaller</td>
<td>Multiple - 1-5/8” x 1” continuous galvanized strut, #PS 400S</td>
</tr>
</tbody>
</table>

F. Power driven inserts and attachments are not permitted unless approved by the Architect/Engineer on express request by the Contractor.

G. In all cases, anchor loading shall be based on hanger spacing, weight of the pipe to be supported when full and insulated, weight of any additional loads imposed upon the anchor, wind loading, seismic loading, quality of the material that the anchor is being installed in, etc. The Contractor shall verify in the field that the anchors used and the materials that they are being installed in are suitable for the load imposed and shall bring any problems to the attention of the Owner's Representative in writing immediately.

H. Where anchors are loaded in shear in existing concrete structure, suitably sized and installed wedge type anchors may be used. Wedge type anchors shall be Hilti Kwik Bolt II.
A. All materials and workmanship shall specifically comply with the above listed Building Code with respect to seismic requirements for the support and anchorage of all mechanical systems and equipment as installed on this project. Lateral forces to be restrained shall be as required by ASCE 7 Section 11 and 13 Architectural, Mechanical, and Electrical Components and Systems. Refer to structural drawings and/or Geotechnical Report for design values.

- Site Class (ASCE 7-05, Table 11.4-1 and 11.4-2) C
  - Seismic Use Group II
  - Seismic Design Category B
  - Spectral Acceleration, Short period (Sps) 1.45

B. All piping support and restraint details and practices shall conform to the publication “Seismic Restraint Manual Guidelines for Mechanical Systems” by SMACNA, 2008 Edition, and/or “Seismic Restraints” by B-Line systems, Inc.

C. DELEGATED DESIGN: Design hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer licensed in the State of Missouri, herein referred to as Seismic engineer. Prepare drawings, calculations and details for any anchorage, bracing and/or sway bracing for seismic restraint as required by the local codes and Authority Having Jurisdiction. Seismic engineer shall inspect the final installation for compliance with the approved Seismic shop drawings. Seismic engineer to identify items that need to be corrected or changed and provide contractor additional/revised drawings as required.

D. SUBMITTALS:
  1. SHOP DRAWINGS: Submit drawings, calculations and details shall be signed and sealed by a Professional Engineer licensed in the State of the Project’s location.
  2. CLOSEOUT: As-built seismic drawings with Letter from Seismic engineer stating that the completed installation meets the design.

E. INSTALLATION: Contractor shall only use those materials submitted and approved. Contractor shall notify Seismic Engineer when actual installation differs from the approved Seismic shop drawing.
20 10 50  BASIC MECHANICAL METHODS - GENERAL

20 10 51  INTENT OF PROJECT DOCUMENTS

A. Install the Work in accordance with the Project Documentation and considerations enumerated in Subsection 20 00 01, GENERAL (Project Documents).

20 10 52  ARRANGEMENT OF WORK

A. All Work shall be arranged so that hangers and supports for the mechanical equipment and materials shall be within the load limitations of the structure and the respective hanger and/or support.

B. Contractor shall not scale from drawings to determine the exact locations for devices, piping, ductwork, etc., but shall follow the architectural drawings, the structural drawings and the actual building conditions, in establishing dimensions and lines of run. The work shall be adjusted to accommodate interferences anticipated and encountered. The Contractor shall verify the exact material quantities and lengths required.

C. Piping that is required to pitch shall have priority over piping that does not pitch. Work which cannot be changed in elevation shall have priority over that which can be moved. Offsets, transitions and changes in direction shall be made in piping and ductwork to maintain headroom and pitch whether or not indicated on the Plans. The Contractor shall provide air vents, traps, dirt legs, drains, lifts, sanitary vents, mechanical vent lines, etc. as required to install the mechanical systems for proper operation and maintenance.

D. Do not install work in the immediate proximity of electrical components (e.g. - panels, switches, controls, boxes, etc.) in equipment rooms. Drip pans above and/or around electrical equipment are not permitted.

E. Aluminum and copper products shall not be encased in concrete.

F. Work in “finished spaces” shall be concealed within walls, chases or above the ceiling unless specifically indicated otherwise. Install the Work to coordinate with other trades and to conform to the architectural reflected ceiling plan.

G. The work shall be installed parallel with the building lines unless specifically shown or noted otherwise.

20 10 53  COORDINATION

A. Each Contractor shall prepare and submit coordination drawings (at a scale equal to or larger than the project documents) to the Architect/Engineer for review prior to any fabrication or installation.

B. It shall be the Contractor’s responsibility to coordinate their work with the work of other trades, and with the architectural and structural drawings. Where physical interferences cannot be resolved between the trades, or when encountered in the field, the Contractor shall prepare composite drawings at a scale of not less than 3/8” = 1'-0” clearly showing the Work of Divisions 20 - 29 in relation to the Work of others to identify the conflict. Submit a proposed resolution to the Architect/Engineer for approval in accordance with Sub-sections 20 00 01, GENERAL (Project Documents) and 20 10 06, SUBMITTALS.
1. Do not proceed with Work in question until the matter is mutually resolved among the involved parties, and adequate information has been submitted to the Architect/Engineer for review. No additional compensation shall be granted for modifications and execution of the resolution(s). Modifications are to be incorporated in the “as-built” drawings.

C. Contractor shall review the Project Documents, site conditions, and the requirements of other disciplines, and shall report any discrepancies between them to the Architect/Engineer and obtain from him written permission for changes necessary in the Mechanical Work. Subsequent clarification(s) by the Architect/Engineer will not be a change in scope of the Work. The Contractor at no addition in the contract price shall perform any such modifications required.

D. Contractor shall verify tie-in locations to verify sizes, direction of flow (via pressure or physical tracing, not labels), materials, elevations, etc. prior to commencing new work. Contractor shall notify Architect/Engineer upon discovery of discrepancy. Work performed prior to verification will be corrected at no cost to Owner.

E. The drawings shall not be scaled; obtain detailed information, shop drawings, installation and maintenance bulletins, etc. to determine exact requirements and to satisfactorily achieve the intent of the Project Documents.

F. The Contractor shall furnish and properly install all sleeves, slots, chases, openings, recesses, supports, anchors and anchor bolts required for his Work in coordination with the other trades as the building is erected.

G. The expenses for changes required by neglect in executing, coordinating or scheduling the Work properly or avoiding conflicts shall be borne by the Contractor precipitating the issue requiring the changes.

20 10 54 DELIVERY, STORAGE AND HANDLING

A. Delivery, storage and handling of equipment and material are the Contractor’s responsibilities. The Contractor shall perform the Work in accordance with the following criteria:

1. Delivery shall be arranged by the Contractor (including Owner furnished items) for the expeditious and economical pursuit of the Work and to meet the scheduling requirements of the Contract.

2. The Contractor will be assigned a “lay-down” area at the job site and shall confine temporary storage to this area.

3. The Contractor may take delivery of equipment and material at his “shop” or an off-site location as suits the performance and schedule of the Work.

4. Regardless of where and how equipment and material are temporarily stored prior to installation, or if installed at the job site prior to acceptance, the Contractor is responsible for the following:
   a. All equipment and material shall be accessible to the Architect/Engineer for inspection.
   b. All equipment and material shall be protected adequately and properly from the weather, dirt and water, chemical, mechanical or comprehensive damages.
   c. The Contractor shall be liable for the repair and/or replacement (including labor) of any equipment and material lost, damaged or defective prior to acceptance.

5. The Contractor shall arrange all labor, tools, services and scheduling to perform the handling of equipment and material for his Work.
A. Each Contractor and Subcontractor shall be responsible for progress and final clean-up of his respective Work in accordance with the Contract Documents, requisite ordinances and regulations. Clean-up and legal disposal of debris from the Work, excess refuse and presence at the job site shall be performed in a timely and satisfactory manner. If not, the Contractor shall be notified of the unsatisfactory condition. If the matter persists, the Contractor will be back charged for the clean-up performed by others.

B. Clean exposed exteriors and limited access interior surfaces of all equipment, piping and ductwork of foreign matter to provide an “as new” condition.

20 10 56 CLEANING OF PIPING SYSTEMS

A. The Contractor shall clean the respective piping system(s) that are included in his scope of work. All systems shall be flushed with water or air (depending on ultimate use) to relieve any congestion and internally cleanse the respective piping system. The Contractor shall provide all flushing media in sufficient quantity, inlet connections, discharge or drainage outlets and any temporary provisions to protect components, or remove it, to facilitate the flushing. Clean and replace all strainer screens and filters. Clean and drain all low points in the piping.

B. Owner’s representative shall be present for flushing, cleaning, and rinsing. Water treatment representative must check water after rinsing to insure all chemical cleaner has been removed and the Alkalinity of the rinse water is equal to that of the make-up water.

C. New or repaired potable water systems shall be purged of deleterious matter and disinfected prior to utilization. The method to be followed shall be that prescribed by the health authority having jurisdiction or, in the absence of a prescribed method, the procedure described in either AWWA C651 or AWWA C652, or as described in this section. This requirement shall apply to “on-site” or “in-plant” fabrication of a system or to a modular portion of a system.

1. The pipe system shall be flushed with clean, potable water until dirty water does not appear at the points of outlet.

2. The system or part thereof shall be filled with a water/chlorine solution containing at least 50 parts per million (50 mg/L) of chlorine, and the system or part thereof shall be valved off and allowed to stand for 24 hours; or the system or part thereof shall be filled with a water/chlorine solution containing at least 200 parts per million (200 mg/L) of chlorine and allowed to stand for 3 hours.

3. Following the required standing time, the system shall be flushed with clean potable water until the chlorine is purged from the system.

4. The procedure shall be repeated where shown by a bacteriological examination that contamination remains present in the system.

20 10 57 PRESSURE TESTING

A. The Contractor shall submit a schedule at the beginning of the Work of the piping systems that are to be pressure tested, and indicate whether tests will be for an entire or partial system. Entire piping systems shall be pressure tested at one time unless it is not possible or practical.

B. All piping to be insulated or concealed shall be pressure tested prior to the application of the insulation or concealment.
C. A representative of the Architect/Engineer, Commissioning Agent, and Owner shall witness all pressure testing. The Contractor shall notify the Architect/Engineer at least three (3) days prior to the test date.

D. Each piping system shall be tested per the method, test pressure, and test duration as specified in the Piping Material Schedules.

E. The Contractor shall provide all test media, measuring devices, inlet connections, test measurement connections, and disposal of test media. The Contractor shall protect, isolate and/or remove piping system components that can not be subjected to test pressures.

F. Hammer each joint in welded or soldered piping while under test. Leaks shall be repaired and the test(s) repeated until the respective piping system is tight.

20 10 58 LEAK TESTING OF REFRIGERANT PIPING

A. After the refrigerant piping connections have all been made, the entire refrigerant system shall be put under pressure and tested for leaks using dry nitrogen to develop the test pressure and the refrigerant charge as the tracer gas for leak testing.

B. A pressure regulator and a relief valve set at the test pressure (see Pipe Material Schedules) shall be used in the nitrogen test hookup.

C. The nitrogen shall be admitted to the system through the gage port on one of the refrigerant valves. All valves in the system shall be back seated so that holding charge refrigerant gas and nitrogen can diffuse throughout the piping.

D. If any leaks are discovered, the joint shall be broken and re-soldered. If possible, the section of piping containing the leaking joint should be isolated from the rest of the system. Dry nitrogen shall be passed through the joint being remade to prevent the formation of copper oxide.

1. Occasionally, a joint may be suspected of leaking, but the leak is so small that it is difficult to get a positive indication with the halide detector. When this happens, completely enclose the joint with a small plastic bag. Tape the open ends of the bag securely to the piping to insure a gas tight seal. Leave the bag in place for several hours.

2. To test a leak, make a small hole in the bag at the lowest point and insert the exploring tube of your halide detector. Make another hole at the top of the bag to admit air. If the joint does have a slow leak, enough refrigerant gas will collect in the bag to give a positive indication.

20 10 59 CHARGING REFRIGERATION SYSTEMS

A. Evacuation and Dehydration. The Contractor shall evacuate and dehydrate the refrigerant system to remove any air and moisture from the system. The manufacturer's literature shall be referred to for the evacuation procedure for each system installed.

1. A vacuum pump capable of producing a vacuum of 1-mm Hg absolute is necessary for field evacuating. A single-stage pump having a free air displacement of 100 liters, or about 3 cubic feet/minute, is suitable. An accurate manometer type high vacuum gage, such as a Stokes or a Zimmerli gage, is also necessary.

2. The vacuum pump shall be connected to the gage port of the suction line shutoff valve, so that moisture in the new refrigerant lines will not be drawn through the compressor when the system is evacuated. The vacuum gage shall be connected to the gage port of the
liquid line shutoff valve. The pump shall be operated until the gage indicated a vacuum of
2.5 mm Hg or less.

3. When the vacuum is sufficient, the refrigerant valves shall be back seated while the
vacuum pump is running. The pump is then stopped. The system shall be allowed to
stand under vacuum for at least 12 hours to allow all moisture to vaporize and to see if
there is any in-leakage of air.

4. After 12 hours, the Contractor shall break the vacuum with oil-pumped dry nitrogen or
gaseous refrigerant and re-evacuate the system to 2.5 mm HG to further reduce the
residual air and moisture to prevent compressor damage.

5. The system can now be charged if the pressure has not risen noticeably.

B. Charging. The Contractor shall determine the weight of a full charge of refrigerant and oil for
the equipment plus refrigerant charge based on the length of refrigerant and in accordance
with the unit manufacturer’s literature.

The following charging procedure shall be used:

1. The Contractor shall follow the manufacturer’s installation instructions and/or industry
standards in charging and start-up of equipment.
20 10 60 BASIC MECHANICAL METHODS - INSTALLATION

20 10 61 GENERAL

A. The Contractor shall install all equipment and material as specified in the Project Documents. The Contractor shall review the installation requirements, and provide all of the appurtenances and accessories required for complete systems and a functioning installation. The Contractor shall be prepared to submit installation details and procedures where specified or requested for approval by the Architect/Engineer.

B. The Contractor shall follow the manufacturer’s instructions for the handling, temporary storage, protection and installation of the respective equipment and material. The Contractor shall promptly notify the Architect/Engineer in writing of any discrepancy or conflict between the Project Documents and the manufacturer’s instructions, and request clarification. Unless there is a specific change in the scope of work, no additional compensation shall be granted for modification(s) and execution of the clarification.

C. Work performed that does not comply with the manufacturer’s instructions, any approval or instructions from the Architect/Engineer, or that causes a significant and/or unapproved deviation from the intent of the Project Documents shall not be grounds for additional compensation for costs to modify the Work in a manner directed by and to the satisfaction of the Architect/Engineer.

D. All Work shall be installed to permit access and/or removal of components (e.g. - coils, fan wheels and shafts, filters, guards, bearings, motors, mechanical drives, etc.), that require periodic maintenance, servicing, repair and/or replacement. Equipment, piping, ductwork, conduit and raceways shall be arranged to permit access to valves, motors, motor and temperature controls, and to clear the opening of doors and access panels.

E. Welded attachments to the building structure are not permitted.

20 10 62 PIPING

A. All piping shall be properly installed and supported with adequate provisions for clearance from other work, for expansion, contraction, slope, anchorage and prevention of transmission of vibration.

B. Piping shall be generally installed parallel to building lines in the most expeditious and economical manner and to facilitate servicing. Piping shall be positioned and installed to provide noiseless circulation, and pitched to provide drainage and avoid air pockets. Valves and specialties shall be located to provide proper function and be readily accessible for servicing and maintenance.

C. All piping connecting to equipment shall be installed without springing and any strain at final connections. The Contractor may be requested to disconnect piping to demonstrate that the piping has been so installed.

D. Steel piping connections to equipment with rotating or reciprocating components shall be provided with a minimum of two grooved clamp type couplings per piping connection, which shall be Victaulic Style 77 couplings or equivalent. Copper piping connections to equipment with rotating or reciprocating components shall be provided with Mason Industries SafetyFlex model SFDEJ flexible joint. Air handling units with internal fan isolation are not included in the above.
E. Changes in direction in the piping shall be made with manufactured fittings only. All elbows shall be long radius (1.5 x diameter) unless specifically noted otherwise. Bending may be permitted on submittal for approval of a satisfactory procedure to the Architect/Engineer for approval. Bending is to be accomplished with hydraulic type equipment producing no mal-formations in the piping.

F. Full size branch connections and branch connections one size smaller in steel piping shall be made with manufactured fittings only. Branch connections two sizes and smaller than the main run may, in special cases with the Engineer's written permission, be made with manufactured fittings, weld-o-let or thread-o-let type fittings for welded piping construction, saddle type fittings for grooved piping construction or a pipe-to-pipe nozzle weld. Small branch connections for thermometers, pressure gauges, controls, etc. may be made with nozzle welded 3000# forged steel threaded couplings, thread-o-lets or saddle fittings. For insulated piping, provide branch connections with sufficient "neck" length to extend beyond the thickness of the insulation.

G. Changes in direction in piping systems using hard temper copper tubing shall be made with manufactured and cataloged elbow fittings. Branch connections and reductions in all copper tubing systems shall be made with tee and reducer fittings. At the Contractor's option, utilizing a "Tee Turner" tool and corresponding procedure may provide branch connections. These joints shall be brazed and not soldered.

H. Minimum slope for piping shall be provided in accordance with the following schedule, unless otherwise specified, noted or shown:

<table>
<thead>
<tr>
<th>Type of Piping</th>
<th>System Component</th>
<th>Pitch of Fall</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sewer, sanitary</td>
<td>main/branch</td>
<td>1/8&quot;/Ft.</td>
</tr>
<tr>
<td>Sewer, storm</td>
<td>main/branch</td>
<td>1&quot;/40/Ft.</td>
</tr>
<tr>
<td>Condensate drain</td>
<td></td>
<td>1&quot;/20Ft.</td>
</tr>
<tr>
<td>Refrigerant piping</td>
<td></td>
<td>1&quot;/20Ft.</td>
</tr>
<tr>
<td>Domestic water</td>
<td></td>
<td>1&quot;/40Ft.</td>
</tr>
</tbody>
</table>

I. All piping materials shall be physically cleaned internally and externally of mill scale, oxidation, grease, oil, dirt, mud, loose and foreign matter before fabrication and installation.

J. All open ends of piping and equipment shall be closed during fabrication and installation to keep dirt and foreign matter out of the Work.

20 10 63  VALVES

A. Shut-off valves shall be provided at all inlet and outlet connections to equipment, at major branch connections to mains, where required for normal service, and where shown on the drawings, flow diagrams or details.

B. Valves shall be the same size as the adjacent piping, except for control valves furnished in Division 25.

C. Valves shall be accessible and free from interference when operated. Valves shall be installed with the stem on or above horizontal. Globe valves shall be installed with pressure under the seat. Butterfly valves shall be free to open and close without obstruction.

D. Valves shall be packed and glands adjusted before final acceptance.
A. The Contractor shall furnish and install the necessary frames, stands, brackets, stiff-legs, hangers, etc. to support or suspend the equipment and material that require this installation arrangement. The Contractor shall be responsible for the size, quantity, location and design of the supports and suspensions. The design shall permit no deflection of the support, the suspension arrangement or related building members, nor impart any vibration into the building structure. Loads transmitted to the building shall be within the limitations of and distributed satisfactorily to the structure. Designs for supports and suspensions shall be submitted for approval to the Architect/Engineer. Any attachment to the floor shall be provided with a minimum of 1” thick concrete or grout between the base and the floor. All associated ferrous metal parts shall be painted or galvanized. Painting shall consist of one (1) coat of base primer on properly prepared surfaces and one (1) coat of rust inhibiting enamel, color selected by the Architect/Engineer.

B. Each exposed mechanical drive and rotating shaft shall be provided with a protective guard. The guards may be provided with the respective equipment or may be field fabricated. The guard shall be constructed to comply with the appropriate safety requirements of the National Institute of Safety and Health and OSHA. Provide adequate and proper access for speed measurements for all rotating shafts. Guards shall not interfere with the lubrication of equipment nor restrict the airflow into fan inlets. The design for field fabricated guards shall be submitted for approval to the Architect/Engineer.

C. All equipment having rotating or reciprocating components shall be provided with captive spring type vibration isolation mounts for seismic and restrained service. Mounts shall be selected at a maximum transmissibility of 0.03 (isolation efficiency of 97%) at the lowest anticipated operating speed of the equipment.

D. Grease fittings for bearings shall be extended to accessible locations.

E. Installation Instruction

1. Equipment shall be set level, plumb, properly oriented, aligned and secured in the location shown on the drawings.

2. Shims used for leveling shall be of size sufficient to cover the entire bearing surface except where shims are used to level preparatory to grouting. Shims used in conjunction with grouting shall be located to properly support equipment at load points to prevent any distortion.

3. Assembly and installation of the equipment shall be in strict compliance with the equipment vendor’s instructions.

4. Where specified, equipment shall be assembled, installed, inspected and adjusted under the supervision of the Vendor’s representative.

5. Lugs, saddles, supports, covers or similar components which have been shipped separately or loose shall be located and attached by the Contractor by means of welds or bolting.

6. Holes in structural steel required for installation of equipment shall be drilled as required.

7. Contractor shall supply and install self-anchoring anchors.

8. The Contractor shall grout under the equipment to effect a firm permanent setting as required.

9. Upon completion of installation the Contractor shall remove all staging, blocking and construction debris from the equipment.
10. The Contractor shall check all packaged or pre-assembled equipment to make sure that all packing shims and blocking is removed before rotating, running or testing the equipment.

F. Equipment Alignment

1. The Contractor shall do a cold final alignment of all rotating equipment shafts and coupling assemblies even when they were factory aligned. The reverse dial indicator method of alignment is preferred whenever possible. The following requirements apply to alignment:
   a. Initial Alignment shall be checked with all piping larger than NPS 1” disconnected from the equipment. Maximum misalignment readings shall be 0.05-in. total indicator reading (TIR) on the rim and on the face of the coupling hub for all equipment unless otherwise noted in the Equipment Data Sheet instructions. Equipment shall rotate freely, all bolts shall be tight, all bearings and couplings shall be lubricated, and all safety guards shall be in place.
   b. Soft Foot. Equipment will be checked for “soft foot”. If the dial indicator indicates more than 0.05 in. (TIR) when any equipment to baseplate bolt is loosened, the equipment will be reshimmed.
   c. Final Alignment. The Architect/Engineer will witness the final alignment check on each piece of rotating equipment. Connecting pipe shall fit up to the equipment without the use of mechanical force. Connecting piping greater than NPS 1” will be bolted to the equipment one at a time, with the dial indicator attached. If the alignment changes by more than 0.05 inches (TIR), the piping will be revised until the alignment change is acceptable.

2. Shims used for aligning the equipment shall be stainless steel and shall be stamped with the shim thickness. The shim shall be large enough to cover the complete load bearing area and the total height shall be a maximum of 1/8 inch and shall be installed between the equipment’s foot and the equipment’s baseplate.

20 10 65 MISCELLANEOUS

A. Sleeves, inserts, etc.

1. The Contractor shall furnish and properly install sleeves, inserts, supports, anchors and anchor bolts required for his Work. The size, quantity and location of chases, openings and recesses in the building structure shall be the responsibility of the Contractor performing the Work that requires these considerations. Patching of oversized openings and finishing thereof shall be the responsibility of the trade or Contractor requiring the opening. Material and labor for openings in new construction requiring structural framing including lintels and angles shall be furnished by the trade requiring the opening and installed by the General Contractor. Lintels shall be structural steel angles, channels, or tees of proper size and sections for the load supported.

2. Sleeves shall be provided for all penetrations through the building structure. Sleeves through floors shall extend 1” above the finished floor except where otherwise noted; sleeves through walls, partitions or structural members shall be flush with the exterior surface on both sides. Sleeves shall sized to include the pipe/duct insulation.

3. The space between the sleeve (or opening in the structure) and the pipe/duct or outside of the insulation of penetrations through fire rated components of the building shall be fire stopped, see Section 20 10 20 Miscellaneous Piping Materials. Penetrations through non-rated components of the building shall be draft stopped, see Section 20 10 20 Miscellaneous Piping Materials.

B. Unions and flanges:
1. A ground joint type union shall be provided in threaded and sweat joint piping, 2” and smaller pipe or tube size, downstream of each branch shut-off valve, control valve and specialty item, the inlet and outlet connections of each piece of equipment, and where shown on the drawings.

2. Flanged connections shall be provided in piping 2-1/2” and larger at each manual valve, control valve, specialty item and the inlet and outlet of each piece of equipment.

C. Interconnections between dissimilar piping material systems shall be made with fittings manufactured for the specific application.
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20 10 70 BASIC MECHANICAL METHODS - RELATED WORK

20 10 71 CONCRETE WORK (CAST-IN-PLACE)

A. General:
   1. This sub-section shall supplement Section 03300 – Concrete Work for the concrete work required to install the work of Divisions 20 - 25.
   2. In the event of a conflict between this sub-section and Section 03300, the more stringent shall apply.

B. The Contractor shall include the following Work:
   1. Provide concrete foundations, bases and/or housekeeping pads for mechanical equipment furnished in his respective scope of work where such are not indicated on the architectural or structural drawings. Concrete work shall include requisite excavation, formwork, reinforcing and contained hardware.
   2. Submit for approval to the Architect/Engineer detailed and dimensioned drawings of size, location, reinforcing and hardware contained therein of concrete work to be provided.

C. Housekeeping Pads:
   1. All equipment setting on concrete or other type of pave flooring shall be set upon a raised “housekeeping” pad, unless noted otherwise.
   2. The Contractor shall be responsible for this size, location, and any required anchor bolts. In general, housekeeping pads shall be a minimum of 3 ½” high, a ¾” chamfer on exposed corners and edges, and a minimum of 3” beyond the equipment on all sides or as required for anchor bolt edge distance.
   4. Specifically designed vibration isolation/inertia concrete bases for equipment will be specified and shown separately.

D. Thrust Blocks:
   1. Thrust blocks shall be installed at all changes in direction and end points in unrestrained underground piping systems.
   2. Thrust blocks shall only contact the backside of the fittings and shall not cover any joints. All thrust blocks will be inspected by the Owner’s Representative prior to backfilling, provide a minimum of 3 days notice.

20 10 72 PAINTING

A. General:
   1. This sub-section shall supplement Section 09900 – Painting for the painting work required for the work installed by Divisions 20 - 25.
   2. In the event of a conflict between this sub-section and Section 09900, the more stringent shall apply.

B. Painting of the following shall be included in the scope of work of this sub-section:
1. All mechanical equipment including housings, fans, etc., not factory painted shall have prime coat and finish painting.

2. All plain steel hanger rods, plain steel pipe hangers, field fabricated or prefabricated steel supports and braces, and other ferrous metal. Prime coat only for all interior work, both exposed and concealed. Prime coat and finish painting of all exterior work.

3. Touch-up, as required, of factory finished equipment to original condition.

4. Interior surface of air ducts, cabinets, enclosures, covers and air dampers where visible from a finished space through grilles and louvers with one coat of flat black paint.

5. All above grade exterior uninsulated piping systems shall have a prime coat and finish painting.

C. Painting of the following shall not be included in the scope of work of this Sub-section, unless noted otherwise:

1. Surfaces to receive special finishes specified elsewhere.

2. Building construction surfaces - floors, ceilings, interior and exterior walls, exposed concrete work, special finishes, etc.

3. All stainless steel, brass, copper, aluminum, plastic, electro-plated and galvanized surfaces.

4. Caulking, sealers, fire stops, etc.

5. Valves, controls, specialties.


7. Light fixtures.

8. Equipment (mechanical and electrical) which has been finished in a factory.

9. Black steel surfaces over 250 degrees F. (e.g. - breechings, kitchen hood exhaust ducts, etc.).

D. General Requirements:

1. The Contractor shall provide all labor, coating materials, accessory materials (e.g.- turpentine, painting thinners, etc.), tools and services necessary and reasonably incidental to the scope of work of Sub-section 20 10 75.

2. Coatings shall be factory prepared and mixed; ready for application upon delivery; have good flow and brushing properties and be capable of drying and curing free of streaks or sags.

3. Materials for each application shall be compatible with one another and with other specified materials with which contact may be made.

4. Products shall meet the following UL fire hazard classifications when tested in accordance with ASTM E84: Flame spread, 0; Fuel contributed, 5; Smoke developed, 15.

5. Coatings shall be applied in accordance with the paint manufacturer's recommendations with the surfaces well illuminated. In general, coatings shall not be applied when the relative humidity is above 60% nor the ambient temperature below 45 degrees F.

6. The Architect/Engineer shall make color selections, when required.

E. Acceptable Manufacturers

1. Benjamin Moore & Co.

2. Porter International

3. Pratt & Lambert, Inc.

4. Sherwin Williams Co.
5. Glidden
6. Pittsburgh

F. The Contractor shall submit the following to the Architect/Engineer for review and approval:

1. Statement of qualification that the company specializes in commercial painting and finishing with a minimum of five (5) years experience.
2. Product data describing the following:
   a. Instructions for substrate preparation including priming.
   b. Instructions for product preparation, application procedures, clean-up and maintenance.
   c. Recommended ambient temperature and relative humidity range, substrate temperature, moisture content and alkalinity at the time of application.
   d. Manufacturer's list of trademarked products for each coat of each system. For each product, state vehicle type, percent solids by volume, method of application, drying time, recommended rate of coverage and dry film thickness for each coat. Coordinate with the Schedule in Sub-section in 20 10 75.84.
   e. Advise any recommendations which differ from the specified or scheduled requirements.
3. Material Safety Data Sheet (MSDS) for each coating and painting product, and maintain a file of it at the job site for reference and emergency use.
4. Certificates and/or test reports demonstrating that the painting products specified meet regulatory requirements.
5. Color charts and available sheens of finish, when required, for selection by the Architect/Engineer.
6. Samples of painting products when requested for inspection by the Architect/Engineer.

G. Painting:

1. The Contractor shall be responsible for delivery, handling and storage of all coating and painting materials for the pursuit of his work.
   a. All painting products shall be delivered in sealed containers.
   b. All painting product containers shall be labeled to show the manufacturer's name, type of coating, brand name, coverage, surface preparation, drying time, clean-up, color designation and instructions for mixing and reducing.
   c. All painting products shall be handled and stored in accordance with the respective manufacturer's recommendations. In the absence of specific instructions, products shall stored in well-ventilated areas at a minimum ambient temperature of 45 degrees F. and a maximum temperature of 90 degrees F.
   d. Precautions shall be exercised to prevent fire hazards and spontaneous combustion. Provide adequate type and quantity of fire extinguisher at the job site.
2. The Contractor shall perform the following in preparation of the painting application:
   a. Verify that surfaces and substrate conditions are ready to receive the application of coatings as specified or in accordance with manufacturer's recommendations. Commencement of application is acceptance of existing conditions.
   b. Provide drop clothes and other protective measures to prevent coatings on other work not included in the scope of work of this sub-section.
   c. Where required by Architect/Engineer, post “WET PAINT” signs.
d. Solvent or power tool clean surfaces, as required or as deemed appropriate, to remove grease, scale, dirt, rust, mill scale, weld splatter and burrs. Apply primer immediately after cleaning.

3. Application:
   a. Coating products shall be prepared and applied in accordance with the respective manufacturer's instructions and reviewed submittals. Dry mil thickness of each coat shall be as scheduled or as recommended by the manufacturer. Finish coat shall not be less than 5.0 mils in thickness, and sufficient to cover completely substrates and undercoats.
   b. Where shop prime coat finishes are specified elsewhere, primer may be omitted, except as otherwise scheduled, specified or recommended by the coating manufacturer. Damaged shop prime coats shall be touched-up, using a primer compatible with or same as original primer.
   c. Each coat shall be applied to provide a uniform finish, without sags, laps, brush marks or other defects. Allow applied coat to dry before next coat is applied.

4. Schedule - Latex, General Painting Materials:
   a. Steel - unprimed, located indoors or outdoors:
      One (1) coat lead and chromate free alkyd primer. Two (2) coats latex, semi-gloss.
   b. Steel - shop primed, located indoors or outdoors:
      Touch-up with lead and chromate free alkyd primer.
      Two (2) coats latex, semi-gloss.
   c. Insulation on mechanical equipment, located indoors:
      One (1) coat latex primer sealer.
      Two (2) coats latex, flat.
   d. Schedule - Epoxy, General Painting Materials:

20 10 73 LUBRICATION

A. Provide all oil and grease for the operation of all equipment until acceptance. The Mechanical Contractor and Subcontractors shall be held responsible for all damage to bearing while the equipment is being operated by them up to the date of acceptance of the equipment. Protect all bearings during installation and thoroughly grease steel shafts and other unpainted steel surfaces to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction. For equipment that is received void (dry) of lubrication the Contractor shall lubricate the equipment before storing to prevent internal damage to the equipment.
20 10 80 TESTING, ADJUSTING AND BALANCING

20 10 81 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Special Conditions apply to this section.

20 10 82 DESCRIPTION OF WORK

A. This scope of services specifies the requirements and procedures for mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results. The test and balance work will be performed by the Owner’s personnel. It is the Contractor’s responsibility to assist as outlined below.

B. Test, adjust and balance the following mechanical systems which are shown in the construction documents.

1. Supply air systems, all pressure ranges, including variable volume and constant volume systems.
2. Return air systems.
3. Exhaust air systems.
4. Hydronic systems.
5. Steam distribution systems.
6. Cooling towers.
7. Verify temperature control system operation.

C. The contractor’s responsibilities are as follows:

1. Notify the Owner’s Representative fourteen (14) days prior to the schedule date for balancing the system.
2. Schedule a two (2) week allowance for the testing and balancing firm to complete the testing and balancing work when scheduling completion of all work required of the Contractor by the contract documents.
3. Cooperate with the testing and balancing firm and shall make all necessary preparations for the TAB efforts.
4. Complete the following work prior to requesting the TAB effort.
   a. Clean and flush all piping systems.
   b. Leak test and make tight all piping systems.
   c. Fill all piping systems with clean water.
   d. Clean and seal all ductwork systems.
   e. Service and tag all equipment.
   f. Set and align all motors and drives.
   g. Start up and prove all equipment and systems.
   h. Make preliminary settings on all control devices and have all systems operational.
   i. Operate all systems successfully for twenty-four (24) hours minimum.
5. Lubricate all motors and bearings.
6. Check fan belt tension.
7. Check fan rotation.
8. Patch insulation, ductwork and housing, using materials identical to those removed.
9. Seal ducts and piping, and test for and repair leaks.
10. Seal insulation to re-establish integrity of the vapor barrier.
11. Attend a coordination meeting prior to the balancing of the system and a coordination meeting following the balancing of the system.
12. Provide a complete set of as-built drawings prior to the TAB effort.
13. Provide craftsmen of the proper trade to work with the TAB firm to make adjustments and installation changes as required.
14. Change out fan sheaves when and if required by the TAB firm.
15. Dedicate the resources to accommodate all changes identified by the test and balance firm in a timely manner.
16. If a significant rebalance (Owner’s determination) of the HVAC system is required due to the Contractor’s failure to properly install and check out the HVAC system, the cost of rebalancing the system shall be borne by the Contractor.

20 10 83 PRE-BALANCING CONFERENCE

A. Prior to beginning of the testing, adjusting and balancing procedures, a conference with the Owner’s representative, Engineer and the Test and Balance Agency’s representative will be held. The objective of the conference is final coordination and verification of system operation and readiness for testing, adjusting and balancing.

20 10 84 SEQUENCING AND SCHEDULING OF SERVICES

A. Test, adjust and balance the air conditioning systems during summer season and heating systems during winter season. This includes at least a period of operation at outside conditions within 5 deg. F wet bulb temperature of maximum summer design condition, and within 10 deg. F dry bulb temperature of minimum winter design conditions. Take final temperature readings during seasonal operation.
20 10 90  BASIC MECHANICAL METHODS - IDENTIFICATION

20 10 91  GENERAL

A. This Sub-section specifies basic materials and methods for identification that shall apply to systems specified in other sections of Divisions 20 - 29 of the Specifications.

B. The Contractor shall submit schedules and listings of Work to be identified indicating color code, material, name plate information and method of application for approval prior to performing the Work.

20 10 92  REFERENCES

A. All provisions and conditions cited in this Sub-section shall apply to Work of all other sections of Divisions 20 - 29 of these Specifications, where and when relevant.

B. Applicable requirements of the current and accepted edition of the following codes and standards shall apply to the Work of this Sub-section:
   1. ANSI/ASME A 13.1 - "Scheme for the Identification of Piping Systems".
   2. NFPA 99 – Health Care Facilities

20 10 93  WORK INCLUDED

A. Each respective Contractor and Subcontractor shall identify the applicable components of his Work in accordance with specifications hereinafter enumerated or where required by other sections of Divisions 20 - 29 of the Specifications.

   1. All equipment items (i.e., air handling units, fans, pumps, etc.).
   2. All and condensate, plumbing, and fire protection valves.
   3. All piping systems identifying the system type and direction of flow.
   4. All underground utilities (i.e., condensate, natural gas, etc.).
   5. All control devices and panels.

20 10 94  SUBMITTALS

A. Contractor shall submit shop drawings for approval in accordance with Section 20 00 43 submittals.

B. Provide an Identification Product Schedule consisting of the following minimum information:
   - Material - type of identification product.
   - System - indicate which system or equipment materials will be used for.
   - Manufacturer - Manufacturer's name, product name and model numbers.
   - Accessories - Miscellaneous materials used in affixing identification.

C. Provide manufacturer's technical product sheet and recommended installation instructions.

D. Provide color list/schedule and lettering sizes for pipe markers, valve tags, and equipment nameplates.

E. Provide a valve tag list for approval prior to ordering or making valve tags.
A. All surfaces to receive identification nameplates or markers shall be clean, degreased, dry, free of oxidation and prepared per manufacturer’s recommendations.

B. Plastic nameplates shall be installed with corrosion-resistant mechanical fasteners. Do not use adhesives.

C. Tags shall be installed with corrosion-resistant chain and end fasteners.

D. Pipe and duct markers shall be installed in accordance with the manufacturer’s recommendations.

E. Valve tag list for each separate trade (i.e., mechanical, plumbing, fire protection, and temperature control) shall each provide a valve tag list in electronic format.

F. Valve tag information is required on “as-built” drawing submittals.

G. Acceptable Manufacturers:
   Products of the following manufacturers may be considered
   1. Seton Nameplate Corp.
   2. Brady Signmark Division
   3. Craftmark Identification Systems
   4. D & G Sign and Label

20 10 96   PIPING IDENTIFICATION

A. All piping, bare pipe or insulated, exposed or concealed, shall be identified by one of the methods specified herein.

B. Markers shall be installed in clear view; aligned with axis of pipe; located at not more than twenty-five foot (25’) intervals on straight runs, risers and drops; located adjacent to each valve, control device and tee fitting; and located on each side of penetrations of the building structure and non-accessible enclosures.

C. The following schedule shall govern label types for each application:

<table>
<thead>
<tr>
<th>Location</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical Rooms</td>
<td>II</td>
</tr>
<tr>
<td>Above Lay-in Ceilings</td>
<td>I</td>
</tr>
<tr>
<td>Exterior/Outdoors</td>
<td>III</td>
</tr>
</tbody>
</table>

1. Pressure Sensitive Tape (Type I): Vinyl pressure sensitive tape color coded and lettered in accordance with ANSI A13.1 for label of service. Flow direction shall be separately labeled with 2” wide pressure sensitive tape. The flow arrow band shall overlap the service label to secure it in place and shall not be less than two complete wraps around the pipe.

2. Plastic Pipe Markers (Type II): Manufactured in accordance with ANSI A13.1 requirements, semi-rigid plastic, pre-formed to fit curvature of pipe or pipe insulation, color coded and imprinted with media identification and flow direction. Available in varied sizes for pipe diameter, wording and inclusion of arrow.

3. Outdoor Pipe Markers (Type III): Non-vinyl chloride markers specifically design for outdoor use. Color coded and lettered in accordance with ANSI A13.1 for label of service with direction of flow arrows.
D. All underground metallic piping shall be identified with continuous 6” wide x 0.004” polyethylene film, color coded, and imprinted for type of utility buried below located in the same trench as the piping and/or utility and positioned approximately 6” to 12” below finished grade.

E. All underground non-metallic piping shall be identified with continuous 6” wide x 0.035 metallic detection tape, color coded and imprinted for type of utility buried below located in the same trench as the piping and/or utility and positioned approximately 6” to 12” below finished grade.

F. The following legend, color, and lettering shall be used:

<table>
<thead>
<tr>
<th>Service and Legend</th>
<th>Color of Field</th>
<th>Letters</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Materials Inherently Hazardous:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Pumped Condensate</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Refrigerant</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Domestic Hot Water</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Domestic Hot Water Return</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Waste</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td>Vent</td>
<td>Yellow</td>
<td>Black</td>
</tr>
<tr>
<td><strong>Materials of Inherently Low Hazard:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cold Water</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td>Drain</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td>Roof Drain</td>
<td>Green</td>
<td>White</td>
</tr>
<tr>
<td><strong>Fire Quenching Materials:</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sprinkler – Fire</td>
<td>Red</td>
<td>White</td>
</tr>
</tbody>
</table>

G. The following legend, color, and lettering shall be used for below ground piping:

<table>
<thead>
<tr>
<th>Service</th>
<th>Color</th>
<th>Legend</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electric 4160 V</td>
<td>Red</td>
<td>Caution Buried High Voltage Electric</td>
</tr>
<tr>
<td>Electric</td>
<td>Red</td>
<td>Caution Buried Electric</td>
</tr>
<tr>
<td>Fiber Optic</td>
<td>Orange</td>
<td>Caution Buried Fiber Optic</td>
</tr>
<tr>
<td>Telephone</td>
<td>Orange</td>
<td>Caution Buried Communication</td>
</tr>
<tr>
<td>CATV</td>
<td>Orange</td>
<td>Caution Buried CATV</td>
</tr>
<tr>
<td>Sewer</td>
<td>Green</td>
<td>Caution Buried Sewer</td>
</tr>
<tr>
<td>Potable Water</td>
<td>Blue</td>
<td>Caution Buried Water</td>
</tr>
<tr>
<td>Non-potable Fire</td>
<td>Purple</td>
<td>Caution Buried Reclaimed Water</td>
</tr>
<tr>
<td>Natural Gas</td>
<td>Yellow</td>
<td>Caution Buried Gas</td>
</tr>
<tr>
<td>Condensate</td>
<td>Purple</td>
<td>Caution Buried Reclaimed Water</td>
</tr>
<tr>
<td>Irrigation Water</td>
<td>Purple</td>
<td>Caution Buried Reclaimed Water</td>
</tr>
</tbody>
</table>

**20 10 97 VALVE IDENTIFICATION**

A. All valves exposed or concealed shall be identified with brass valve tags indicating the service of system the valve is in and the number of the valve.

B. Valve tags shall be minimum 1-1/2” diameter brass stock with ¼” legend identifying and ½” valve number both shall be black enamel filled. Legends shall be HVAC, PLBG, SPR, and GAS.

C. Valve tags shall be secured in place with a No. 6 brass bead chain or No. 16 brass jack chain. Chains shall be attached to the valve lever handle or around the valve stem.
D. An additional 10 consecutively numbered tags for each service shall be provided to the Owner for future use.

E. Service valves and isolation valves shall be labeled consecutively with supply being odd and return even (i.e., chilled water pump service valves shall be No. 1 on pump discharge and No. 2 on pump suction). Where a valve does not have a match skip the next number. All single valves for make-up water, expansion tanks, etc. can be numbered consecutively and shall be last in the sequence.

F. Balance valves that are not used as a combination balance/service valve are not required to be labeled.

G. Temperature control valves shall be identified with a ¼" “T.C.” legend and shall be numbered consecutively starting with major equipment and then terminal units (i.e., AHU-1 preheat, cooling, reheat control valves shall be numbered 1, 2, 3 respectively).

20 10 98   EQUIPMENT IDENTIFICATION

A. All major equipment items (i.e., chillers, air handling units, fans, terminal units, pumps, boilers, etc.) shall be identified with appropriately sized nameplates permanently attached to the respective equipment.

B. Small equipment items (i.e., in-line pumps, pot feeders, etc.) shall be identified with brass valve tags, see requirements for valve tags and chains.

C. Equipment that is controlled by the Building Automation Control System shall be labeled with a 2” x 5” yellow label with black letters:

   “CAUTION – THIS EQUIPMENT IS UNDER COMPUTER CONTROL AND MAY CYCLE AT ANY TIME.”

D. Interior equipment nameplates shall be 1/16” thick two-ply acrylic plastic 2-1/2” x 1” size minimum with white letters on a black background. Tag size shall be appropriate for equipment name, letters shall be a minimum of 1/2" high.

E. Exterior equipment shall be identified with nameplates suitable for exterior use or shall be engraved aluminum plates .020” thick, minimum size shall be 4” x 1-1/2” plates.

F. Nameplates shall be attached with corrosion-resistant No. 3 round head or No. 4 sheetmetal screws.

20 10 99   DUCTWORK IDENTIFICATION

A. Supply, return and exhaust ductwork uninsulated or insulated, exposed or concealed, shall be identified as specified herein, except for exposed ductwork in finished areas.

B. Markers shall be installed in clear view; installed on both sides of the duct; run parallel to the ductwork; located at not more than twenty-five foot (25’) intervals on straight runs at all branch locations; and located within 2 feet on each side of penetrations of the building structure and non-accessible enclosures.

C. Markers shall be pressure sensitive vinyl tape labeled for service and direction of airflow. Minimum size shall be 2” high x 8” long.

D. Supply air ductwork labels shall be green with white letters. Return, relief, and outdoor air ductwork labels shall be blue with white letters. Exhaust air ductwork shall be yellow with black letters. Outdoor air labels shall have an “air” legend.
A. The materials specified herein Section 20 10 90 shall apply to Division 25 Temperature Control Systems. Additional identification work is specified in Division 25.
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20 20 10 ELECTRICAL REQUIREMENTS

20 20 11 GENERAL

A. This Subsection specifies the basic requirements for electrical components which are an integral part of "packaged" mechanical equipment. These components include, but are not limited to, factory installed motors, starters, disconnect switches, control panels and related prewiring of power and control wiring for a single external electrical service connection. All material and equipment shall be provided for the application and service intended.

B. Specific electrical requirements (e.g. horsepower, electric characteristics, etc.) for mechanical equipment shall be specified within the respective equipment specifications or shall be scheduled on the Plans.

C. The Contractor shall verify that electrical characteristics of material and equipment furnished for Divisions 20 - 25 equipment are in accordance with the electric service and comply with the specifications and requirements of Division 26 - 29.

D. Unless otherwise specified as an integral part of packaged mechanical equipment, motor control centers, motor starters and disconnect switches and the power wiring from power source to motor starting equipment (including variable frequency drive packages) and wiring from that equipment to the respective motors including final connections shall be performed as Electrical Work of Division 26 - 29.

E. The field installation of electrical components, not included in Division 26 - 29, that are specified to be provided with the mechanical equipment and are shipped separately shall be the responsibility of the Contractor furnishing the base equipment.

F. All electrical components and material shall be UL labeled.

G. Submittals for the applicable electrical equipment shall include the following: identification of the equipment which the electrical material is to serve, application, voltage, phases, full load amperage, wattage and NEMA enclosure. For motors: horsepower, RPM, full load power factor and efficiency, frame size and service factor.

H. Identification of electrical components of mechanical equipment shall be in accordance with Subsection 20 10 90, "Basic Mechanical Methods - Identification".

20 20 12 REFERENCES

A. Electrical material and equipment provided for Divisions 20 - 29 shall meet the applicable requirements of the latest accepted edition of the following codes and standards:

- ANSI American National Standards Institute
- EEI Edison Electrical Institute
- IEEE Institute of Electrical and Electronic Engineers
- NEC National Electrical Code
- NEMA National Electrical Manufacturers Association
- UL Underwriter's Laboratories, Inc.

20 20 13 MOTORS

A. The following are basic minimum requirements for all motors. Additional motors, more detailed and specific requirements may be specified with the respective equipment.
B. Single-phase motors shall be provided for all motors 1/2 HP or less, except as specified or scheduled otherwise and shall be of the permanent split capacitor (PSC) type.

C. Polyphase motors shall be provided for all motors 3/4 HP or larger, except as specified or scheduled otherwise with a minimum power factor of .85 at 65% of full load or shall be power factor corrected.

D. Multi-speed motors shall have dual windings wound to the speeds scheduled or specified.

E. Torque characteristics shall be sufficient to satisfactorily accelerate the driven load(s) with low in rush current.

F. Motor horsepower sizes shall be large enough so that the driven load shall not require the motor to operate in the service factor range.

G. Temperature rating: Rated for 40 deg. C environment with maximum temperature rise for continuous duty at full load of 40°C for open dripproof motors, 50°C for splash proof motors, and 55°C for totally enclosed motors (Class B insulation). Motors used with variable frequency drives/inverters shall be NEMA MG1, Part 31 Compliant and have a Class B temperature rise with Class F insulation design to resist transient spikes, high frequencies, and short rise time pulses produced by inverters.

H. Starting capability: Frequency of starts as specified by the automatic control system. For manually controlled motors, not less than five (5) evenly time spaced starts per hour.

I. Service factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

J. Motor construction:
   1. NEMA standard frame sizes, general-purpose open dripproof (unless otherwise specified), continuous duty, Design “B” (unless “C” is required for high starting torque). Motor frame, end bells and conduit box shall be cast iron; stator windings shall be copper. Aluminum is unacceptable for any parts. Provide grounding lug in motor terminal box.
   2. Motors located outdoors or otherwise exposed to water, dust, etc where an open motor would not be suited, shall be totally enclosed fan-cooled (TEFC).
   3. Bearings: Ball or roller bearings with inner and outer shaft seals. Externally accessible inlet/outlet grease fittings. Where motors are enclosed within equipment, extend grease tubing to exterior of the enclosure. Bearings designed to resist thrust loading for drives producing lateral or axial thrust. Fractional horsepower, light duty motors may have sleeve bearings.
   7. Nameplate: Indicate full identification of manufacturer’s name, model number, serial number, horsepower, speed, voltage, characteristics, construction, special features, etc. Nameplates in harsh environments such as for cooling towers, or in pool equipment rooms, etc. shall be suited to the specific application.


20 20 14 MOTOR CONTROLS

A. Motor Starters: NEMA 1, general-purpose enclosures with padlock ears, unless specified otherwise. Type, size and duty shall be as specified or as recommended by the motor
manufacturer and the requirements of the driven equipment for applicable protection and start-up conditions.

B. **Manual Starters:** Pilot light and extra positions for multi-speed motors. Melting alloy type thermal overload relay protection.

C. **Magnetic Starters:** Hand-off-Auto selector switches, pilot lights, interlock contacts, switches and other devices as required for control requirements. Trip-free thermal overload relays for each phase. Built-in 120 volt control circuit transformer, fused from line side, where power service exceeds 240 volts. Externally operated manual reset; under-voltage release of protection.

D. **Acceptable Manufacturers:** Allen-Bradley, Cutler-Hammer, General Electric, Square D.

### 20 20 15 DISCONNECT SWITCHES

A. **Fusible:** For 3/4 horsepower and larger. Disconnect switch shall be horsepower rated, heavy duty, spring reinforced fuse clips each phase, quick-make/quick-break mechanism with arc quenchers, dead front line side shield, solderless lugs, silver electroplated current carrying parts, lockable hinged door, capacity and electric characteristics as specified.

B. **Non-fusible:** For 1/2 horsepower motor and smaller. Disconnect switch shall be horsepower rated, toggle switch type, quantity of poles and voltage rating as specified.

### 20 20 16 MULTI-SPEED MOTORS AND CONTROLS

A. Multi-speed motors, when required, shall be specified under the heading of the respective equipment to be driven.

B. Motor controls for multi-speed applications shall be specified, also, under the heading of the respective equipment, if said equipment is a "packaged" type unit.

C. Otherwise, multi-speed motor controls shall be specified in Division 26.

### 20 20 17 VARIABLE SPEED DRIVES

A. Motor controls for variable speed drives shall be specified under the heading of the respective equipment, if said equipment is a "packaged" type unit.

B. Otherwise, variable speed drives shall be specified in Division 26.

### 20 20 18 CONTROL PANEL

A. NEMA 1 general-purpose enclosure for indoor application; NEMA 3R weather resistant enclosure for exterior location.

B. Factory mount panel(s) and internal power and control devices. Pre-wire all devices for the operation of the related equipment so that only one main power connection shall be required in the field.

C. Provide internal protection for each circuit, maximum 120-volt secondary control transformer(s), terminal strips for wiring terminations, identification of components and wiring diagram inside the cover.
202020 DRIVES AND GUARDS

202021 GENERAL

A. This Subsection covers V-belt, sprocket-chain, gear and direct coupled drives.

B. All drives shall be selected for 150% of specified motor nameplate horsepower.

C. All drives shall be installed, balanced and aligned in accordance with the respective manufacturer's instructions and recommendations.

202022 V-BELT DRIVES

A. All motors shall be provided with variable pitch pulleys with design RPM at mid-range of adjustment.

B. V-belts shall be premium quality, endless cord impregnated rubber with trapezoidal cross section, type A, B, C or D, matched set (if more than one), 95% minimum drive efficiency.

C. The driving motor shall be installed on an adjustable bolt device to provide for belt tension adjustment.

D. Acceptable manufacturers:
   1. V-belt drives: Browning, Eaton, Gates

202023 DIRECT DRIVES

A. Wherever available, motors and related direct driven equipment shall be mounted on a common base.

202024 GUARDS

A. All belts, chains, pulleys, shafts, sheaves, sprockets, gears, couplings, projecting setscrews, keys and any other rotating parts shall be provided with guards by the Contractor furnishing the base equipment.

B. Guards shall be designed and arranged in accordance with OSHA requirements.

C. Guards shall completely enclose the drive, shall be secured to the respective equipment and shall be removable for servicing. Wherever available from the manufacturer, guards shall be provided with the equipment. If not, these shall be field fabricated.

D. Provide reinforced openings with removable coverplates for access to motor and driven shafts for speed measurement.

E. Extend tubing for grease fittings inside the guard to accessible locations outside the guard.

202025 INSTALLATION AND OPERATION

A. Install, balance and align all drives in accordance with the respective manufacturer's instructions and recommendations.

B. The balancing and alignment of drives including pinning, doweling and grouting shall be the responsibility of the Contractor furnishing the equipment. Any adversities arising from executing the Work shall be resolved/remedied by the Contractor.
C. Verify all electrical characteristics prior to running electric motor driven equipment. Check motor amperage draw and rotation for proper operation.
20 25 00 INSULATION

20 25 01 GENERAL

A. This Section specifies mechanical insulation of piping, equipment and ductwork.

B. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Divisions 20 - 29 of the Specifications.

C. Provisions and conditions cited in this Section shall apply to Work for other sections of Divisions 20 - 29 of these Specifications.

20 25 02 REFERENCES, REGULATORY REQUIREMENTS

A. Work for this Section of the Specifications shall be performed in accordance with the Codes, Standards, etc. as identified in Division 20 in addition to the following:

1. State and local Air Pollution Codes and Regulations.
3. UL 1479/ASTM E-814 Fire Test of Through-Penetration Firestops.

20 25 03 RELATED SECTIONS OF THE SPECIFICATIONS

A. Requirements of the following Sections of the Specifications apply to Work for this Section:

.1 Division 20 - Basic Mechanical Conditions
.2 Division 20 - Basic Mechanical Materials and Methods
.3 Division 22 - Plumbing Work
.4 Division 23 - HVAC Piping and Equipment
.5 Division 24 - Air Distribution

20 25 04 DEFINITIONS

A. The term “fitting” where used in this Section of the Specifications shall be construed as an elbow, tee or reducer. Unions, flanges and valves shall not be considered as fittings.

B. The term “cold” shall be defined as the temperature of a surface that may result in the formation of condensation.

C. The term “accessory” shall include staples, bands, wire, mesh, clips, pins, studs, tape, anchors, corner angles, cements, adhesives, coatings, sealers, mastics, finishes, etc.

D. The term “ASJ” where used in this Section of the Specifications shall mean a reinforced vapor retarding All Service Jacket.

E. The term “SSL” where used in this Section of the Specifications shall mean Self-sealing Lap Joint closure system for longitudinal jacket joints.

F. The term “supply air” where used in this Section of the Specifications shall mean downstream of a coil.

G. The term “outdoor air” where used in this Section of the Specifications shall mean ambient air that has not been conditioned.

H. The term “return air” where used in this Section of the Specifications shall mean conditioned air that is returned from the space.
I. The term “mixed air” where used in this Section of the Specifications shall mean air streams that are a mixture of “outdoor air” and “return air”.

J. The term “relief air” where used in this Section of the Specifications shall mean excess return air that is relieved from the building.

K. The term “exhaust air” where used in this Section of the Specifications shall mean air that is removed due to contaminates, odors, or heat.

20 25 05 WORK INCLUDED

A. Furnish material, labor and services necessary for and incidental to the insulation of the following systems where shown on the Plans and as hereinafter specified. Include all necessary considerations in the related sections of the Specifications (Subsection 20 25 03) to perform the Work completely.

1. Refrigerant piping.
2. Condensate drain piping.
3. Waste piping and floor drains located above grade serving condensate drains.
4. Make-up cold water piping.
5. Reheat coils and return bends of uncased coils, including VAV boxes.
6. Ductwork/sheetmetal systems.
7. Domestic hot, hot recirculating and cold-water piping.
8. Domestic hot water storage tanks and other equipment.
9. Storm water drainage.

B. Providing appropriate size calcium silicate/cellular glass/piped shield manufactured inserts to the trade contractor for installation between the pipes and oversized hangers as specified in this section.

C. Fire wrapping piping system located in occupied spaces or plenum spaces that do not meet flame spread 25 and smoke development 50.

20 25 06 SUBMITTALS

A. The Contractor shall submit shop drawings for approval in accordance with Subsection 20 00 43, Duties of Contractor - Submittals.

B. Provide an INSULATION PRODUCT SCHEDULE consisting of the following minimum information:

- Material - type of insulation material, jackets, or covers.
- Manufacturer - manufacturers name, product name, and K-value where applicable.
- Accessories - tapes, staples, coatings, adhesives including manufacturer's name and product name.
- Systems - indicate systems where product is used.

C. Provide an INSULATION THICKNESS SCHEDULE consisting of the following minimum information:

- System - indicate which system insulation is installed.
- Location - inside, outside, concealed, exposed, etc.
- Size - indicate size range of pipe, insulation type used.
- Thickness - indicate insulation thickness in inches.
D. Provide manufacturer's technical product data of each material and accessory item with engineering support information and recommended installation procedure. Indicate product number, “K” value, thickness and required accessories for each application.

E. At the completion of the project, submit a letter stating all materials are asbestos free, and meet the specified ASTM E-84 flame/smoke rating of 25/50, and that all piping and duct penetrations are smoke or fire stopped as required by the Code.

20 25.07 SPECIAL REQUIREMENTS

A. Contractor's Qualifications: Contracting company shall be one specializing in insulation application and have a minimum of three (3) years experience in this work.
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20 25 10 INSULATION MATERIALS

20 25 11 GENERAL

A. Materials and accessories furnished for this Section of the Specifications shall be standard cataloged products, new, commercially available and suitable for the service specified.

B. Insulation material and/or accessories containing asbestos are prohibited.

20 25 12 FIRE SAFETY STANDARDS

A. All insulation material shall have composite fire and smoke hazard ratings in accordance with NFPA 255 and UL 723 not exceeding the following values as tested by the latest procedures of ASTM E-84: flame spread of 25; smoke developed of 50.

B. Accessories such as adhesives, mastics, cements, tapes and cloths for seams, joints and fittings shall have the same ratings as hereinbefore listed. All products and their respective shipping cartons shall have indications that flame and smoke ratings meet the aforementioned requirements. Any treatment of jackets or facings to impart acceptable flame and smoke safety values shall be permanent; water-soluble applications are prohibited. The Insulation Contractor shall bear responsibility that all products to be used meet the foregoing criteria.

20 25 13 TYPES OF INSULATION MATERIALS

The following types of insulation material are enumerated in the respective INSULATION MATERIAL SCHEDULE. K values listed are in units of (Btu in/hr ft.2 °F) and are based on specific products and are to be met or exceed. ANSI/ASTM types or class shall not provide relief for any K value specified.

A. Type CS: Hydrous calcium silicate, molded pipe or block form, asbestos free, ANSI/ASTM C533, Type I, “k” value of 0.41 at 200 degrees F for pipe, “k” value of 0.39 at 200 degrees F for block, density of 15#/cubic foot. Owens-Corning Calcium Silicate or equivalent by Knauf, Manville or Pabco.

B. Type GF1: Glass fiber, non-combustible, preformed for pipe and tube application, ANSI/ASTM C547, Class 1, “k” value of 0.23 at 75 degrees F. Owens-Corning type ASJ with SSL-II vapor retarder jacket or equivalent by CertainTeed, Knauf, Manville or Schuller.

C. Type GF2: Glass fiber, non-combustible, rigid board with vapor retarder facing, ANSI/ASTM C612, “k” value of 0.24 at 75 degrees F, density of 3#/cubic foot. Owens-Corning type 703 with ASJ 25 jacket or equivalent by CertainTeed, Knauf, Manville or Schuller.

D. Type GF3: Glass fiber, flexible blanket, laminated to reinforced kraft vapor retarder facing, ANSI/ASTM C553, Type II, “k” value of 0.27 at 75 degrees F, density of 1#/cubic foot. Owens-Corning type 100 All-Service faced duct wrap or equivalent by CertainTeed, Knauf, Manville or Schuller.

E. Type F1: Flexible elastomeric foamplastic with smooth exterior surface, preformed for pipe and tube application, ASTM C534, Type I, “k” value of 0.28 at 75 deg. F. Armstrong AP Armaflex pipe insulation, K-Flex LS tube, Aerocel EDPM tube.

F. Type F2: Flexible elastomeric foamplastic with smooth exterior surface, sheet material, ASTM C534, type II, “k” value of 0.28 at 75 degrees F. Armstrong AP Armaflex sheet material, K-Flex LS sheet, Aerocel EDPM sheet.

G. Type FG: Rigid foamglass preformed for pipe applications ASTM C552, K value of 0.33 at 75°F with all-purpose vapor retarder jacket. Pittsburgh Corning Foamglass.
H. **Type PI:** Polyisocyanurate preformed for pipe applications ASTM C591, aged “k” value of 0.19 at 75 degrees F, density of 2#/cubic foot. Shall be ASTM E84 less than 25/50 rated. Saran 560 vapor barrier.

I. **Type PH:** Phenolic preformed for pipe applications ASTM C1126, Type III, grade 1. ASTM E84 less than 25/50 rated, Saran 560 vapor barrier, 0.15@75°F.

### 20 25 14 TYPES OF PIPING JACKET MATERIALS

A. .016” aluminum or 0.010” stainless steel jackets with moisture barrier shall be cut and fitted to size required. Fold a ¼” safety edge on exposed side, roll to diameter required and secure with ¼” x 0.020” aluminum or ¼” x 0.015” stainless steel bands respectively on 9” centers (4 bands per 3 foot section of jacketing). Provide appropriate seals, and shed water toward low end of pitched piping. Install lap on top quadrant (2 or 10 o’clock position) of outside diameter of insulation and line up bands and seals to present neat and workmanlike appearance. Fitting covers shall be consistent with piping insulation jacketing. Secure in place with SS screws or banding. Seal with approved caulking. Sharp edges shall be turned under or otherwise protected.

B. PVC jacketing 0.030” thick for pipe insulation and PVC fitting covers shall be applied over the insulation and vapor barrier system where indicated below for aesthetics or mild abuse areas.

C. Finish piping insulation with factory or field application for respective locations as follows:

<table>
<thead>
<tr>
<th>Description</th>
<th>Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dry, low abuse:</td>
<td>Concealed, not exposed to view. Mechanical equipment room. Exposed, finish space.</td>
</tr>
<tr>
<td>Pipe:</td>
<td>ASJ jacket.</td>
</tr>
<tr>
<td>Fittings:</td>
<td>Pre-molded PVC covers.</td>
</tr>
<tr>
<td>High abuse area:</td>
<td>Exposed vertical risers in all Storage Rooms, Janitor Closets. Exposed, unfinished space.</td>
</tr>
<tr>
<td>Pipe:</td>
<td>Stainless steel jacket with seam away from abusive force. Apply to height of 8 feet.</td>
</tr>
<tr>
<td>Fittings:</td>
<td>Formed stainless steel covers.</td>
</tr>
<tr>
<td>Outdoors:</td>
<td>All</td>
</tr>
<tr>
<td>Pipe:</td>
<td>Smooth aluminum jacket with seam on topside at 2 or 10 o’clock position of horizontal runs.</td>
</tr>
<tr>
<td>Fittings:</td>
<td>Formed aluminum covers.</td>
</tr>
<tr>
<td>Pipe:</td>
<td>PVC cover.</td>
</tr>
<tr>
<td>Fittings:</td>
<td>Pre-molded PVC covers.</td>
</tr>
</tbody>
</table>

### 20 25 15 DELIVERY AND STORAGE OF MATERIALS

A. All of the insulation materials and accessories covered by this specification shall be delivered to the job site and stored in a safe, dry place with appropriate labels and/or other product identification.

B. The Contractor shall use whatever means are necessary to protect the insulation materials and accessories before, during, and after installation. No insulation material shall be installed that
has become damaged in any way. The Contractor shall also use all means necessary to protect work and materials installed by other trades.

C. If any insulation material has become wet because of transit or job site exposure to moisture or water, the Contractor shall not install such material, and shall remove it from the job site. An exception may be allowed in cases where the Contractor is able to demonstrate that wet insulation when fully dried out (either before installation, or afterward following exposure to system operating temperatures) will provide installed performance that is equivalent in all respects to new, completely dry insulation. In such cases, consult the insulation manufacturer for technical assistance and provide the Architect/Engineer with a copy of manufacturer’s recommendation for approval.

20 25 16 ACCEPTABLE MANUFACTURERS

The following are acceptable manufacturers for products specified in this section of the specification.

A. Metal jackets:
   1. Childers Products Co., Inc.
   2. Insul-Coustics
   3. Pabco Surfit Metal Corp.
   4. RPR Products, Inc.

B. PVC covers:
   1. Proto Corp.
   2. Ceeleco Corp.
   3. Speedline PVC Corp.

C. Adhesives and Coatings:
   1. Alpha Associates
   2. Miracle Adhesives
   3. Vimasco Corporation

D. Fasteners
   1. ACS Industries
   2. GEMCO
   3. Midwest Fasteners

E. Fire Stop
   1. 3M
   2. Metacaulk
   4. USG Interior, Inc.
A. Service: Hot and cold piping

B. Domestic water- hot, hot recirc.
   2" and smaller
   1" Type GF1, F1
   (Contractor's option)
   2-1/2" and larger
   1-1/2" Type GF1

C. Domestic water-cold
   ½" Type F1, GF1
   (Contractor's option)

D. Storm water from the roof drain to the first floor level below the roof. Thereafter, all horizontal piping only and related elbows to vertical. Insulate drain body with ½" sheet Armaflex.

E. Refrigeration Piping:
   Type F1
   Suction - 2" and smaller
   3/4"
   2-1/2" and larger
   1"
   Hot gas/discharge - All sizes
   3/4" where piping is 8'-0" or less AFF

F. Condensate Drain Lines:
   ½" Type F1
   All except air handling units in Mechanical Rooms where drain line is 2'-0" or less in total length and located at the Mechanical Room floor.

G. Waste Piping and Floor Drains:
   1/2" Type F1
   Piping above grade serving floor drains, hub drains, indirect cabinets, etc., that receive condensate from cooling coils. Insulate piping to where it connects to main waste pipe.

H. Sump Pump Discharge Lines:
   ½" Type F1

I. Fittings (hot and cold):
   Molded/preformed fittings, secured in place with twine or tape, seal all “cold” applications prior to installing jacket material.

J. Unions, flanges:
   Type F1, same thickness as adjacent piping.
   Form external collar, minimum 1” overlap on adjacent insulation. Use adhesive to secure in place and maintain vapor barrier.

K. Unions, flanges:
   No insulation.
L. Valves (hot piping): Insulate valve body only.

M. Joints: Lines subject to condensation: seal longitudinal laps of jacket with adhesive and wrap butt joints between sections with 2” wide tape.
INSULATION MATERIAL SCHEDULE  I-2

A. Service: “Hot” equipment

B. Domestic hot water storage tanks 2”

C. Insulation Material: Type GF2
   Option #1: Owens-Corning type ASJ w/ SSL jacket for round surfaces
   Option #2: Owens-Corning Pipe & Tank Insulation for round surfaces

D. Flanges: No insulation.

E. Attachment: Secure rigid board with welded pins on 12” centers. Secure with ¾” x 0.020” SS bands on 12” centers. Fit ends of tanks and irregular surfaces by segmenting or scoring board and wiring into place.

F. Joints: Point and fill-in all joints and voids with insulating cement or fill-in all joints and voids by stuffing with mineral wool.

G. Finish: 0.016” smooth aluminum jacket with moisture barrier, secured with ½” x 0.015” SS bands on 9” centers and SS sheet metal screws.
<table>
<thead>
<tr>
<th>System</th>
<th>Service</th>
<th>Config.</th>
<th>Liner</th>
<th>Insulation</th>
<th>Location</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAU-1</td>
<td>Exhaust</td>
<td>Rect.</td>
<td>None</td>
<td>None</td>
<td>From Room to Energy Recovery Wheel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exhaust</td>
<td>Rnd.</td>
<td>None</td>
<td>None</td>
<td>From Room to Energy Recovery Wheel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply Duct</td>
<td>Rect.</td>
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<td>1&quot; GF3</td>
<td></td>
<td>All</td>
</tr>
<tr>
<td>AHU-1</td>
<td>Supply Duct</td>
<td>Rect.</td>
<td>None</td>
<td>1&quot; GF3</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply Duct</td>
<td>Round</td>
<td>None</td>
<td>1&quot; GF3</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Return Duct</td>
<td>Rect.</td>
<td>None</td>
<td>None</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transfer Ducts</td>
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<td>1&quot;</td>
<td>None</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>AHU-2</td>
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<td>Rect.</td>
<td>None</td>
<td>1&quot; GF3</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply Duct</td>
<td>Round</td>
<td>None</td>
<td>1&quot; GF3</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Return Duct</td>
<td>Rect.</td>
<td>None</td>
<td>None</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transfer Ducts</td>
<td>Rect.</td>
<td>1&quot;</td>
<td>None</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>RLF-1</td>
<td>Inlet Duct</td>
<td>Rect.</td>
<td>None</td>
<td>None</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>RLF-2</td>
<td>Inlet Duct</td>
<td>Rect.</td>
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<td>None</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>EF-1</td>
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<td>Rect.</td>
<td>None</td>
<td>1&quot; GF3</td>
<td>10' within building exterior</td>
<td></td>
</tr>
<tr>
<td>EF-2</td>
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<td>Rect.</td>
<td>None</td>
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<td></td>
</tr>
</tbody>
</table>
20 25 30 INSULATION APPLICATION

20 25 31 INSULATION APPLICATION - GENERAL

A. Respective piping system, duct system and/or equipment shall be pressure tested, proved tight and accepted, as specified in section for installation of such, before insulation is applied. Sheet metal ductwork joints shall be sealed prior to insulating. Coordination among the respective contractors is essential.

B. Insulation materials and accessories shall be applied in accordance with respective manufacturer's recommendations and recognized industry practice for the insulation to serve its intended purpose. All surfaces to receive insulation shall be clean, dry, free of oxidation and prepared as required.

C. The insulation work shall be subject to inspection during the various applications and construction phases. Material, accessories, finishes, methods and workmanship that are not in compliance with these Specifications and/or approved submittals may lead to rejection of the Work and replacement at the Contractor's expense.

D. Painting of piping for corrosion protection, where specified, shall be performed before insulation is applied.

E. Painting of piping for color coding, where specified, shall be performed after insulation is applied.

20 25 32 INSULATION APPLICATION - PIPING

A. Insulate each piping section with single thickness full-length units of insulation, with a single cut piece to complete the run where a fitting is encountered. Do not use cut pieces or scraps abutting each other.

B. Extend piping insulation without interruptions through walls, floors, and similar piping penetrations, except where otherwise specified.

C. Insulation on unions, flanges, valves, strainers, expansion joints, pump impeller housings and other equipment requiring accessible servicing shall be removable and reusable without damage. Items requiring periodic attention shall have covers and/or casings to contain the insulation.

D. All "cold" piping systems shall be insulated with type and thickness of material herein specified and shall have a continuous vapor retarder through all fittings, hangers, supports and sleeves.

E. In cold systems flanges, unions, valves, etc., shall be covered with an oversized pipe insulation section sized to provide the same thickness as on the main piping section. An oversized insulation section shall be used to form a collar between two insulation sections with low-density blanket insulation being used to fill gaps. Jacketing shall match that used on main piping system. Rough cut ends shall be coated with suitable weather and/or vapor resistant mastic as required by the system location and service. All valve stems must be sealed with caulkig that allows free movement of the stem but provides a seal against moisture incursion.

F. In hot system flanges, unions, valves, etc., shall be left exposed; insulation ends shall be tapered and sealed to allow bolts to be removed or other required access.
G. The installation of cold piping systems shall use oversize (outside the thickness of the insulation) pipe hangers.

1. Piping systems 3" and smaller, the Insulation Contractor shall replace temporary wood blocking with insulation of thickness as scheduled in this section of the specification. Metal pipe shields shall be placed between the pipe hanger and the insulation.

2. Piping systems 4" and larger, the Insulation Contractor shall replace the temporary wood blocking with high density pre-formed insulation (i.e. calcium silicate, cellular glass) inserts with suitable characteristics for the weight, temperature and application and insulation protection shields at each hanger. The specified insulation should stop and start at the insert at the hanger locations. The insert shall be wrapped with vapor barrier jacketing. Circumferential joints shall be taped with vapor barrier tape and coated with vapor barrier sealant. B-Line, or equivalent, figure B-3380 through B-3384, 360 deg. calcium silicate insert/shields and figure B-3153 protection shields may be used or equivalent may be field fabricated per details submitted for approval.

3. If in the event pipe hangers are not oversized, this Contractor shall notify the Engineer and the Contractor(s) who provided and/or installed hangers. Hangers shall be corrected before pipe is insulated.

4. Where size on size hangers have been approved by the Engineer in writing for use in special situations, the insulator shall insulate the hanger and hanger rod with ½" Type F insulation. Pipe insulation shall terminate at each side of the hanger and have vapor barrier end joint butt strips. Hanger insulation shall overlap pipe insulation a minimum of 4" on each side of the hanger and secured to the pipe insulation with contact adhesive. Hanger rods shall be insulated for a minimum of 12" secured to the rod with contact adhesive and the end sealed with a bead of caulking.

5. The Contractor shall adjust hangers after the insulation and pipe shields have been installed to provide an evenly supported piping system. No hanger shall bear the entire weight or not carry any weight of piping system.

H. Special requirements for fiberglass pipe insulation:

1. Fiberglass pipe insulation, All Service Jacket/Self Sealing Lap (ASJ w/SSL) type, shall be installed with laps positioned to shed water, position at either 10 o’clock or 2 o’clock and shall not be visible to view. End joint butt strips shall be installed on all piping with ½” adhesive to adhesive overlap.

2. For piping systems using fiberglass insulation, the fittings shall be insulated with: double thickness molded fiberglass fittings, or preformed cellular glass fittings secured with twine or wire; or with flexible elastomeric foamplastic; at the Contractor’s option. The pre-molded PVC fitting covers shall be installed over the fiberglass inserts and secured with SS tacks. Victaulic fittings or couplings shall be insulated with sheet elastomeric foam plastic insulation formed to the fitting and formed “collars” over all couplings encountered.

3. For piping systems using fiberglass insulation, butt joints in hot piping shall be made with 2” wide vapor barrier tape over butt joints. Butt joints in cold piping shall be made with a wet coat of vapor barrier lap cement on butt joints and seal joints with 2” vapor barrier tape. All pipe insulation ends shall be tapered and sealed.

4. On “cold” applications only, the following additional requirements shall apply: the premolded fittings shall be sealed with an approved vapor barrier retardant prior to installing the jacket materials. Premolded PVC fitting covers shall then be installed over the premolded inserts, all joints shall be sealed with vapor barrier cement and 2” vapor barrier tape on lap joints. Premolded stainless steel or aluminum fitting covers shall be installed per the manufacturer’s instructions and a bead of clear silicon caulk applied to all joints. Straight lengths of insulation abutting all fittings shall have both ends sealed with vapor barrier cement to prevent “wicking” or moisture migration. At a maximum of twenty-
one foot (21") intervals, joining ends of the butt joints shall be sealed with vapor barrier
cement prior to butting together to prevent “wicking” or moisture migration.

I. For piping systems using elastomeric foamplastic insulation, joints and seams shall be sealed
with manufacturer’s recommended contact adhesive. Fittings shall be insulated from
segments fabricated from pipe insulation or sheet material, secured and sealed with contact
adhesive. Termination points and ends shall be sealed to the pipe to prevent backflow of
condensation on the inside of the insulation. Any piping outdoors or otherwise exposed to UV
or ozone provide two (2) coats of WB Armaflex or Rubatex 374 finish.

20 25 33  INSULATION APPLICATION - EQUIPMENT

A. Manufactured equipment (i.e. air handling equipment, terminal units, air device plenums, etc.)
requiring insulation shall be specified in the respective equipment specifications to be factory
insulated with internally applied liner or double wall casing.

20 25 34  INSULATION APPLICATION - DUCTWORK

A. Ductwork systems shall be insulated in accordance with the insulation schedules. Insulate
each duct section with single thickness full length pieces. Do not use scraps abutting each
other.

B. Extend insulation without interruptions through walls, floors, and similar penetration, except
where otherwise specified.

C. “Cold” duct systems shall have insulation with a continuous vapor retarder through all fittings,
hangers, supports, air devices, fire dampers, duct mounted coils, dampers, and other devices
in the ductwork system, etc.

D. In “cold” duct systems, using rigid board or sheet elastomeric foam insulation, support angles,
stiffener angles, ductmate flanges, etc. they shall be covered with an oversized insulation strip
sized to provide the same insulation thickness as on the duct. Provide a minimum of 2” of
overlap on each side of the obstruction.

E. Board insulation shall be properly cut and dry fitted to the surface to be insulated. Edges shall
be neat and clean cut. No intermediate cut pieces shall be allowed on the bottom and sides of
the ductwork. Insulation board shall be secured in place using mechanical fasteners such as
welded pins or speed clips. Locate not less than 3” from each edge or corner and
approximately 12” on centers on all sides. There shall be a minimum of two (2) rows of pins on
the bottom of the duct and one (1) on the sides. Additional pins may be needed on the bottom
to prevent sagging. All seams, joints, penetrations and breaks in the vapor retarder jacket
shall be sealed with pressure sensitive tape matching insulation facing. Edges shall be
provided with 28 ga. 1” x 1” aluminum corner beading properly secured and shall have the
same facing material as the insulation board.

F. Flexible duct wrap insulation shall be cut properly and fitted to “stretchout” dimensions and a 2”
piece of insulation removed from the facing at the end of the piece to form an overlapping
staple and tape flap. Insulation shall be installed with facing outside so tape flap overlaps
facing at the other end. Insulation shall be butted tightly. Seams shall be stapled on 6” centers
with outward clinching staples. Adjacent sections of duct wrap insulation shall be butted tightly
with the 2” tape flap overlapping and stapled. For horizontal oval ducts over 30” wide, duct
wrap insulation shall be secured additionally to the bottom of the duct with mechanical
fasteners such as pins and speed clip washers spaced on 18” centers to prevent sagging. All
seams, joints, tears, punctures and other penetrations in the vapor retarder jacket shall be
sealed with FRK backing pressure sensitive tape.
G. Stop and point insulation around access doors and damper operators to allow operation without disturbing insulation.

H. Where a duct run changes from interior lining to exterior application (or vice versa), there shall be a 6" overlap of insulation.

I. In "cold" duct system with internal duct insulation, with 1 1/2 " thickness flexible duct wrap, insulate air devices, fire dampers, duct mounted coils, dampers, and other devices in the ductwork system that are not internally insulated.

**20 25 35 PVC PIPING INSULATION PLENUM FIRE WRAP**

A. Provide 1/2 inch minimum thickness fire resistant blanket wrap consisting of inorganic blanket encapsulated with a scrim-reinforced aluminum foil and overlap seam to provide a flexible, non-combustible enclosure for cables and PVC non-plenum rated pipe in return air plenums as tested to UL 910.

B. Plenum Wrap shall be tested in accordance with the following:

   - **ASTM C 411, ASTM C 518, ASTM E 84, ASTM E 136, and UL 910**
   - Maximum Flame Spread (Ft.) 0.01
   - Maximum Smoke (Optical Density) 0.01
   - Average Smoke (Optical Density) 0.00
   - Surface Burning Characteristics (ASTM E 84)

C. Cut Fire Barrier Plenum Wrap to a length sufficient to wrap completely around the perimeter of the pipe, plus provide a longitudinal overlap of not less than 1 inch and an overlap of 1 inch, minimum, over the adjacent wrap section. Use aluminum foil tape to seal cut edges of the blanket. Temporarily secure Plenum Wrap in place using 3/4 inch wide filament tape. Install minimum 1/2 inch wide by 0.015 inch (28 gauge) thick stainless steel metal banding with stainless steel metal band clamp or 16 gauge galvanneal tie wire around the Plenum Wrap to hold it in place. Place the bands or tie wires 1/4 inch from each edge of the blanket and at the midpoint of the blanket, 11-3/4 in. on center. Tension the banding or tie wire to hold the Plenum Wrap snugly in place, compressing the foil but not cutting the foil.

D. PVC Piping Insulation Plenum Fire Wrap shall be 3M Fire Barrier Plenum Wrap 5A or approved equivalent.

**END OF SECTION**

20 00 00
21 00 00 FIRE PROTECTION SYSTEM

21 00 01 GENERAL

A. This section specifies a hydraulically calculated fire protection system designed and installed by the Contractor as described on the drawings and hereinafter.

B. It is the intent that the drawings and specifications shall describe and provide for a working installation complete in every detail and all items necessary for such complete installation shall be furnished whether specifically mentioned or not.

C. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Divisions 20 - 29 of the Specifications.

D. Provisions and conditions cited in this Section shall apply to Work for other sections of Divisions 20 - 29 of these Specifications.

21 00 02 REFERENCES, REGULATORY REQUIREMENTS

A. Work for this Section of the Specifications shall be performed in accordance with the Codes, Standards, etc. as identified in Division 20 in addition to the following:

2. The Local Authority having jurisdiction.

21 00 03 REFERENCES, RELATED SECTIONS OF THE SPECIFICATIONS

Requirements of the following Sections of the Specifications apply to Work for this Section:

A. Division 20 - Basic Mechanical Conditions.

B. Division 20 - Basic Mechanical Materials and Methods

21 00 04 DEFINITIONS

A. The term “layout” where used in this Section of the Specifications shall mean drawings prepared by the Contractor showing where all piping and heads are located. These drawings should include pipe elevations, need not include pipe sizes and should not include hydraulic calculations.

B. The term “Authority Having Jurisdiction” or “AHJ” where used in this Section of the Specification shall mean the organization, office, or individual responsible for approving equipment, an installation, or a procedure.

C. The term “rhythm” where used in this Section of the Specifications shall mean spaced in a manner which would place the heads at the same location with respect to lights or diffusers (i.e., for a row of lights spaced at 12’ centers heads shall also be on 12’ centers so that the heads will remain the same number of ceiling tiles or distance away from the lights; where there is an odd number of tiles between lights or diffusers, it is also preferable to have heads located at the tile centered between them).

D. The term “working drawings” where used in this Section of the Specifications shall mean drawing of the quality and containing all information as which would be required for approval by local official and for field construction.
21 00 05  WORK INCLUDED

A. Furnish material, labor and services necessary for and incidental to the installation of the following systems where shown on the Plans and as hereinafter specified. Include all necessary work in the related sections of the Specifications (Subsection 21 00 03 to perform the Work completely.

B. Furnish and install a complete hydraulically engineered fire protection system for a fully sprinklered building, including but not limited to:
   1. Wet pipe systems for areas not subject to freezing.
   2. All required fire department connections, backflow prevention devices, meters, post indicating valves, detector checks, vaults, etc.
   3. Hydraulic calculations shall include the domestic water demand in all common piping back to the point of the flow test.

C. Verify actual water supply with a test, preferably witnessed or performed by the local fire official.

D. Contractor shall coordinate his work with the work of other trades, and with the architectural and structural drawings.

21 00 06  SUBMITTALS

A. The Contractor shall prepare submittals for approval in accordance with Subsection 20 00 43, Duties of Contractor - Submittals.

B. Submit “Layout drawings” and equipment cut sheets with 30 days from the General Contractor’s contract date.

C. Contractor shall submit “Working drawings” coordinated with the other trades for review prior to any fabrication or installation and prior to the General Contractor’s fourth partial pay request.

21 00 07  SPECIAL REQUIREMENTS

A. The Contractor preparing the drawings and calculations shall be NICET Level 3 certified or a Professional Engineer licensed in the State of Missouri whichever is required by the Authority Having Jurisdiction.

B. All equipment shall be U.L. Listed for use in fire protection systems.

C. Where Pipe and accessories installed under this section of the specification tie-in to existing systems, Contractor shall verify existing lines for: sizes, direction of flow (via pressure or physical tracing of piping, not labels), materials, and elevations before installing new work. Contractor shall notify Architect/Engineer upon discovery of discrepancy. Work performed prior to verification will be corrected at no cost to Owner.

21 00 08  CLOSE-OUT REQUIREMENTS

A. Reference Section 20 00 48.

B. Where NFPA maintenance information is utilized, it shall be edited to contain only information that is relevant to this project.
21 00 10 DESIGN

21 00 11 WATER SUPPLY

A. The water supply shall be a connection to the City water supply.

B. The water pressure read at hydrant #0648 read on March 25, 2014 had a static pressure of 79 psi and a residual pressure of 55 psi flowing 1250 gal/min.

C. This information is provided for general information only.

D. In sprinkler systems that require a fire pump to meet sprinkler requirements, the sprinkler pipe sizes shall be based on Pipe Schedule method. This is to provide maximum sprinkler operation when the fire pump is not available, and minimizes the size of the fire pump. This also provides the possibility that with future water infrastructure improvements, the fire pump would no longer be required.

D. Design water pressure requirements shall include a minimum of 10-psi safety factor. Where Authority having jurisdiction requires a higher safety factory it shall be used.

E. The point of this Contractor's work shall start where determined by the “General Contractor” and local trade practices.

21 00 12 LAYOUT - GENERAL TO ALL SPRINKLER SYSTEMS

A. The “layout” shall be submitted to the Architect prior to performing hydraulic calculation, sizing pipes or seeking approvals from the authority having jurisdiction.

B. The Architect/Engineer will review “layout” for aesthetics, and pipe routings for consistency with the construction documents.

C. Minimum head spacing shall be as per NFPA-13., additional heads may be required by the Architect/Engineer to create spacing that works with the reflected ceiling plans. Contractor shall layout any areas not shown on the plans with symmetry and “rhythm” in mind.

D. Heads shall be on return bends and centered ± 1” for 2’ x 2’ ceiling tiles, or on quarter points ± 1” for 4’ x 2’ ceiling tiles.

E. Contractor shall not scale the drawing, refer to architectural drawings for dimensions. Where the room dimension is at the maximum size listed for the sprinkler heads, install an additional row of sprinklers.

F. Contractor shall locate heads in the field from the final wall locations. It shall be brought to the Architect’s/Engineer’s attention where the center of tile location exceeds the maximum distance of the sprinkler. Additional heads shall be added and the layout modified as directed by the Architect/Engineer at no additional cost to the Owner.

G. All sets and rises shall be located above ceilings of adjacent spaces of rooms without ceilings as opposed to making the sets and risers in the exposed spaces.

H. Inspector test connections and auxiliary drains shall be piped to spaces not occupied by building occupants, i.e., Mechanical Rooms, Storage Rooms, Janitor’s Closets, etc.
21 00 13 APPROVALS

A. Submittal drawings shall show lights, ducts, and pipes indicating all necessary rises and drops in sprinkler piping required for routing. Drawings shall be of a minimum of the same scale as the contract documents (1/8" = 1'-0" scale). A ¼" scale drawing of the service entrance and an elevation of the service entrance shall be required. A sprinkler riser diagram showing all control valves, test connections, supervisory switches, and drains shall be required.

B. The "layout" submittals shall contain at least two (2) copies of reproducible sepias of piping layout. Equipment cut sheets shall also be provided at this time.

C. Any pipe sizing or hydraulic calculations performed prior to the Contractor receiving the "layout" submittal with the 'approved stamp' of the Engineer shall be at the Contractor's own risk. Any design changes resulting in resizing pipe and/or revising hydraulic calculations will be done at no cost to the Owner.

D. The "working drawing" submittals shall contain at least two (2) copies of reproducible sepias of piping layout and at least two (2) copies of hydraulic calculations. Calculations shall include peaking information for each area calculated. The hydraulic calculation used for the system design shall be clearly identified from all other hydraulic calculations and should show the safety factor the designed system has relevant to the available water test pressure.

E. Hydraulic calculations shall include: actual pipe internal diameters and coefficients of materials approved in the "layout" submittal; design density; remote area size; and area per sprinkler.

F. The Contractor shall not pursue any approvals or interpretations of the design documents except through the office of the Architect/Engineer.

G. All work shall meet the requirements of the Owner, authority having jurisdiction, Architect and Engineer. These requirements may be greater than required by NFPA. Work shall not start prior to the Contractor receiving the "working drawing" shop drawings with the 'stamp' of the Engineer and approval from the authority having jurisdiction.

21 00 14 TESTING

A. Preliminary testing witnessed by the Architect/Engineer shall be conducted to assure proper operation before the final test is scheduled. Prior to this testing, pipes shall be flushed, hydrostatically tested, and all valves and devices shall be operated. All requirements of "System Acceptance" of NFPA 13 shall be met in full.

B. The sprinkler system shall be final Acceptance tested in the presence of the Owner's Representative and the governing agencies having jurisdiction for approval.

21 00 15 ACCEPTANCE

A. Acceptance test performed as described above.

B. Contractor shall fill out completely and sign Contractor's Material and Test Certificate provided in NFPA-13 and submit to Engineer for approval and thus system acceptance.

C. Spurious Alarms

1. If the Owner experiences an unacceptable number of spurious or unexplained false alarms during the installation and guarantee periods, the Contractor shall be responsible for providing the necessary labor, material and technical expertise to correct the problem to the satisfaction of the Owner.
2. Any spurious alarms associated with waterflow devices or valve supervisory switches, range hood and duct fire suppression system monitoring devices, or monitoring of special suppression systems are considered unacceptable.

3. The Contractor shall coordinate with the fire alarm contractor to resolve spurious or unexplained false alarms.

D. Keys and Special Tools

1. The Contractor shall supply the Owner with three complete sets of any special tools or keys necessary for normal operation and maintenance of the system. Keys and locks for equipment shall be identical.

21 00 16 SPACE CLASSIFICATION

A. The most stringent of NFPA-13, local practices, or the following criteria shall be used in the sprinkler system design and hydraulic calculations.

1) Light Hazard:
   - Offices
   - Toilet Rooms
   - Lobby/Commons Area
   - Corridors
   - Meeting Rooms
   - Training Room
   - Locker Rooms
   - Vending
   - Multi-Purpose Rooms
   - Vestibules
   - Stairs
   - Hospitals

2) Ordinary Hazard, Group 1:
   - Mechanical Rooms
   - Elevator Equipment Room
   - Janitor's Closet
   - Laundry Room
   - Kitchens

3) Ordinary Hazard, Group 2:
   - Storage

B. The hazard protection level shall be increased as required for areas with hazardous materials, flammable and combustible liquids, or storage that requires additional protection per NFPA 13. The sprinkler design criteria for spaces with hazardous materials and/or flammable and combustible liquids shall be in accordance with NFPA 30 and the requirements for Extra Hazard occupancies of NFPA 13.

C. Reduction in design area shall be permitted for quick response sprinklers in accordance with NFPA 13.
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21 00 20 SERVICE ENTRANCE

21 00 21 BACKFLOW PREVENTION DEVICE

A. Minimum requirements shall be a double check valve assembly with OS&Y gate shutoff valves. Double check valves shall be Watts Series 709, Ames Series 2000, or equivalent.

B. Where required by local codes or the authority having jurisdiction provide a reduced pressure backflow preventer assembly with OS&Y gate shutoff valves. Reduce pressure valves shall be Watts Series 909, Ames Series 4000, or equivalent.

21 00 22 HOSE CONNECTIONS

A. Furnish and install fire department connections (FDC) as indicated on the plans.

B. Fire department connection shall be UL 405 listed, 175 psig rated, aluminum body, complete with identification plate.

C. Hose threads shall be according to NFPA 1963 and shall conform to the local fire department standards.

D. Finish shall be dark, hard anodized aluminum.

E. Labeling shall be "AUTO SPRINKLER".

F. Fire department connection shall be 4-inch Knox Storz Lock with straight adapter.

G. Outlets and/or pump test connections shall match the type, finish, and appearance of fire department connections and be furnished by the same manufacturer.

H. INSTALLATION: Provide with a UL 1726 ball drip installed at the low point of the piping. Pipe to a building drain.

21 00 23 WATER FLOW SWITCH

A. Water flow detectors shall be UL 346, electrical-supervision, paddle-operated-type, 250 psig rated, designed for horizontal or vertical installation. Install on the sprinkler system as indicated and where required. Detectors shall be mounted in accordance with the manufacturer's instructions. They shall be designed to signal any flow of water that equals or exceeds 10 gpm. Detector switch mechanisms shall incorporate an instantly recycling pneumatic retard element with an adjustable range of 0 to 60 seconds. Switches shall be form C contacts at 10A/120V or 2A/24VDC suitable for operation on 120-volt A.C. or 24-volt D.C. Detectors shall be of dust tight construction. Detector switch enclosures shall be tamper-proof. Water flow switch shall be Potter-Roemer model VSR-F or equivalent.

B. The detector shall be furnished, installed under this Section and wired complete under Division 26.

21 00 24 SUPERVISORY SWITCH

A. Supervisory switches, UL 753 listed, shall be installed on all indicating and zone shutoff valves. Switch shall be mounted so as not to interfere with the normal operation of the valve and shall be adjusted to operate within two revolutions of the valve control or when the stem has moved no more than one-fifth of the distance from its normal position. The mechanism shall be contained in a rust resistant housing. The switch mechanism shall be form C contacts.
at 10A/120VAC or 2A/24 VDC suitable for operation at 120-volt A.C. or 24-volt D.C. The entire installed assembly shall be tamper-proof and arranged to cause a switch operation if the housing cover is removed or if the unit is removed from its mounting. Supervisory switch shall be Potter-Roemer model OSYSU-2 or equivalent.

B. Supervisory switches shall be furnished and installed under this Section and wired complete under Division 26.

21 00 25 VALVES

A. All valves shall be UL listed or F.M. approved and rated for 175 psi and listed for use in fire protection systems.

B. Zone valves shall be, flanged or groove-end, UL 262 OS&Y gate valve or UL 1091 butterfly valve with manual gear operator, position indicator, and integral tamper switch.

C. Drain valves shall be MSS SP-80, Type 2, Class 125 minimum, threaded or groove-end rising stem globe valve.

D. Check valves shall be UL 312 flanged or groove-end swing check. Where used on fire department connections, valve shall have integral ball drip.

E. Flow test and drain valve shall be a ball valve with sight glass. Valves shall be Guardian #9215 or equivalent.

21 00 26 GAUGES

A. Furnish and install pressure gauges at locations shown on the plans and where required for flow testing. Gauges shall be UL 393 listed for use in sprinkler systems, ¼ NPT or larger, 3-½ inch face, with an upper limit at least twice the normal working pressure. Each gauge shall have a shutoff valve and be arranged for draining without disturbing the gauge.

21 00 27 SPARE HEAD CABINET

A. Furnish and install, at the F/P service entrance, a cabinet stocked with sprinkler head wrench(es), and spare sprinkler heads. Provide a minimum of two (2) heads of each type of sprinkler head. Where this quantity is less than what is required by NFPA provide additional heads in proportion to the types and temperatures utilized throughout the building.

21 00 28 PIPING MATERIAL AND FITTING SCHEDULE

A. Size: 2-1/2” and larger above grade.
   1. Pipe: Schedule 40 steel.
   2. Fittings: Butt-welded, groove-end, forged steel flanges, thread-o-let, weld-o-let.
   4. Tests: Hydrostatically at not less than 200 psi for two (2) hours per NFPA 13, 2010, Section 24.2.1.1 and NFPA 13, 2016, Section 25.2.1.1.

B. Size: 2” and smaller above grade.
   2. Fittings: Cast iron.

4. Tests: Hydrostatically at not less than 200 psi for two (2) hours per NFPA 13, 2010, Section 24.2.1.1 and NFPA 13, 2016, Section 25.2.1.1.

C. Size: All below grade.

1. Pipe: Ductile iron.
2. Fitting: Ductile iron.
3. Joints: Mechanical (restrained joints (mega-lug))

4. Tests: Hydrostatically at not less than 200 psi for two (2) hours per NFPA 13, 2010 and 2016, Section 10.10.2.2.1.

5. Provide adequately designed and sized concrete anchor/thrust blocks at fire hydrants.

6. Provide retainer glands where flanged ductile iron pipe is installed at point of building entry.

D. The following types of fittings are prohibited: plain end couplings and fittings, saddle tee, Victaulic flange rings, and Victaulic reducing couplings.

E. Pipe velocities shall not exceed 14 feet per second in any section of the piping system.
21 00 30 WET PIPE SPRINKLER SYSTEM

21 00 31 SPRINKLER HEADS

A. All sprinkler heads are to be quick response liquid in glass bulb type, with a minimum of ½ inch orifice, ½ inch NPT, and a K factor of 5.65. Sprinklers have an orifice larger than ½ inch shall be ¾” NPT.

B. In finished spaces with ceilings, concealed sprinklers with an adjustable white coverplate shall be used. Heads shall be equivalent to the Viking model Horizon Mirage, Star model Stealth S110, Central model Royal Flush Concealed, or Reliable model G4QR.

C. In unfinished spaces or in concealed locations, upright and pendent sprinkler heads with a natural bronze finish shall be used. Heads shall be equivalent to the Viking Microfast Model M, Reliable model F1FR, or Star model SG.

D. In finished spaces without ceilings the heads shall be the same as above with the addition of a white factory finish.

E. Sidewall sprinklers where utilized in Unobstructed Construction shall be horizontal recessed type with a white factory finish. Heads shall be equivalent to Viking Microfast model M, Reliable HSW-1, or Star Galaxy model.

F. Sprinklers located in mechanical rooms, janitor’s closets or other locations where they are likely to be damaged shall be furnished with wire guards.

G. Temperature range and response time shall be suitable for the location and the expected heat release. Within a space all sprinklers should be the same Temperature Range and Response Time to avoid “skipping”.

END OF SECTION

21 00 00
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22 00 00 PLUMBING WORK

22 00 01 GENERAL

A. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Divisions 22 of the Specifications.

B. Provisions and conditions cited in this Section shall apply to Work for other sections of Divisions 22 of these Specifications.

C. Each plumbing fixture, accessory, equipment item and specialty shall be installed in accordance with the respective manufacturer’s recommendations.

D. Plumbing fixtures, equipment and specialties shall be protected against damage in the period between installation and acceptance. Any item damaged shall be removed, repaired and/or replaced at no additional compensation.

E. All operable devices and features of plumbing fixtures, accessories, equipment and specialties provided for in the Scope of Work of this Section shall be operated and proved to function satisfactorily for a period of eight (8) hours. Adjust, balance, lubricate as required, and instruct the Owner in the proper operation and maintenance of each device.

F. The plumbing system shall comply with the 2011 Reduction of Lead in Drinking Water Act. Components shall be “lead free” equivalent of model number specified regardless if manufacturer’s prefix and suffix have been included.

22 00 02 REFERENCES, REGULATORY REQUIREMENTS

A. Work for this Section of the Specifications shall be performed in accordance with the Codes, Standards, etc. as identified in Division 20.

22 00 03 RELATED SECTIONS OF THE SPECIFICATIONS

The following sections of the Specifications apply to Work under this Section:

1. Division 20 - Basic Mechanical Conditions and Basic Mechanical Material and Methods
2. Division 25 - Temperature Control (for monitoring domestic water temperature)

22 00 04 DEFINITIONS

(None)

22 00 05 WORK INCLUDED

A. Furnish material, labor and services necessary for and incidental to providing the following Plumbing Work where shown on the Plans and as hereinafter specified. Include all necessary work in the related sections of the Specifications (Subsection 20 00 43) to perform the Work completely.

1. Sanitary waste system, including but not limited to, sanitary piping, vent piping, plumbing fixtures, floor drains, and cleanouts.
2. Storm water drainage system, including but not limited to, storm water piping, roof drains, overflow drains, area drains, subsoil drain, sump pump, and cleanouts.
3. Potable domestic water system, including but not limited to, backflow preventers, pressure regulators, water meter, cold water piping, hot water piping, hot water return piping, and connection to all plumbing fixtures, equipment or specialties.
4. Domestic hot water system, including but not limited to, gas fired/electric hot water heater, storage tank, circulator pump, and expansion tank. Refer to Division 23 for heat exchanger scope.

5. Valved branches in the potable domestic water system with backflow preventers for extension under other sections of the specification for make-up water usage.

6. Water softener system including, but not limited to mineral tank, brine tank, automatic controls, unsoftened and softened water piping.

7. Contractor shall coordinate his work with the work of other trades, and with the architectural and structural drawings.

8. Provide sufficient labor and resources required for the testing and balancing (Refer to Section 20 10 80) and for the commissioning process.

9. Smoke stopping of all penetrations of pipes and firestopping of the same through fire rated partitions as shown on the architectural drawings including, but not limited to stairways, shafts, corridors, floors, roofs, and required exits. (Refer to Section 20 10 20).

10. Cleaning and pressure testing equipment, piping, and accessories installed under this section of the specification. (Refer to Section 20 10 50).

11. All seismic restraints for the above work. (Refer to Section 20 10 40).

12. Installing accessories specified under other sections of the specification referenced in subsection 20 00 05.

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**22 00 06 SUBMITTALS (SEE SUBSECTION 20 00 43)**

A. The Contractor shall submit the following shop drawings for approval in accordance with Subsection 20 00 43 - Submittals.

1. Piping materials and valves as specified in Piping Material Schedule(s) in subsection 22 20 00.

2. All specified drains and overflows in subsection 22 30 00.

3. All specified plumbing fixtures in subsection 22 40 00.

4. All specified plumbing equipment in subsection 22 60 00.

5. All specified plumbing specialties in subsection 22 80 00.

6. All general items specified under Division 20 utilized in the installation of work required by this section of the specification.

B. Provide manufacturer's technical product data of each material and accessory item with engineering support information and recommended installation procedure. Data shall be specific to product specified and clearly identified on all data sheets, which contains multiple models or sizes.

C. At the completion of the project, submit a letter stating all materials are asbestos free, and meet the specified ASTM E-84 flame/smoke rating of 25/50, and that all piping and duct penetrations are smoke or fire stopped as required by the Code.

D. Contractor shall submit coordination drawings to the Engineer for review prior to any fabrication or installation. (Refer to Section 20 10 50).

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**22 00 07 SPECIAL REQUIREMENTS**

A. Where Pipe and accessories installed under this section of the specification tie-in to existing systems, Contractor shall verify existing lines for: sizes, direction of flow (via pressure or physical tracing of piping, not labels), materials, and elevations before installing new work.
Contractor shall notify Architect/Engineer upon discovery of discrepancy. Work performed prior to verification will be corrected at no cost to Owner.

B. Where lines installed under this section of the specification tie-in to existing lines Contractor shall verify all existing lines, their elevations and directions of flow before running any new lines.

1. Contractor shall notify Architect/Engineer upon discovery if the new line cannot tie-in to the existing line due to location, elevation, or direction of flow.
22 20 00 PLUMBING PIPING SYSTEMS

A. General

1. Furnish and install the piping systems shown on the Plans and as hereinafter specified in the respective PIPING MATERIAL SCHEDULE. Include all necessary considerations in the related sections of the Specifications (subsection 22 00 05) to provide for complete systems.

B. All drainage lines shall be flushed clean at the completion of the Work. Rod out any obstructions encountered.

C. All domestic water lines shall be flushed clean at the completion of the Work. Refer to Section 20 10 56 – Cleaning of Piping Systems.

D. Pressure test each respective piping system for tightness to the test pressure indicated without loss. Repair any leaks and retest, as required. If test pressure is not indicated, hydrostatically test to 1.5 times the system operating pressure.

E. The Plans indicate the approximate location and arrangement of roughing-in for waste, vent and domestic water piping to serve the respective plumbing fixture, equipment and specialties. Final locations and arrangements shall be determined from approved shop drawings of the respective item.

F. Provide approved backflow preventers in all branch lines in the domestic water system for connections to non-domestic applications.

G. Main vents shall be the same size as waste lines and shall extend 12” minimum above the roof. Minimum vent thru the roof (VTR) shall be 3” size.

H. Install all piping with pitch to vent or drain. Provide drain valves at low points and air vents at high points. Drain valves and air vents shall be ¾” bronze, 2 piece body ball valves with ¾” hose end adapter, cap, and chain. In ½” through 2” pipe, contractor may use Webstone model T-drain.

I. The plumbing system shall comply with the 2011 Reduction of Lead in Drinking Water Act.

22 20 01 PIPING MATERIAL SCHEDULE  P-1

A. Service: Storm water drainage (ST), below grade.
Sanitary waste (SAN), and Vent (V), below grade.
Piping within the building perimeter to 5’ beyond the building limit.

B. Design: Pressure: gravity vented.
Temperature: 140 degrees F.

C. Pipe: Schedule 40 PVC solid core.

D. Fittings: Schedule 40 PVC DWV.

E. Joints: Solvent.

F. Test: Pressure test at not less than 15 feet static head of water for two (2) hours minimum.
**22 20 02 PIPING MATERIAL SCHEDULE P-2**

A. Service:  
Storm water drainage (ST), above grade. 
Sanitary waste (SAN) and Vent (V), above grade.  
Piping within the building perimeter.

B. Design:  
Pressure: gravity vented.  
Temperature: 140 degrees F.

C. Pipe:  
Cast iron soil pipe, no-hub.

D. Fittings:  
Cast iron, no-hub.

E. Joints:  
No-hub stainless steel coupling assembly, with neoprene rubber gasket.

F. Test:  
Pressure test at not less than 15 feet static head of water for two (2) hours minimum.

**22 20 03 PIPING MATERIAL SCHEDULE P-3**

A. Service:  
Potable water, below grade – outside the building.

B. Rating:  
Pressure: 250 psig at 150°F

C. Pipe:  
1. 3” and larger: Ductile iron pressure pipe, bituminous-coated Exterior. Cement lined interior.

2. 2” and smaller: Copper, annealed “soft”, seamless, type K.

3. 2” – 4” : Copper, drawn “hard”, type K.

D. Fitting:  
1. Ductile iron, mechanical joint, bituminous coated exterior. Cement lined interior.

2. Wrought copper, solder ends.

E. Joints:  
1. IBAA Iron Megalug or equivalent restraints at all joints.

2. 95-5 solder

F. Valves:  
Gate valve, Class 125 cast iron body, bolted bonnet, non-rising stem, resilient wedge, stem nut, and curb box.

G. Test:  
Hydrostatically pressure test at 200 psi for four (4) hours minimum.

H. Note #1:  
Provide retainer glands where flanged ductile iron pipe is installed at point of building entry.
A. Service: Storm water drainage (ST), above grade. Sanitary waste (SAN) and Vent (V), above grade. Piping within the building perimeter.

B. Design: Pressure: gravity vented. Temperature: 140 degrees F.

C. Pipe: Cast iron soil pipe, no-hub.

D. Fittings: Cast iron, no-hub.

E. Joints: No-hub stainless steel coupling assembly, with neoprene rubber gasket.

F. Flashing: Provide 6#/SF sheet lead flashing consistent with the type of roof construction x 12" high for all vents-thru-roof (VTR), except for membrane type roofing only which flashing shall be provided by roofing contractor. Minimum VTR shall be 3" size (see also 20 10 26).

G. Test: Pressure test at not less than 15 feet static head of water for two (2) hours minimum.

A. Service: Domestic water, above grade. Includes cold water (CW), hot water (HW), hot water recirculating (HWR) and softened water (SW). Sump pump discharge piping.

B. Design: Pressure: 100 psig. Temperature: 180 degrees F. max. for hot water only.

C. Pipe: Copper, hard drawn, seamless, type L.

1. Fittings: Wrought copper, solder ends.

2. Dielectric Isolation union/union flanges between Fittings: water piping and non-copper connections and at all equipment connections.

D. Flanges: Cast bronze, 125 psi.

E. Joints: All 95/5 Solder

F. Valves: All valves shall be lead free.

1. Shut-off/Service:

   3" and smaller Ball valve, bronze body, two piece, full port, stainless steel ball and trim.

   4" and larger Gate valve, Class 125 cast iron body, bolted bonnet, non-rising stem, resilient wedge.

2. Balancing/Throttling:
3” and smaller  “Circuit Setter”

3. Check Valve:

3” and smaller  Class 125 bronze, horizontal swing, Y-pattern, regrinding type, renewable seat and disc, solder ends.
4” and larger  Class 125-iron body, bolted bonnet, horizontal swing, renewable seat and disc, bronze mounted, flanged ends.

4. Hose End Interior: ¾” hose thread outlet x copper sweat inlet with integral vacuum breaker. Nibco figure 63-VB.

5. Hose End Interior: ¾” hose thread outlet x copper sweat inlet with integral vacuum breaker. Nibco figure 63-VB.

6. Test: Hydrostatically pressure test at 150 psi for four (4) hours minimum.
22 30 00 DRAINS AND CLEANOUTS

A. General

1. Furnish and install the following drains and cleanouts where shown on the Plans and as hereinafter specified. Drains and cleanouts shall have all options, body material, top size, top style, top material, and accessories as specified whether or not listed as a prefix, suffix, or catalog number.

B. Drain and cleanout outlets shall be compatible with respective piping material and size. Outlets below grade shall be push type. Outlets above grade may be no-hub or push type at the Contractor’s option. Tops shall be compatible with the flooring system.

C. Provide deep seal P-traps for all floor drains.

D. Provide full size cleanouts up to 4” size above the lowest floor line in all drainage risers, and where total of the fittings exceed 120 degrees and at changes in direction greater than 60 degrees in horizontal drainage lines, and at intervals of not greater than fifty (50) feet in straight piping runs 4” diameter and smaller, and one hundred (100) feet for piping over 4” diameter.

E. Do not install cleanouts in electrical equipment rooms. Extend the cleanout to outside the room limits.

F. Where cleanout is located in open ground, extend the cleanout to finished grade elevation and install a 16” x 16” x 8” deep concrete pad at grade to secure the cleanout.

G. Submit with products, a room by room schedule indicating floor drains and cleanouts to be used including top size, shape, floor finish material, and setting height with respect to concrete slabs. Any drain body set prior to approval shall be performed with block-outs to allow correct tops and finished heights to be adjusted.

22 30 01 FLOOR DRAINS

A. Floor Drain: (FD-A):

Cast iron body with flashing flange, integral reversible clamping collar, seepage openings, 6” x 6” square adjustable satin nickel bronze, strainer top with vandal proof fasteners and be 3” outlet. Wade W-1103-G6-1-176, Zurn ZN-415-6S-VP, J.R. Smith 2000-B06NB-U-L, MIFAB F1100C-S6-1, or approved equivalent.

B. Floor Drain: (FD-B):

Cast iron body with flashing flange, integral reversible clamping collar, seepage openings, 7” cast iron loose set tractor strainer and 3” outlet. Wade W-1103-TS7, Zurn Z-415-7N, J.R. Smith 2000-D-Cl, MIFAB F1100C-N-1, or approved equivalent.

C. Floor Drain: (FD-C):

Cast iron body with flashing flange, integral reversible clamping collar, seepage openings, 6” round adjustable satin nickel bronze round strainer top, vandalproof. Wade W-110X-STD6-1176, Zurn ZN-415-6B-VP, J.R. Smith 2000-A06NB-U-L, or approved equivalent.

D. Floor Drain: funnel drain (FD-D):
Cast iron body with flashing flange, integral reversible clamping collar, seepage openings, adjustable nickel bronze, 6" square strainer top with 4" diameter funnel. Wade 1000-STD6-EF4, Zurn ZN-505-T, J.R. Smith 3510, or approved equivalent.

22 30 02  ROOF DRAINS

A. Roof Drain: (RD).
   Cast iron body with flange, flashing collar and gravel stop, removable cast iron dome and under deck clamp, sump receiver pan, adjustable extension. Provide extension, as required, to suit thickness of roof construction. Wade W-300X-AE-42-52-53, Zurn ZC-100-C-EA-R, J.R. Smith 1015-R-C-C1D, MIFAB R1200-EU-M, or approved equivalent.

B. Overflow Drain: (OV).
   Same specification as subsection 22 30 02, except add 2" high dam. Wade W-300X-AE-D-42-52-53, Zurn ZC-100-C-EA-R-89, J.R. Smith 1015-C-C1D-WD, MIFAB R1200-EU-M-R, or approved equivalent. All overflow drains should have an overflow discharge tongue at discharge location, J. R. Smith model 1770T or approved equivalent.

22 30 03  TRENCH DRAIN

A. Trench Drain: (TD-A).
   Cast iron floor drain with flange, integral clamping collar, seepage openings, ½" plugged primer tap, and adjustable 4" x 12" rectangular nickel bronze strainer with vandalproof screws. Wade W-110X-H12, Zurn ZN-415-13J-VP, J.R. Smith 2000-M-U, MIFAB F1100-RS-1, or approved equivalent.

B. Trench Drain: (TD-B)

22 30 04  SHOWER DRAINS:

A. Shower Drain (SD-A):
   Cast iron, double drainage flange spigot outlet, adjustable strainer heads, weep holes. Provide 6" x 6" satin nickel bronze adjustable strainer with vandalproof screws for finished tile floor application. Wade Series 1100-G6-1-176, Zurn ZN-415-6S-VP, J.R. Smith 2000-B06NB-U-L, MIFAB F11000-S6-1, or approved equivalent.

22 30 05  FLOOR SINK:

A. Floor Sink (FS-A):
   Cast iron 12" square floor sink with 8" sump, A.R.E. interior aluminum dome strainer, and nickel bronze hinged top. Wade W-9140, Zurn ZN-1901-K, J.R. Smith 3150, MIFAB FS1700-1, or approved equivalent.

B. Floor Sink (FS-B):
   Same as floor sink FS-A, except with sediment bucket. Wade W-9140-27, Zurn ZN-1901-K-23, J.R. Smith 3151, MIFAB FS1700-1-5, or approved equivalent.

22 30 06  CLEANOUTS

A. Cleanout: interior finished floor (FCO):
Cast iron body, threaded adjustable housing, flanged ferrule with straight thread gasketed plug and square secured satin nickel bronze scoriated top, vandal proof, tops shall be for tile, carpet, ceramic tile, terrazzo tile as required. Wade W-6000-TS-179-118, Zurn Z-1400-T-BP-VP, J.R. Smith 4052-U, MIFAB C1100-S-1-6, or approved equivalent.

B. **Cleanout: interior unfinished floor (FCO):**

Cast iron body, threaded adjustable housing, flanged ferrule with straight thread gasketed plug and round secured satin nickel bronze scoriated top, vandal proof. Wade W-6000-1-179-118, Zurn Z-1400-BP-VP, J.R. Smith 4032-U, MIFAB C1100-R-1-6, or approved equivalent.

C. **Cleanout: exterior location (YCO):**

Cast iron body, threaded adjustable housing, flanged ferrule with straight thread gasketed plug and round secured satin nickel bronze scoriated top. Wade W-6000-1-118, Zurn Z-1400-BP, J.R. Smith 4032, MIFAB C100-S-1, or approved equivalent.

D. **Cleanout: wall type for concealed riser in finished spaces (WCO):**

Provide cleanout fitting with screwed plug opening and countersunk plug. Provide 8” x 8” square access covers with polished nickel bronze beveled edge frame with anchor lugs for over the wall installation, smooth stainless steel cover, and vandalproof screws. Wade 8480ST-179, Zurn ZANB-1462-8-VP, J.R. Smith 4730-U-NB, MIFAB C1460-S-3-6, or approved equivalent.

E. **Cleanout: wall type for concealed riser in unfinished spaces (WCO):**

Provide cleanout fitting with screwed plug opening and countersunk plug. Provide round access covers with smooth stainless steel cover, and vandalproof center screw. Wade, Zurn, J.R. Smith, MIFAB, or approved equivalent.
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22 40 00 PLUMBING FIXTURES

A. General

1. Furnish and install the following plumbing fixtures where shown on the Plans and as hereinafter specified. Plumbing fixtures and accessories shall have all options, body material, water consumption, and accessories as specified where or not listed as a prefix, suffix, or catalog number. Include all necessary work in the related sections of the Specifications (subsection 22 00 03) and accessories to provide for complete installation and operation of the respective fixture.

2. All plumbing fixtures and non-metal accessories shall be white color, except where shown or specified otherwise.

3. Vitreous china fixtures, where specified, shall be best quality, non-absorbent. Warped or imperfect fixtures shall not be accepted. Enameled cast iron fixtures, where specified, shall be thoroughly fused and bonded to body without discoloration, chips, flaws or cracks. Finish all exposed surfaces.

4. Fixture trim shall be cast brass with polished chrome-plated finish on exposed surfaces, except where shown or specified otherwise.

5. Fixture traps shall be tubular wall type, minimum 17 gauge with integral cleanout plugs, polished chrome plated finish, except where shown or specified otherwise. Size to suit fixture tailpiece. Comply with local plumbing code.

6. All water closets, urinals, and lavatories shall be from the same manufacturer. All faucets, for lavatories, janitor sinks, sinks shall be from the same manufacturer. All supplies and stops for lavatories and sinks shall be from the same manufacturer.

7. Furnish accessories for fixtures requiring trim, carriers, brackets, back-up plates, specialties, etc. for respective complete installation.


9. Provide stops (valves) in all water supplies to all fixtures.

10. Provide escutcheon plates for all wall penetrations for exposed connections to fixtures.

11. Division 22 shall provide templates of openings required for countertop mounted fixtures to the General Contractor.

12. Connections between plumbing fixture outlets and respective waste piping shall be gas and watertight. Use suitable and approved setting compound or gasket; rubber gaskets or putty are not acceptable.

13. Acceptable manufacturers:
   a. Fixtures - American Standard, Kohler, Eljer, Crane
   b. Carrier - Wade, Zurn, J.R. Smith, Watts
   c. Flush Valve – Sloan, Zurn
   e. Faucets: Chicago, Kohler, Delta, American Standard, Zurn.

22 40 01 WATER CLOSET: FLOOR MOUNTED HANDICAPPED (WC-A):

A. Toilet:
Vitreous china elongated bowl, 1.28-1.6 gal/flush, siphon-jet, floor mounted 17" rim height, with 1-1/2" top inlet spud, High Efficiency Toilet (HET). Conforms to ANSI Standard A112.19.2M, ADA, and ANSI 117-1 fixture dimensions. American Standard “Madera FloWise” model 3043.001, Kohler “Highcliff” model K-96057-0, Sloan model ST-2029, Toto CT705ELN or Zurn model Z5665-BWL.

B. Seat:
Solid plastic, open front less cover for elongated bowl, integral bumpers and external check hinges with stainless steel bolts. Church #9500C. Bemis #1655C.

C. Flush Valve (Automatic Flush Valve):
Quiet, exposed diaphragm type, closet flushometer, infrared sensor, non-hold-open, integral 24 VAC solenoid operator, 1” IPS screw driver angle stop with protective cap, adjustable tail piece, vacuum breaker flush connection and spud coupling for 1-1/2” top spud, wall and spud flanges. Sloan Royal model no. 111-ES-S (less transformer).

22 40 02 WATER CLOSET: FLOOR MOUNTED (WC-B):

A. Toilet:

B. Seat:
Solid plastic, open front less cover for elongated bowl, integral bumpers and external check hinges with stainless steel bolts. Church #9500C. Bemis #1655C.

C. Flush Valve (Automatic Flush Valve):
Quiet, exposed diaphragm type, closet flushometer, infrared sensor, non-hold-open, integral 24 VAC solenoid operator, 1” IPS screw driver angle stop with protective cap, adjustable tail piece, vacuum breaker flush connection and spud coupling for 1-1/2” top spud, wall and spud flanges. Sloan Royal model no. 111-ES-S (less transformer). (Sloan Regal Pro model 111-ES-S (less transformer) or Zurn ZEMS 6000AV-WS1).

22 40 03 WATER CLOSET: CHILDREN'S USAGE (WC-C) (STANDARD):

A. Toilet:
Vitreous china bowl, 1.6 gal/flush siphon-jet, floor mounted and with 1-1/2” (top) inlet spud. Conforms to ANSI Standard A112.19.2M fixture dimensions. American Standard “BABY DEVORO” 1.6/FV, Model 2282.010, Crane “1.5 Baby Bowl”, model 3-380E. Kohler “Primary” model K-4321, Eljer “Kindergarten 1.6” model 111-0335.

B. Seat:
Solid plastic child seat, open front less cover, integral bumpers and internal check hinges. American Standard, Eljer, Crane, or Kohler.

C. Flush Valve (Automatic Flush Valve):
Quiet, exposed diaphragm type, 1.6 gal/flush closet flushometer, infrared sensor, non-hold-open integral 24 VAC solenoid operator, 1” IPS screw driver angle stop with protective cap, adjustable tailpiece, vacuum breaker flush connection and spud coupling
for 1-1/2” top spud, wall and spud flanges.  Sloan Royal Model No. 110-ES-S (less transformer).  (Sloan Regal Pro model 110-ES-S or Zurn ZEMS 6000AV-WS1).

22 41 01  URINAL: HANDICAPPED (U-A):

A.  Urinal:
Vitreous china water saver (1.0 gallons per flush) siphon-jet, wall hung and with 3/4” (top) inlet spud, 2”IPS female threaded outlet (rear) connection and wall hanger.  Conforms to ANSI Standard A112.19.2 fixture dimensions.  Installed in accordance with ADA Standards requirements for hadicapped usage.  American Standard “Trimbrook”, model 6561.017.  Kohler “Freshman” model K-4989-T or Zurn Z5730.

B.  Carrier:

C.  Flush Valve: (Automatic Flush):
Quiet exposed urinal flush valve (1.0 gallons per flush), infrared sensor, non-hold-open, integral 24 VAC solenoid operator, ¾” IPS screwdriver angle stop with protective cap, adjustable tailpiece, vacuum breaker flush connection and spud coupling for ¾” top spud, wall and spud flanges.  Installed in accordance with ADA Standards requirements for handicapped usage.  Sloan Royal model no. 186-1-ES-S (less transformer).  (Sloan Regal Pro model 186-1-ES-S (less transformer) or Zurn ZEMS 6003AV-WS1).

22 42 01  LAVATORY: WHEELCHAIR ACCESSIBLE, WALL-HUNG (L-A):

A.  Lavatory:

B.  Faucet:
Infrared sensor operated automatic lavatory faucet, adjustable run-time, adjustable sensor range, serviceable strainer, single 24 VAC solenoid valve, ½ gpm vandalproof spray head.  All wires shall be metal jacketed.  Thermostatic temperature mixing valve with hot and cold water supply check valves.  Zurn Z-6901-F, Chicago 650-CP.  Sloan ETF-80-A (less transformer).

C.  Wheelchair Lavatory Strainer:
1-1/4” x 5” offset x 17 gauge cast brass grid strainer, integral spud and tailpiece.  McGuire Mfg. catalog no. 155-WC.  Dearborn Brass catalog no. 760W.

D.  Supplies:
Loose keyed angle stops with lock shield caps and ½” (nominal) copper solder (5/8” ODS) inlet x 1/2” OD outlet x 12” long flexible risers.  Provide cast brass escutcheons.  Chicago Faucet no. 1027-CP with no. 1003 escutcheons.  McGuire, Dearborn, Brass Craft, Engineered Brass, American Standard, Kohler, Eljer.

E.  Trap:
1-1/2” x 1-1/4” x 17 gauge tubular P-trap with clean-out, plug and wall escutcheon.  McGuire Mfg. catalog no. 8902.  Dearborn Brass catalog no. 510.
F. Insulation Kit:
   Conforms to 28CFR Part 36, Article 4.19.4 (7/26/91). Truebro model no. 103W. Dearborn Brass catalog no. 515FST and 515KIT.

G. Carrier:

LESS SINK, FAUCET AND ACCESSORIES ONLY (L-B):

   Architect to arrange countertop and wheel chair access to suit ADA compliance.

A. Lavatory:
   Refer to casework specifications for lav type (not provided under Division 22.

B. Faucet:
   Infrared sensor operated automatic lavatory faucet, adjustable run-time, adjustable sensor range, serviceable strainer, single 24 VAC solenoid valve, ½ gpm vandalproof spray head. All wires shall be metal jacketed. Thermostatic temperature mixing valve with hot and cold water supply check valves. Zurn Z-6901-F, Chicago 650-CP. Sloan ETF-80-A (less transformer).

C. Wheelchair Lavatory Strainer:
   1-1/4" x 5" offset x 17 gauge cast brass grid strainer, integral spud and tailpiece. McGuire Mfg. catalog no. 155-WC. Dearborn Brass catalog no. 760W.

D. Supplies:
   Loose keyed angle stops with lock shield caps and ½" (nominal) copper solder (5/8" ODS) inlet x 1/2" OD outlet x 12" long flexible risers. Provide cast brass escutcheons. Chicago Faucet no. 1027-CP with no. 1003 escutcheon. McGuire, Dearborn, Brass Craft, Engineered Brass, American Standard, Kohler, Eljer.

E. Trap:
   1-1/2" x 1-1/4" x 17 gauge tubular P-trap with cleanout, plug and wall escutcheon. McGuire Mfg. catalog no. 8902. Dearborn Brass catalog no. 510.

F. Insulation Kit:
   Conforms to 28CFR Part 36, Article 4.19.4 (7/26/91). Truebro model no. 103W. Dearborn Brass catalog no. 515FST and 515KIT.

SINK: STAINLESS STEEL, SINGLE COMPARTMENT, COUNTERTOP WITH SWING SPOUT (S-A):

A. Sink:
   18 gauge, type 302 stainless steel, self-rim single bowl sink. Inside bowl dimensions: 16" x 13-1/2" x 7-1/2". Faucet deck with (3) holes on 4" centers. Elkay model #LR-1919, Just SL-2019-A-GR.

B. Faucet:
   8" centers, 8" swing spout, single wing handles, aerator. Chicago Faucet no. 201-L8-E3-369 or Kohler K-7761-K/K-16010-4, Delta 2100 HDF, Zurn Z-831J1 or approved equivalent.

C. Strainer:
Stainless steel crumb basket with rubber stop for 3-1/2" drain opening and 1-1/2" OD brass tailpiece. Elkay model no. LK-35, Just J-35.

D. **Supplies:**

Loose keyed angle stops with lock shield caps and ⅛" (nominal) copper solder (5/8" ODS) inlet x 1/2" OD outlet x 12" long flexible risers. Provide cast brass escutcheons. Chicago Faucet no. 1027-CP with no. 1003 escutcheon. McGuire, Dearborn, Brass Craft, Engineered Brass, American Standard, Kohler, Eljer.

E. **Trap:**

1-1/2" x 17 gauge tubular P-trap with cleanout plug and wall escutcheon. McGuire Mfg. catalog no. 8902.

22 43 02 **SINK:** CLINIC SERVICE SINK, WALL HUNG WITH SWING SPOUT (S-B):

A. **Sink:**

18 gauge, type 302 stainless steel, self-rim single bowl sink. Inside bowl dimensions: 19-1/2" x 19" x 10-1/8". Faucet deck with (3) holes on 4" centers. Elkay model #DLR-191910, Just SL-2019-A-GR.

B. **Faucet:**

8" centers, 8" swing spout, single wing handles, aerator. Chicago Faucet no. 201-L8-E3-369 or Kohler K-7761-K/K-16010-4, Delta 2100 HDF, Zurn Z-831J1 or approved equivalent.

C. **Strainer:**

Stainless steel crumb basket with rubber stop for 3-1/2" drain opening and 1-1/2" OD brass tailpiece. Elkay model no. LK-35, Just J-35.

D. **Supplies:**

Loose keyed angle stops with lock shield caps and ⅛" (nominal) copper solder (5/8" ODS) inlet x 1/2" OD outlet x 12" long flexible risers. Provide cast brass escutcheons. Chicago Faucet no. 1027-CP with no. 1003 escutcheon. McGuire, Dearborn, Brass Craft, Engineered Brass, American Standard, Kohler, Eljer.

E. **Trap:**

1-1/2" x 17 gauge tubular P-trap with cleanout plug and wall escutcheon. McGuire Mfg. catalog no. 8902.

22 44 01 **MOP SINK BASIN:** (MSB):

A. **Receptor (basin):**

24" x 24" x 12" high, precast terrazzo one-piece basin, ground smooth, grouted and sealed to resist stains. Top edge capped with 20-gauge type 302 stainless steel cast integrally on all four sides. Williams “SERVICEPTOR”, model SB-900 or Fiat model TSB-100.

B. **Faucet:**

Vacuum breaker rigid spout with ¾" hose thread outlet, wall brace and pail hook, ½" F union inlets on exposed valves on 6" centers, lever handles, indexed and tabbed for “HOT” and “COLD”. Chicago Faucet no. 835 for overhead supplies. Chicago Faucet no. 897 or Zurn Z841M1 for supplies thru-the-wall.

C. **Strainer:**
Cast brass outlet with stainless steel strainer cast integrally into bottom of basin to provide for an inside caulk connection for a 3” waste pipe.

D. **Splash Panels:**

Provide 20 gauge 302 stainless steel sheet splash catcher panels on one or two sides as required.

**22 45 01 ELECTRIC WATER COOLER: BI-LEVEL, WITH BOTTLE FILLING STATION (EWC-A):**

A. Wall mounted, refrigerated, bi-level for general public and handicapped usage. Lower unit shall be wheelchair accessible. Upper unit shall have sensor activated bottle filling station. Bubbler shall be activated by mechanical push-bar and have built-in pressure regulator for supply pressure range from 20 to 125 psi. All exposed surfaces shall be satin-finish type 304 stainless steel. All waterway components shall be copper construction with lead-free connections. Refrigeration system shall be air-cooled; chill the drinking water in a storage tank type heat exchanger; have an adjustable thermostatic control; be rated to cool 8 gph from 80 deg. F to 50 deg. F at 90 deg. F room temperature; be certified by ARI, UL and CSA and comply with all local building codes and ADA Requirements. Halsey Taylor Model no. HTHBHVR8BL-NF with louver screens or approved Elkay equivalent.

B. For masonry construction applications, Plumbing Contractor will mount water cooler directly to wall using factory supplied mounting box. For non-masonry applications, provide and mount using Josam 17550-WCBL, J.R. Smith 0823, MIFAB MC-31, Wade W-403-BL-M36, Watts CA-431-1, or Zurn 1225-BL.

**22 45 02 ELECTRIC WATER COOLER: SINGLE, NON-FILTERED, BOTTLE FILLER (EWC-B):**

C. Wall mounted, refrigerated for general public and handicapped usage. See architectural elevation drawings for mounting heights. Bubbler shall be activated by mechanical push-bar and have built-in pressure regulator for supply pressure range from 20 to 125 psi. All exposed surfaces shall be satin-finish type 304 stainless steel. All waterway components shall be copper construction with lead-free connections. Refrigeration system shall be air-cooled; chill the drinking water in a storage tank type heat exchanger; have an adjustable thermostatic control; be rated to cool 8 gph from 80 deg. F to 50 deg. F at 90 deg. F room temperature; be certified by ARI, UL and CSA and comply with all local building codes and ADA Requirements. Provide Halsey Taylor Model HTHBHVR8-NF with louver screens, no substitutions.

For masonry construction applications, Plumbing Contractor will mount water cooler directly to wall using factory supplied mounting box. For non-masonry applications, provide and mount

**22 46 01 SHOWER: HANDICAPPED SINGLE OUTLET, INDIVIDUAL STALL (SH-A):**

A. **Shower:**

Handicapped Individual shower must comply with all ADA requirements. Individual handicap shower combination shall consist of the following:

- Shower valve with integral service stops.
- Wall connections.
- In-line vacuum breaker.
- 30” adjusting bar with slide bracket.
- A quick disconnect (detachable) flexible rubber lined metal hose.
- Nylon and chrome FS hand spray unit.
- Symmons Safetymix 1-25-FSB-X.
B. Contractor shall provide all accessory fittings as necessary to complete shower fitting assembly.

**22 46 02 SHOWER FLOOR: (SF-A):**

A. **Floor:**
   Precast, terrazzo composition, ground smooth, grout and sealed to resist stains and moisture. 2” drain outlet cast-in-place for inside caulk connection and with removable stainless steel strainer. For recessed arrangement with elevated flanges on three (3) sides and threshold on fourth side. Install on top of finished floor.

B. **Color:**
   Forward color selection chart with submittal for approval.

C. mount using Wade W-440-A11-M36, Zurn 1225-BL, J.R. Smith 0830, or Watts CA-421-HFH.

**22 47 01 EMERGENCY EYEWASH – DECK MOUNTED (EW-A)**

A. Deck mounted, stainless steel construction, corrosion resistant, forged brass squeeze valve. Unit shall have (2) polypropylene ‘GS Plus’ spray heads with integral “flip-top” dust covers, filters and 1.8-GPM flow control orifices mounted on a stainless steel head assembly. Activate valve by squeezing handle. Unit shall include ANSI compliant sign. Unit shall be fully factory assembled and hydrostatically tested to meet or exceed ANSI Z358.1 – 2009, and come with a full 2-year warranty. Unit shall be Water Save EW1022. Contractor is required to drill mounting holes in countertop. Emergency eyewash is to be mounted on the right hand side of faucet.
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22 60 00 PLUMBING EQUIPMENT

A. General

1. Furnish and install the following plumbing equipment where shown on the Plans and as hereinafter specified. Include all necessary considerations in the related sections of the specifications (subsection 22 00 02) and accessories to provide for complete installation and operation of the respective equipment item.

22 60 01 GAS FIRED WATER HEATER

A. Heater shall be gas-fired equipped to burn natural gas with gas controls to totally regulate gas input pressure between 7”-14” water column to the required burner/pilot operating pressures as controlled by the heater's controls to maintain setpoint temperature adjustable between 100°F - 160°F. The American Gas Association shall certify the design to meet the latest ANSI Standard.

B. ASME Stamped tank shall be steel, rated for 150 psi working pressure, all internal surfaces exposed to water shall be glass lined, insulated with foam insulation, exceeding ASHRAE 90.1., covered with a minimum 16 ga. outer jacket, and have baked enamel finish.

C. Heater shall have an ASME pressure/temperature relief valve, replaceable magnesium anode rods, high temperature safety gas shutoff, draft hood, non-metallic dip tube, and drain valve with hose end and cap.

D. Water heater shall meet or exceed the capacity scheduled. Manufactured by PVI Industries or preapproved equivalent by Lochinvar or AO Smith.

E. Each water heater shall be provided with a condensation neutralization kit.

22 60 02 DOMESTIC WATER CIRCULATING PUMP

A. Domestic hot water circulating pump shall be lead free all bronze body with bronze impeller, line mounted, with capacities as scheduled. Refer to Division 23 21 40 for equivalent models to the scheduled pump.

22 60 03 WATER SOFTENER

A. Provide as indicated a vertical pressure type water softener system complete with pressure vessel, softening resin, control valve, brine maker and electronic controller. The main operating valves and manifold piping shall be factory assembled and shipped attached to the resin tank for ease of installation and start up. Piping shall be Schedule 40 galvanized steel and galvanized fittings shall be standard Class 150 threaded malleable iron. The equipment shall be installed according to the manufacturer's recommendations and the Manufacturer's Representative shall place the equipment in service and instruct the Owner's personnel in its care, maintenance and operation. The Contractor shall be responsible for the satisfactory performance of the equipment in accordance with the guarantees required.

B. Design Parameters (Each Unit)

<table>
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<tr>
<th>Parameter</th>
<th>Specification</th>
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<td>Design Rated Flow and Pressure Drop</td>
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</tr>
<tr>
<td>Maximum Rated Flow and Pressure Drop</td>
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<td>Anticipated Daily Water Usage</td>
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<td>Daily Hours of Water Demand</td>
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<td>Volume of Treated Water Before Regeneration</td>
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C. Influent Water Analysis

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<tr>
<td>Eff. Hardness, gpg @ 100% Cap</td>
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</tr>
</tbody>
</table>

D. Softener Tanks – Each system shall include (2) tank(s) Tank(s) shall be electrical welded pressure vessel, low carbon steel construction rated for 100.0 psi working pressure and a minimum design pressure of 1.2 times the working pressure amount. The side shell height shall be sufficient to allow for proper freeboard space above the resin bed for adequate expansion of the resin during backwashing. A vacuum breaker shall be provided to protect the Fiberglass tank.

E. Internal Distribution – The units shall be configured to provide even flow distribution through the resin bed and prevent channeling.

F. Operating Valves – The operating valves shall be designed into a fully automatic multiport diaphragm type. The multiport design shall incorporate all valves necessary for complete control of the softener service and regeneration steps.

The diaphragm valves shall be slow opening and closing, free of water hammer. The diaphragm assembly shall be fully guided on its perimeter to assure a smooth reliable shut off without sticking. There shall be no dissimilar metals within the valve and no special tools shall be required to service the valve.

The main operating valve shall include a valve mounted automatic self-adjusting brine injector to draw brine and control rinse at a constant rate regardless of water pressure in the range of 35.0 and 100.0 psi

The main operating valve shall be protected externally and internally against corrosion with an application of NSF-61 listed electrodeposition coating. The level of surface coverage will meet the minimum specifications set by the manufacturer of the water softener system.

The valve shall have a soft water sampling cock.

The unit shall be supplied so that the valve will allow automatic bypass of untreated water during regeneration. The bypass shall be integral to the main operating valve body and be capable of being easily modified to prevent untreated water bypass.

G. Flow Sensors – Flow sensors with applicable fittings shall be provided configured for a flow range of 4 to 300 gpm. The wetted surfaces of the flow sensors shall be constructed of non-corroding materials. Sensor accuracy shall be 2% over full range.

H. Brine System – Provide a complete brine system consisting of a plastic tank, cover, salt platform, brine well, an automatic brine valve and all necessary fittings for operation with the...
water softening system. The brine valve will automatically open to admit brine to the resin tank during reduction and close automatically providing positive shut-off to prevent air from entering the system. The brine valve will also regulate the flow of soft water into the brine tank during refill. The brine valve works with the timed fill feature of the main operating valve controls to admit the correct volume of fresh water to the brine tank in accordance with the refill time setting in the control program. The brine valve will include a float operated safety shut-off valve as a back up to the timed refill from the main operating valve control to prevent brine tank overflow.

I. Controls – A fully integrated programmable microprocessor driven electronic controller shall be provided to automatically cycle the main operating valve through the regeneration sequence. The controller shall be capable of initiating a regeneration by accepting an internal signal. The controller shall sequence all steps of an automatic regeneration and automatically return the softener to a service or stand-by mode. The initiating time and/or volume setpoints shall automatically reset upon completion of the regeneration sequence.

a. An operator selected program of immediate or delayed volume initiated regeneration for parallel configurations shall be available. The controller shall be capable of being programmed in the field without additional interface devices. The controller shall indicated various data that includes flow rate, capacity remaining, total flow since installation, number of regenerations in the last 14 days, days since the last regeneration, total number of regenerations for the life of the unit, time of day, number of connected units, progressive flow trip point, and unit in regeneration.

b. Control shall have a dedicated flow sensor. Mode of operation shall be as follows:

i. Controller shall allow for a regeneration delay. The purpose of the delay shall be to inhibit consecutive regenerations thereby allowing a suitable amount of time to pass between regenerations for making saturate brine solution.

c. The controller shall include a sealed keypad, capable of programming all controller functions, located on the face of the controller. The controller display shall be a multi-line OLED display capable of full text readouts of operating status and codes. In the event of a loss of power, the controller shall save pertinent programmed data allowing the regeneration process to operate as normal once power is restored.

d. The controller shall be provided with an audible alarm which can be disabled. Visual alarms shall be posted on the controller display.

e. The controller shall be configured with regeneration sequence timers, lockout functions, regeneration override, flow rate indication and flow totalizer.

J. Furnish with equipment a titration type soft water test kit, equal to Hach Model SB.

K. A complete set of instructions, including installation, loading start-up, adjustment, servicing and a parts list shall be provided with the equipment. Attrition loss of mineral shall be guaranteed to not to exceed 3% per year for a period of three (3) years. All mechanical equipment shall be guaranteed for one year from data of installation or 18 months from data of manufacturer (whichever comes first) against any defects in workmanship or materials. Any part proving defective will be replaced or repaired within this period.
L. The services of a factory authorized service representative shall be included to inspect installation, provide operator training and for initial start-up and system operation.

M. The water softening system shall be a Culligan International model CTM 90-PF 16in Duplex Tank or approved equal.
22 80 00 PLUMBING SPECIALTIES

A. **General**

1. Furnish and install the following plumbing specialties where shown on the Plans and as hereinafter specified. Include all necessary considerations in the related sections of the specifications (subsection 22 00 02) and accessories to provide for complete installation and operation of the respective item.

2. Specialties shall comply with the 2011 Reduction of Lead in Drinking Water Act. Components shall be “lead free” equivalent of model number specified regardless if manufacturer’s prefix and suffix have been included.

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**22 80 01  WALL HYDRANT: EXTERIOR WITH BOX (WH-A)**

A. ¾” hose outlet x ¾” (nominal) copper sweat straight inlet, non-freeze, anti-siphon wall hydrant with bronze casing, approved ASSE 1019-2004 integral backflow preventer and polished nickel bronze, stainless steel, or chromeplated box. Wade W-8600L-175, Zurn Z-1300, J.R. Smith 5519, Watts HY-429 with box, MIFAB MHY-26, Woodford B65.

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**22 80 02  WALL HYDRANT: INTERIOR WITH BOX (WH-B)**

A. ¾” hose outlet x ¾” (nominal) copper sweat straight inlet, anti-siphon wall hydrant with bronze casing, integral backflow preventer and polished nickel bronze or chromeplated box. Wade W-8600MT-175, Zurn #Z-1335, J.R. Smith 5509QT-SAP-NB, Watts HY-330-49, Woodford B76.

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**22 80 03  HOSE BIBB (HB-A): INTERIOR (COLD WATER ONLY)**

A. ¾” hose outlet x copper sweat inlet with integral vacuum breaker. Woodford 26.

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**22 80 04  HOSE BIBB (HB-B): INTERIOR (COLD AND HOT WATER)**

A. Vacuum breaker rigid spout with ¾” hose thread outlet, wall brace and pail hook, ½” F union inlets on exposed valves on 6” centers, four arm metal handles, indexed and tabbed for “HOT” and “COLD”. Chicago Faucet no. 835 for overhead supplies. Chicago Faucet no. 897, Zurn Z-841M1 with lever handles for supplies thru-the-wall.

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**22 80 05  BACKFLOW PREVENTER - REDUCED PRESSURE**

A. Furnish and install reduced pressure backflow preventer at water service entrance and at cross connection locations.

B. Assembly shall include shut off valves, strainer, test cocks, and pressure relief valve with ASME A112.1.2 air-gap fitting located between two positive seating check valves. Construction shall be all bronze with quarter-turn, full port, resilient seated ball valve shut offs for sizes 2” and smaller. 2-1/2” and larger shall be bronze, cast-iron, steel or stainless steel body and interior coating according to AWWA C550 or FDA approved epoxy coating with OS&Y resilient seated gate valve shut offs.

C. Discharge from air gap shall be piped to a floor drain.

D. Backflow preventer shall be Watts 909, or Wilkins 375/375A.
22 80 06 PRESSURE REDUCING VALVE - AUTOMATIC (3" AND LARGER)

A. Automatic, pressure piloted, flanged cast iron body with interior coating according to AWWA C550, bronze trim, pressure gauge connections, position indicator, and means for discharge pressure adjustment. Watts E115 or Wilkins ZW1109.

B. PRESSURE REDUCING VALVE - (2-1/2" and smaller)
   1. Watts U5B or Wilkins 600.

22 80 07 EXPANSION TANK

A. Expansion tank shall be a steel hydro-pneumatic diaphragm type tank rated for a working pressure of 125 psig at 200°F. All internal wetted parts shall comply with FDA regulations and approvals. Capacity shall be as scheduled on the plans.

B. Expansion tank shall be Amtrol Therm-X-Trol Model ST or approved equal.

<table>
<thead>
<tr>
<th>UNIT DESIG.</th>
<th>AMTROL MODEL NO.</th>
<th>TOTAL VOLUME (GAL.)</th>
<th>ACCEPTANCE VOLUME (GAL)</th>
<th>MAXIMUM PRESSURE (PSI)</th>
<th>PRESSURE CHARGE (PSI)</th>
<th>INSTALLATION TYPE</th>
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<td>ST-12VC</td>
<td>6.4</td>
<td>3.2</td>
<td>100</td>
<td>60</td>
<td>VERTICAL</td>
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</tbody>
</table>

22 80 09 TEMPERATURE RELIEF VALVES:

A. Temperature relief valves on domestic hot water system shall be a self-contained, reverse acting, with adjustable setpoint as manufactured by Spence, ¾", 2020 TDGQF or equivalent.

22 80 10 CAST IRON DOWNSPOUT SHOES

A. Furnish and install one-piece cast iron downspout shoes with 5/8” fastening lugs. Downspout sizes and outlet sizes shall be coordinated with the plans. The length shall provide between 12” and 18” of exposed shoe above grade. Vertical storm piping may be required to obtain desired invert elevation. Downspout shoes shall be offset type as manufactured by Neenah or approved equal.

22 80 11 THERMOSTATIC MIXING VALVES

A. Furnish and install thermostatic tempering valves with integral check valves, removable cartridge strainers, stainless steel pistons, and thermal bellows – rough bronze finish.

B. Mixing valves serving tempered water, individual fixtures or small groups of fixtures shall be Armstrong TMV Model 215 or approved equivalent.

C. A central thermostatic mixing station shall be used to temper domestic hot water supply to the building. (The total load for the building is 7 gpm). System shall consist of a thermostatic mixing valve designed specifically to be installed as the primary control valve within a pumped recirculation system. Valves shall be Armstrong TMV Model 425 or approved equivalent.
22 80 12 WATER HAMMER ARRESTORS

A. Furnish and install all stainless steel shock absorbers at all solenoid, remote operated or quick closing valves such as restroom devices for each battery of fixtures. Install on both domestic hot and cold water branch lines in an upright position. Install in ADA water closet stall with wall access panel. JR Smith 5005 to 5050 depending on manufacturer’s recommended sizing.

22 80 13 ROOF HYDRANT: EXTERIOR FREE STANDING ROOF MOUNTED (COLD WATER ONLY) (RH-A)

A. Free standing roof hydrant with ¾” hose connection outlet with integral backflow preventer x 1”copper sweat inlet and 1/8” NPT drain hole. Woodford RHY2-MS, no substitutions.

B. Roof hydrants shall be installed with ½” drain line installed with cleanout ports. A 1/8” to ½” transition shall be provided. Drain lines shall be extended to the nearest floor drain or mop sink basin.

END OF SECTION
22 00 00
23 00 00 HVAC PIPING AND EQUIPMENT

23 00 01 GENERAL

A. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Division 20 of the Specifications.

B. Provisions and conditions cited in this Section shall apply to Work for other sections of Division 20 of these Specifications.

23 00 02 REFERENCES, REGULATORY REQUIREMENTS

A. Work for this Section of the Specifications shall be performed in accordance with the Codes, Standards, etc., as identified in Division 20.

23 00 03 REFERENCES, RELATED SECTIONS OF THE SPECIFICATIONS

Requirements of the following Sections of the Specifications apply to Work for this Section:
1. Division 20 - Basic Mechanical Conditions and Basic Mechanical Materials and Methods
2. Division 24 – Air Distribution
3. Division 25 - Temperature Controls

23 00 04 DEFINITIONS

(none)

23 00 05 WORK INCLUDED

A. Furnish material, labor and services necessary for, and incidental to, installing the following systems where shown on the Plans and as hereinafter specified. Include all necessary work in the related sections of the Specifications (Sub-section 23 00 03 to provide for complete systems.

1. Air handling equipment including, but not limited to, central station air handling units, packaged DX rooftop air handling units, terminal units, return fans, exhaust fans, coils, condensing units.

2. Condensing units/remote air-cooled condenser systems including, but not limited to, refrigerant piping, filter-drier, sight glasses, service valves, test-charge ports and accessories.

3. Natural gas piping, service valves, and gas pressure regulators.

4. All seismic restraints for the above work (Refer to Section 20 10 40).

5. Smoke stopping of all penetrations of pipes and ductwork, and firestopping of the same through fire rated partitions as shown on the Architectural drawings including, but not limited to stairways, shafts, corridors, floors, roofs, and required exits (Refer to Section 20 10 20).

6. Cleaning and pressure testing equipment, piping, and accessories installed under this section of the specification. (Refer to Section 20 10 50).

7. Leak testing and charging of field piped refrigerant systems (Refer to Section 20 10 50).

8. Provide sufficient labor and resources required for the testing and balancing (Refer to Section 20 10 80) and for the commissioning process.
9. Installing accessories specified under other sections of the specification referenced in Sub-section 23 00 05, including but not limited to, flow meters, control valves, thermowells, and taps for pressure sensors.

23 00 06 SUBMITTALS:

A. The Contractor shall submit the following for approval in accordance with Subsection 20 00 43, Duties of the Contractor - Submittals.

1. Piping materials, valves, and accessories as specified in Piping Materials Schedule(s) in this section of the specification.

2. All specialties including, but not limited to, thermometers, gauges, relief valves, pressure regulators, backflow preventers, flow switches, and vacuum breakers.

3. All HVAC equipment specified in this Division 23 including, but not limited to, packaged equipment, air handling units, fans, terminal units and steam humidifier.

4. All general items specified under Division 20 utilized in the installation of work required by this section of the specification.

B. Provide manufacturer's technical product data of each material and accessory item with engineering support information, installation manual, operation and maintenance manual. Data shall be specific to product specified and clearly identified on all data sheets, which contains multiple models or sizes.

C. At the point where the mechanical system has been installed and checked by the Contractor and the systems are ready for testing and adjusting, submit a letter to the Architect/Engineer stating such. Refer to Section 20 10 85.

D. At the completion of the project, submit a letter stating all materials are asbestos free, and meet the specified ASTM E-84 flame/smoke rating of 25/50, and that all piping and duct penetrations are smoke or fire stopped as required by the Code.

E. Contractor shall submit coordination drawings to the Engineer for review prior to any fabrication or installation (Refer to Section 20 10 50).
PART 1 - GENERAL

1.1. DESCRIPTION

A. The purpose of this section is to specify Division 23 responsibilities in the commissioning process, which are being directed by the CxA.

B. The systems to be commissioned are listed in Section 01 09 00 Part 1.10.

C. Commissioning requires the participation of Division 23 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 01 09 00. Division 23 shall be familiar with all parts of Section 01 09 00 and the commissioning plan issued by the CxA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.2. RESPONSIBILITIES

A. Mechanical, Controls and TAB Contractors. The commissioning responsibilities applicable to each of the mechanical, controls and TAB contractors of Division 23 are as follows (all references apply to commissioned equipment only):

Construction and Acceptance Phases

1. Attend a commissioning scoping meeting and other meetings necessary to facilitate the Cx process.

2. Contractors shall provide the CxA with normal cut sheets and shop drawing submittals of commissioned equipment.

3. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of start-up and functional testing procedures.
   a. Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner-contracted tests, fan and pump curves, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner to keep the warranty in force clearly identified. In addition, the installation, start-up and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Agent.
   b. The Commissioning Agent may request further documentation necessary for the commissioning process.
   c. This data request may be made prior to normal submittals.

4. Provide a copy of the O&M manuals and submittals of commissioned equipment, through normal channels, to the CxA for review and approval.

5. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

6. Provide limited assistance to the CxA in preparing the specific functional performance test procedures as specified in Section 23 08 00. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

7. Develop a full start-up and initial checkout plan using manufacturer’s start-up procedures and the prefunctional checklists from the CxA for all commissioned equipment. Submit to CxA for review and approval prior to startup. Refer to Section 01 09 00 for further details on start-up plan preparation.
8. During the startup and initial checkout process, execute the mechanical-related portions of the prefunctional checklists for all commissioned equipment.

9. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.

10. Address current A/E punch list items before functional testing. Air and water TAB shall be completed with discrepancies and problems remedied before functional testing of the respective air- or water-related systems.

11. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

12. Provide skilled technicians to perform functional performance testing under the direction of the CxA for specified equipment in Section 01 09 00. Assist the CxA in interpreting the monitoring data, as necessary.

13. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, CPM and A/E and retest the equipment.

14. Prepare O&M manuals according to the Contract Documents, including clarifying and updating the original sequences of operation to as-built conditions.

15. During construction, maintain as-built red-line drawings for all drawings and final CAD as-builds for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).

16. Provide training of the Owner’s operating staff using expert qualified personnel, as specified.

17. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

1. Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.

2. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

B. Mechanical Contractor. The responsibilities of the HVAC mechanical contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. Provide startup for all HVAC equipment, except for the building automation control system.

2. Assist and cooperate with the TAB contractor and CxA by:
   a. Putting all HVAC equipment and systems into operation and continuing the operation during each working day of TAB and commissioning, as required.
   b. Including cost of sheaves and belts that may be required by TAB.
   c. Providing test holes in ducts and plenums where directed by TAB to allow air measurements and air balancing. Provide an approved plug.
   d. Providing temperature and pressure taps according to the Construction Documents for TAB and commissioning testing.

3. Install a P/T plug at each water sensor which is an input point to the control system.

4. List and clearly identify on the as-built drawings the locations of all air-flow stations.

5. Prepare a preliminary schedule for Division 23 pipe and duct system testing, flushing and cleaning, equipment start-up and TAB start and completion for use by the CxA. Update the schedule as appropriate.
6. Notify the CPM or CxA depending on protocol, when pipe and duct system testing, flushing, cleaning, startup of each piece of equipment and TAB will occur. Be responsible to notify the CPM or CxA, ahead of time, when commissioning activities not yet performed or not yet scheduled will delay construction. Be proactive in seeing that commissioning processes are executed and at the CxA has the scheduling information needed to efficiently execute the commissioning process.

C. Controls Contractor. The commissioning responsibilities of the controls contractor, during construction and acceptance phases in addition to those listed in (A) are:

1. **Sequences of Operation Submittals.** The Controls Contractor’s submittals of control drawings shall include complete detailed sequences of operation for each piece of equipment, regardless of the completeness and clarity of the sequences in the specifications. They shall include:
   a. An overview narrative of the system (1 or 2 paragraphs) generally describing its purpose, components and function.
   b. All interactions and interlocks with other systems.
   c. Detailed delineation of control between any packaged controls and the building automation system, listing what points the BAS monitors only and what BAS points are control points and are adjustable.
   d. Written sequences of control for packaged controlled equipment. (Equipment manufacturers’ stock sequences may be included but will generally require additional narrative).
   e. Start-up sequences.
   f. Warm-up mode sequences.
   g. Normal operating mode sequences.
   h. Unoccupied mode sequences.
   i. Shutdown sequences.
   j. Capacity control sequences and equipment staging.
   k. Temperature and pressure control: setbacks, setups, resets, etc.
   l. Detailed sequences for all control strategies, e.g., economizer control, optimum start/stop, staging, optimization, demand limiting, demand controlled ventilation, etc.
   m. Effects of power or equipment failure with all standby component functions.
   n. Sequences for all alarms and emergency shut downs.
   o. Seasonal operational differences and recommendations.
   p. Initial and recommended values for all adjustable settings, setpoints and parameters that are typically set or adjusted by operating staff; and any other control settings or fixed values, delays, etc. that will be useful during testing and operating the equipment.
   q. Schedules, if known.
   r. To facilitate referencing in testing procedures, all sequences shall be written in small statements, each with a number for reference. For a given system, numbers will not repeat for different sequence sections, unless the sections are numbered.

2. **Control Drawings Submittal**
   a. The control drawings shall have a key to all abbreviations.
   b. The control drawings shall contain graphic schematic depictions of the systems and each component.
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c. The schematics will include the system and component layout of any equipment that the control system monitors, enables or controls, even if the equipment is primarily controlled by packaged or integral controls.
d. Provide a full points list with at least the following included for each point:
   1) Controlled system
   2) Point abbreviation
   3) Point description
   4) Display unit
   5) Control point or setpoint (Yes / No)
   6) Monitoring point (Yes / No)
   7) Intermediate point (Yes / No)
   8) Calculated point (Yes / No)

Key:
   Point Description: DB temp, airflow, etc.
   Control or Setpoint: Point that controls equipment and can have its setpoint changed (OSA, SAT, etc.)
   Intermediate Point: Point whose value is used to make a calculation which then controls equipment (space temperatures that are averaged to a virtual point to control reset).
   Monitoring Point: Point that does not control or contribute to the control of equipment, but is used for operation, maintenance, or performance verification.
   Calculated Point: “Virtual” point generated from calculations of other point values.

The Controls Contractor shall keep the CxA informed of all changes to this list during programming and setup.

3. An updated as-built version of the control drawings and sequences of operation shall be included in the final controls O&M manual submittal.

4. Assist and cooperate with the TAB contractor in the following manner:
   a. Meet with the TAB contractor prior to beginning TAB and review the TAB plan to determine the capabilities of the control system toward completing TAB. Provide the TAB any needed unique instruments for setting terminal unit boxes and instruct TAB in their use (handheld control system interface for use around the building during TAB, etc.).
   b. For a given area, have all required prefunctional checklists, calibrations, startup and selected functional tests of the system completed and approved by the CxA prior to TAB.
   c. Provide a qualified technician to operate the controls to assist the TAB contractor in performing TAB, or provide sufficient training for TAB to operate the system without assistance.

5. Assist and cooperate with the CxA in the following manner:
   a. Using a skilled technician who is familiar with this building, execute the functional testing of the controls system as specified for the controls contractor. Assist in the functional testing of all equipment specified. Provide two-way radios during the testing as necessary.
   b. Execute all control system trend logs specified.

6. The controls contractor shall prepare a written plan indicating in a step-by-step manner, the procedures that will be followed to test, checkout and adjust the control system prior to functional
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performance testing, according to the process in Section 01 09 00. At minimum, the plan shall include for each type of equipment controlled by the automatic controls:

a. System name.
b. List of devices.
c. Step-by-step procedures for testing each controller after installation, including:
   1) Process of verifying proper hardware and wiring installation.
   2) Process of downloading programs to local controllers and verifying that they are addressed correctly.
   3) Process of performing operational checks of each controlled component.
   4) Plan and process for calibrating valve and damper actuators and all sensors.
   5) A description of the expected field adjustments for transmitters, controllers and control actuators should control responses fall outside of expected values.
d. A copy of the log and field checkout sheets that will document the process. This log must include a place for initial and final read values during calibration of each point and clearly indicate when a sensor or controller has “passed” and is operating within the contract parameters.
e. A description of the instrumentation required for testing.
f. Indicate what tests on what systems should be completed prior to TAB using the control system for TAB work. Coordinate with the CxA and TAB contractor for this determination.

7. Provide a signed and dated certification to the CxA and CPM upon completion of the checkout of each controlled device, equipment and system prior to functional testing for each piece of equipment or system, that all system programming is complete as to all respects of the Contract Documents, except functional testing requirements.

8. Beyond the control points necessary to execute all documented control sequences, provide monitoring, control and virtual points as specified in Section Direct Digital Control Systems.

9. List and clearly identify on the as-built duct and piping drawings the locations of all static and differential pressure sensors (air, water and building pressure).

D. TAB Contractor. The duties of the TAB contractor, in addition to those listed in (A) are:

1. Six weeks prior to starting TAB, submit to the CPM the qualifications of the site technician for the project, including the name of the contractors and facility managers of recent projects the technician on which was lead. The Owner will approve the site technician’s qualifications for this project.

2. Submit the outline of the TAB plan and approach for each system and component to the CxA, CPM and the controls contractor six weeks prior to starting the TAB. This plan will be developed after the TAB has some familiarity with the control system.

3. The submitted plan will include:
   a. Certification that the TAB contractor has reviewed the construction documents and the systems with the design engineers and contractors to sufficiently understand the design intent for each system.
   b. An explanation of the intended use of the building control system. The controls contractor will comment on feasibility of the plan.
   c. All field checkout sheets and logs to be used that list each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
d. Discussion of what notations and markings will be made on the duct and piping drawings during the process.

e. Final test report forms to be used.

f. Detailed step-by-step procedures for TAB work for each system and issue: terminal flow calibration (for each terminal type), diffuser proportioning, branch / sub-main proportioning, total flow calculations, rechecking, diversity issues, expected problems and solutions, etc. Criteria for using air flow straighteners or relocating flow stations and sensors will be discussed. Provide the analogous explanations for the water side.

g. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.

h. Details of how total flow will be determined (Air: sum of terminal flows via BAS calibrated readings or via hood readings of all terminals, supply (SA) and return air (RA) pitot traverse, SA or RA flow stations. Water: pump curves, circuit setter, flow station, ultrasonic, etc.).

i. The identification and types of measurement instruments to be used and their most recent calibration date.

j. Specific procedures that will ensure that both air and water side are operating at the lowest possible pressures and provide methods to verify this.

k. Confirmation that TAB understands the outside air ventilation criteria under all conditions.

l. Details of whether and how minimum outside air CFM will be verified and set and for what level (total building, zone, etc.).

m. Details of how building static and exhaust fan / relief damper capacity will be checked.

n. Proposed selection points for sound measurements and sound measurement methods.

o. Details of methods for making any specified coil or other system plant capacity measurements.

p. Details of any TAB work to be done in phases (by floor, etc.), or of areas to be built out later.

q. Details regarding specified deferred or seasonal TAB work.

r. Details of any specified false loading of systems to complete TAB work.

s. Details of all exhaust fan balancing and capacity verifications, including any required room pressure differentials.

t. Details of any required interstitial cavity differential pressure measurements and calculations.

u. Plan for hand-written field technician logs of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests (scope and frequency).

v. Plan for formal progress reports (scope and frequency).

w. Plan for formal deficiency reports (scope, frequency and distribution).

4. A running log of events and issues shall be kept by the TAB field technicians. Submit hand-written reports of discrepancies, deficient or uncompleted work by others, contract interpretation requests and lists of completed tests to the CxA and CPM at least twice a week.

5. Communicate in writing to the controls contractor all setpoint and parameter changes made or problems and discrepancies identified during TAB which affect the control system setup and operation.

6. Provide a draft TAB report within two weeks of completion. A copy will be provided to the CxA. The report will contain a full explanation of the methodology, assumptions and the results in a clear format with designations of all uncommon abbreviations and column headings. The report
should follow the latest and most rigorous reporting recommendations by AABC, NEBB or ASHRAE Standard 111.

7. Provide the CxA with any requested data, gathered, but not shown on the draft reports.

8. Provide a final TAB report for the CxA with details, as in the draft.

9. Conduct functional performance tests and checks on the original TAB as specified for TAB in Section 15997.

E. Mechanical Designer/Engineer. Refer to Section 01 09 00 for the responsibilities of the mechanical designer/engineer.

1.3. RELATED WORK

A. Refer to Section 01 09 00 Part 1.6 for a listing of all sections where commissioning requirements are found.

B. Refer to Section 01 09 00 Part 1.10 for systems to be commissioned and Section 01 09 000 Part 3.6 for functional testing requirements.

PART 2 - PRODUCTS

A. TEST EQUIPMENT

B. Division 23 shall provide all test equipment necessary to fulfill the testing requirements of this Division.

C. Refer to Section 01 09 00 Part 2.1 for additional Division 23 requirements.

PART 3 - EXECUTION

3.1. SUBMITTALS

A. Division 23 shall provide submittal documentation relative to commissioning as required in this Section Part 1, Section 01300.0520 Construction Submittal Procedures and Section 01 09 00 Part 3.3.

3.2. STARTUP

A. The HVAC mechanical and controls contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in 01 09 00 Part 3.4. Division 23 has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning agent or Owner.

B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems or sub-systems at the discretion of the CxA and CPM. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all prefuctional checklists as soon as possible.

3.3. TAB

A. Refer to the TAB responsibilities in Part 1.2 above.

3.4. FUNCTIONAL PERFORMANCE TESTS

A. Refer to Section 01 09 00 Part 1.10 for a list of systems to be commissioned and to Part 3.6 for a description of the process.

3.5. TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS

A. Refer to Section 01 09 00 Part 3.4 for specific details on non-conformance issues relating to prefuctional checklists and tests.

B. Refer to Section 01 09 00 Part 3.7 for issues relating to functional performance tests.

3.6. OPERATION AND MAINTENANCE (O&M) MANUALS
A. The following O&M manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.

B. Division 23 shall compile and prepare documentation for all equipment and systems covered in Division 23 and deliver this documentation to the GC for inclusion in the O&M manuals, according to this section and Section 01730, prior to the training of owner personnel.

C. The CxA shall receive a copy of the O&M manuals for review.

D. **Special Control System O&M Manual Requirements.** In addition to documentation that may be specified elsewhere, the controls contractor shall compile and organize at minimum the following data on the control system in labeled 3-ring binders with indexed tabs.

1. Three copies of the controls training manuals in a separate manual from the O&M manuals.

2. Operation and Maintenance Manuals containing:
   a. Specific instructions on how to perform and apply all functions, features, modes, etc. mentioned in the controls training sections of this specification and other features of this system. These instructions shall be step-by-step. Indexes and clear tables of contents shall be included. The detailed technical manual for programming and customizing control loops and algorithms shall be included.
   b. Full as-built set of control drawings (refer to Submittal section above for details).
   c. Full as-built sequence of operations for each piece of equipment.
   d. Full points list. In addition to the updated points list required in the original submittals (Part 1 of this section), a listing of all rooms shall be provided with the following information for each room:
      1) Building
      2) Floor
      3) Room number
      4) Room name
      5) Air handler unit ID
      6) Reference drawing number
      7) Air terminal unit tag ID
      8) Heating and/or cooling valve tag ID
      9) Minimum cfm
     10) Maximum cfm
   e. Full print out of all schedules and set points after testing and acceptance of the system.
   f. Full as-built print out of software program.
   g. Electronic copy on disk of the entire program for this facility.
   h. Marking of all system sensors and thermostats on the as-built floor plan and mechanical drawings with their control system designations.
   i. Maintenance instructions, including sensor calibration requirements and methods by sensor type, etc.
   j. Control equipment component submittals, parts lists, etc.
   k. Warranty requirements.
   l. Copies of all checkout tests and calibrations performed by the Contractor (not commissioning tests).
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3. The manual shall be organized and subdivided with permanently labeled tabs for each of the following data in the given order:
   a. Sequences of operation
   b. Control drawings
   c. Points lists
   d. Controller / module data
   e. Thermostats and timers
   f. Sensors and DP switches
   g. Valves and valve actuators
   h. Dampers and damper actuators
   i. Program setups (software program printouts)

4. Field checkout sheets and trend logs should be provided to the CxA for inclusion in the Commissioning Record Book.

E. **Special TAB Documentation Requirements.** The TAB will compile and submit the following with other documentation that may be specified elsewhere in the Specifications.
   1. Final report containing an explanation of the methodology, assumptions, test conditions and the results in a clear format with designations of all uncommon abbreviations and column headings.
   2. The TAB shall mark on the drawings where all traverse and other critical measurements were taken and cross reference the location in the TAB report.

F. **Review and Approvals.** Review of the commissioning related sections of the O&M manuals shall be made by the A/E and by the CxA. Refer to Section 01 09 00 Part 3.8 for details.

3.7. **TRAINING OF OWNER PERSONNEL**

   A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to Section 01 09 00 Part 3.9 for additional details.

   B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner personnel for commissioned equipment. Refer to Section 01 09 00 Part 3.9 for additional details.

   C. **Mechanical Contractor.** The mechanical contractor shall have the following training responsibilities:
      1. Provide the CxA with a training plan two weeks before the planned training according to the outline described in Section 01 09 00 Part 3.9.
      2. Provide designated Owner personnel with comprehensive orientation and training in the understanding of the systems and the operation and maintenance of each piece of HVAC equipment including, but not limited to, pumps, air conditioning units, air handling units, fans, terminal units, controls and air quality treatment systems, etc.
      3. Training shall normally start with classroom sessions followed by hands-on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
      4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
      5. The appropriate trade or manufacturer’s representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer’s representative. Practical building operating expertise
as well as in-depth knowledge of all modes of operation of the specific piece of equipment are required. More than one party may be required to execute the training.

6. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

7. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.

8. Training shall include:
   a. Use of the printed installation, operation and maintenance instruction material included in the O&M manuals.
   b. A review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.
   c. Discussion of relevant health and safety issues and concerns.
   d. Discussion of warranties and guarantees.
   e. Common troubleshooting problems and solutions.
   f. Explanatory information included in the O&M manuals and the location of all plans and manuals in the facility.
   g. Discussion of any peculiarities of equipment installation or operation.
   h. The format and training agenda in *The HVAC Commissioning Process, ASHRAE Guideline 1-1989R*, 1996 is recommended.
   i. Classroom sessions shall include the use of overhead projections, slides, video/audio-taped material as might be appropriate.

9. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures.

10. The mechanical contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not controlled by the central control system.

11. Training shall occur after functional testing is complete, unless approved otherwise by the Construction Project Manager.

D. Controls Contractor. The controls contractor shall have the following training responsibilities:

1. Provide the CxA with a training plan four weeks before the planned training according to the outline described in Section 01 09 00 Part 3.9.

2. The controls contractor shall provide designated Owner personnel training on the control system in this facility. The intent is to clearly and completely instruct the Owner on all the capabilities of the control system.

3. Training manuals. The standard operating manual for the system and any special training manuals will be provided for each trainee, with three extra copies left for the O&M manuals. In addition, copies of the system technical manual will be demonstrated during training and three copies submitted with the O&M manuals. Manuals shall include detailed description of the subject matter for each session. The manuals will cover all control sequences and have a definitions section that fully describes all relevant words used in the manuals and in all software displays. Manuals will be approved by the CxA. Copies of audiovisuals shall be delivered to the Owner.

4. The trainings will be tailored to the needs and skill-level of the trainees.
5. The trainers will be knowledgeable on the system and its use in buildings. For the on-site sessions, the most qualified trainer(s) will be used. The Owner shall approve the instructor prior to scheduling the training.

6. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.

7. The controls contractor shall attend sessions other than the controls training, as requested, to discuss the interaction of the controls system as it relates to the equipment being discussed.

8. There shall be three training sessions (Times listed here are minimums. Control contractor to confirm actual training time required and confirm with CxA and Owner.):
   a. **Training I. Control System.** The first training shall consist of 4 hours of actual training. This training may be held on-site or in the supplier’s facility. If held off-site, the training may occur prior to final completion of the system installation. Upon completion, each student, using appropriate documentation, should be able to perform elementary operations and describe general hardware architecture and functionality of the system.
   b. **Training II. Building Systems.** The second session shall be held on-site for a period of 8 hours of actual hands-on training after the completion of system commissioning. The session shall include instruction on:
      1) Specific hardware configuration of installed systems in this building and specific instruction for operating the installed system, including HVAC systems, lighting controls and any interface with security and communication systems.
      2) Security levels, alarms, system start-up, shut-down, power outage and restart routines, changing setpoints and alarms and other typical changed parameters, overrides, freeze protection, manual operation of equipment, optional control strategies that can be considered, energy savings strategies and set points that if changed will adversely affect energy consumption, energy accounting, procedures for obtaining vendor assistance, etc.
      3) All trending and monitoring features (values, change of state, totalization, etc.) including setting up, executing, downloading, viewing both tabular and graphically and printing trends. Trainees will actually set-up trends in the presence of the trainer.
      4) Every screen shall be completely discussed, allowing time for questions.
      5) Use of keypad or plug-in laptop computer at the zone level.
      6) Use of remote access to the system via phone lines or networks.
      7) Setting up and changing an air terminal unit controller.
      8) Graphics generation
      9) Point database entry and modifications
      10) Understanding DDC field panel operating programming (when applicable)
   c. **Training III.** The third training will be conducted on-site six months after occupancy and consist of 4 hours of training. The session will be structured to address specific topics that trainees need to discuss and to answer questions concerning operation of the system.

E. **TAB** The TAB contractor shall have the following training responsibilities (Time listed here is minimum time required. TAB Contractor to confirm actual training time required and confirm with CxA and Owner.):
   1. TAB shall meet for 2 hours with facility staff after completion of TAB and instruct them on the following:
      a. Go over the final TAB report, explaining the layout and meanings of each data type.
b. Discuss any outstanding deficient items in control, ducting or design that may affect the proper delivery of air or water.

c. Identify and discuss any terminal units, duct runs, diffusers, coils, fans and pumps that are close to or are not meeting their design capacity.

d. Discuss any temporary settings and steps to finalize them for any areas that are not finished.

e. Other salient information that may be useful for facility operations, relative to TAB.

3.8. Deferred Testing

A. Refer to Section 01 09 00 Part 3.10 for requirements of deferred testing.

3.9. Written Work Products

A. Written work products of Contractors will consist of the start-up and initial checkout plan described in Section 01 09 00 Part 3.11 and the filled-out start-up, initial checkout and prefunctional checklists.

END OF SECTION 23 08 00
23 10 00 HYDRONIC PIPING

A. Itemization of the piping materials for specific system application are enumerated in the following sub-sections for the respective PIPING MATERIAL SCHEDULE. Specific requirements for materials shall be as listed in Division 20 Basic Materials and Methods.

B. Manufacturer’s mill reports and applicable documents to certify the validity of the procured piping materials shall be on file at the Contractor’s office.

C. Install all piping with pitch to vent or drain. Provide drain valves at low points and air vents at high points. Drain valves and air vents shall be ¾” bronze 2 piece body ball valves with ¾” hose end adapter, cap and chain. In ½” through 2” pipe, contractor may use Webstone model T-drain. Use eccentric reducing fittings (installed top level) as required to avoid air pockets.

D. Gaskets and packings containing asbestos are not acceptable.

E. Where Pipe and accessories installed under this section of the specification tie-in to existing systems, Contractor shall verify existing for: sizes, direction of flow (via pressure or physical tracing of piping, not labels), materials, and elevations before installing new work. Contractor shall notify Architect/Engineer upon discovery of discrepancy. Work performed prior to verification will be corrected at no cost to Owner.

23 10 01 PIPING MATERIAL SCHEDULE M-1

A. Service: Condensate drain piping.

B. Design: Atmospheric

C. Pipe: Type L copper

D. Fittings: Wrought copper, solder ends. 90° elbows are not permitted, use (2)

45° elbows or "Y" provided with cap in unconnected straight run.

E. Extend piping from all cooling coil drain pans to the location of discharging indirectly to the building drain system. Pipe size shall be unit connection size unless indicated larger on the plans.

F. Connections to the drain pans shall be made through a water seal trap with the downstream side vented to atmosphere.
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23 23 00 MISCELLANEOUS PIPING

A. Itemization of the piping materials for specific system application are enumerated in the following sub-sections for the respective PIPING MATERIAL SCHEDULE. Specific requirements for materials shall be as listed in Division 20 10 00 Basic Materials and Methods.

B. Manufacturer’s mill reports and applicable documents to certify the validity of the procured piping materials shall be on file at the Contractor’s office.

C. Gaskets and packings containing asbestos are not acceptable.

23 23 01 PIPING MATERIAL SCHEDULE M-2

A. Service: Natural Gas Piping, above grade.

B. Design: Pressure: 2 psig.

C. Pipe: Black carbon steel, Schedule 40, ASTM-53, ERW.

D. Fittings:
   1. 2” and smaller Malleable iron, screwed
   2. 2-1/2” and larger Black carbon steel, buttwelded

E. Joints:
   1. 2” and smaller Threaded
   2. 2-1/2” and larger Welded
   3. All sizes concealed in chases or walls or above gyp/plaster ceilings Welded

F. Valves: Relublable plug type U.L. listed for natural gas service installed where shown and within 6 feet of the equipment served.

G. Note: All piping methods and materials shall be in accordance with NFPA 54, National Gas Code.

H. Pressure Test: New piping shall be installed, capped, and pressure tested with Nitrogen at 50 psi for two (2) hours. After the piping has passed the above pressure test the final tie-ins shall be made, then the system will be filled with natural gas and the final joints will be checked with soap.
23 23 02 PIPE MATERIAL SCHEDULE M-3

A. Service: Refrigerant

B. Design:
   Pressure: 300 psig
   Maximum temperature: 300°F

C. Pipe: Type ACR copper pipe

D. Fittings: Wrought copper, brazed

E. Valves:

F. Pressure Test: Refer to Section 20 10 60.

23 23 03 MISCELLANEOUS SPECIALTIES

A. Natural Gas Specialties

1. Pressure Regulators: Furnish and install Maxitrol, Schlumberger, Fisher or equivalent "pounds to inches" gas pressure regulators with changeable springs for outlet pressure adjustment.
   a. Furnish and install pressure gauges and gauge cocks on both the high pressure and low pressure side of the gas service entrance.

2. Gas valves 2” and smaller: threaded end, two piece bronze body, UL listed natural gas, ball valve, Nibco 580/5-70-UL or equivalent.

3. Gas valves 2-1/2” and larger: flanged end, class 125, short pattern cast iron body, lubricated plug, UL listed natural gas, Milliken 171M, Nordstrom 143, Resun R-1431

4. Meter shall be Roots series B3 as manufactured by DMD Dresser with a Mercury Instruments model Mini-Max volume corrector.

B. Seismic Shut-Off Valves

1. Furnish and install a Pacific Seismic Products seismic gas shut-off valve designed for dry fuel gas operation up to 60 psig. Valve shall be of the line size specified on the drawings and shall be UL listed and shall meet California standards for earthquake actuated automatic gas shut off systems standard No. 12-23-1, ANSI Z21.70, 1981 and ASCE 25-97 standards.

C. Roof Mount Refrigerant Piping Pedestals

1. Provide premanufactured pipe support system anchored to roof deck for all roof mounted refrigerant piping.

2. All pedestals shall include cant and be anchored to the deck. Coordinate cant size with roofing contractor.

3. Piping supports shall be spaced using the guidelines in division 20 10 42.

4. Refer to division 20 10 26 and the detail on drawings for more information.

D. Roof Mount Other Piping Pedestals

1. Provide premanufactured pipe support system not anchored to roof deck for all roof mounted natural gas and condensate piping.

2. All pedestals shall include cant and be not anchored to the deck. Coordinate cant size with roofing contractor.

3. Piping supports shall be spaced using the guidelines in division 20 10 42.
   Pedestals shall be Pate, nVent Caddy, Miro, or approved equivalent.
23 70 00 PACKAGED EQUIPMENT

23 70 01 CONDENSING UNITS

A. Condensing units shall be U.L. Listed, fully assembled, piped, and wired packaged units, shipped as one piece, which are a current production line and fully cataloged by the manufacturer. Unit shall be shipped with a full refrigerant and oil charge.

B. Unit casing shall be removable service panels constructed of a minimum 18 gauge G90 galvanized steel with a factory baked enamel finish. The finish and hardware shall be tested in accordance with ASTM B117 salt spray test for a minimum of 500 hours. Unit frame shall be heavy gauge with lifting holes/fork lift slots.

C. Compressor shall be isolator mounted, high efficient, hermetically sealed, refrigerant cooled, reciprocating or scroll type with high starting torque. At least one of the compressors per condensing units shall be VFD. Motor shall be capable of operating at plus/minus 10 percent of nameplate voltage. Motor shall have internal temperature and current sensors for motor protection. Units larger than 7 tons shall have multiple compressors with a minimum of two stages of control. Each compressor shall have separate refrigeration circuits each with a thermostatic expansion valve. Each compressor shall have an automatic resetting low pressure safety and a manual reset high pressure safety. Refrigeration filter-drier, sight glass, liquid service valve, suction service valve, and gauge ports shall be factory furnished and installed.

D. Condenser coils shall be 3/8” smooth bore copper tubes with aluminum fins mechanically bonded to the tubes. Fins shall not be spaced closer than 12 fins per inch. Provide subcooling circuits integral with the condenser coils for a minimum of 10°F subcooling. Coils shall be factory pressure tested to 425 psig. PVC coated metal coils guards shall be factory installed for coil protection. Condenser fan(s) shall be aluminum or galvanized steel blades with non-corrosive hubs. Fan motors shall be direct connected, totally enclosed, permanent split capacitor type, with built-in thermal overload protection.

E. Condensing units shall be completely factory wired with terminal block connections for all customer wiring interfaces. Units shall have a non-fused single point power disconnect switch and a factory installed, wired, and fused 24 volt control power transformer. Factory controls shall include: anti-short circuit time delay relay(s), pump down cycle, and coil frost control.

F. Units shall have a complete one year warranty and a five year warranty on the compressor.

G. Condensing units shall be selected at 100°F ambient.

H. Units shall be as manufactured by Trane, York, Carrier, McQuay, or approved equal.

23 70 02 DUCTLESS SPLIT SYSTEM:

A. Furnish and install ductless split system DX air conditioning/heat pump units as specified herein and as shown on the drawings. System shall consist of wall or ceiling mounted ductless indoor fan coil unit, remote air cooled condenser, controls, refrigerant pipe sets, and all accessories.

B. Indoor unit shall feature crossflow supply air fan, aluminum fin/copper tube cooling coil, housing and mounting bracket, integral condensate pump.
C. Exterior unit shall feature Rotary-Hermetic compressor with crankcase heater, propeller fan, fan guard, and all refrigerant accessories. Refrigerant shall be R-410A. System shall be designed for up to 50 foot refrigerant tube length. Unit electrical power shall be 208/230 volts, 1 phase, 60 hertz.

D. Unit shall have a single point power connection. Power shall be 208/230 volts, 1 phase, 60 hertz.

E. Units shall be manufactured by Daikin, Mitsubishi, Trane or LG.
AIR HANDLING UNITS

ROOFTOP UNITS

A. Furnish and install rooftop units as specified below, and as described in diagrams and schedules on the drawings.

B. Factory assembled and tested; designed for roof or slab installation; and consisting of compressors, condensers, evaporator coils, condenser and evaporator fans, refrigeration, gas heat coils, filters, and dampers.

C. Unit shall be completely factory assembled, piped and wired and shipped in one section. Unit shall be specifically designed for outdoor roof top application with a fully weatherproof cabinet.

D. All cabinet walls, access doors, roof and floor shall be a high performance composite panel constructed with G90 galvanized steel on both sides and a closed cell polyurethane foam interior core providing a rigid, impact resistant surface.

1. The walls of the air tunnel compartments shall be 2 inches thick with a minimum R value of 12.5.
2. The walls of the coil compartment shall be 1 ½ inches thick with a minimum R value of 9.4.
3. The roof of the air tunnel compartments shall be sloped at a minimum of ¼ inch per foot and shall be an average of 2 ½ inches thick and an R value of 15.7.
4. The floor of the conditioned air and control compartments shall be 1 inch thick with a minimum R value of 6.25.
5. The access doors shall be 1 ½ inches thick with a minimum R value of 9.4.
6. The foam shall have a minimum density of 2 pounds per cubic feet.
7. All foam material shall be tested in accordance with ASTM D-1929 for a minimum flash ignition temperature of 610 degrees F.
8. All panels shall have a thermal break with no metal path from inside to outside.

E. Paint finish shall be capable of withstandng at least 2000 hours, with no visible corrosive effects, when tested in a salt spray and fog atmosphere in accordance with ASTM B 117-95 test procedure.

F. Unit specific color coded wiring diagrams shall match the unit color coded wiring and will be provided in both point-to-point and ladder form. Diagrams shall also be laminated in plastic and permanently affixed inside the control compartment.

G. Access to filters, heating section, and other items needing periodic checking or maintenance shall be through hinged access doors with quarter turn lockable latches. Door fastening screws are not acceptable. The blower access door shall be bolted closed.

H. Access doors shall have stainless steel hinges and full perimeter gasketing.

I. All openings through the base pan of the unit shall have upturned flanges of at least 1/2” in height around the opening through the base pan.

J. Air side service access doors shall have rain break overhangs.

K. Unit shall have decals and tags to indicate unit lifting and rigging, service areas and caution areas. Installation and maintenance manuals shall be supplied with each unit.
L. Unit shall be furnished with double sloped 304 stainless steel drain pans.

M. The fan shall be direct drive single width single inlet un-housed airfoil centrifugal, plenum fans. Supply fans shall have all aluminum construction. Fans attached to 1760 rpm motors shall be rated for a minimum of 1800 RPM maximum speed. Fans attached to 1170 rpm motors shall be rated for a minimum of 1200 RPM maximum speed. Direct drive fans shall be directly connected to and supported by the motor shaft. Motor bearings shall be rated for 200,000 hours service and shall have external lubrication connections. Fan(s) and motor(s) shall be dynamically balanced, and the entire fan assembly mounted on rubber isolators. Supply air shall be from the bottom of the cabinet. (Variable Volume Systems VFD drive(s) shall be factory mounted and wired to the fan motor(s).

N. Outside Air shall be a fully modulating economizer for control by others with a DDC signal. The outside air damper and return air damper assembly shall be constructed of extruded aluminum, hollow core, air foil blades with rubber edge seals and aluminum end seals. Damper blades shall be gear driven and designed to have no more than 25 CFM of leakage per sq.ft. Of damper area when subjected to 2 in. w.g. air pressure differential across the damper. Damper motor shall be spring return to ensure closing of outdoor air damper during periods of unit shutdown or power failure.

O. Air Cooled Condenser Section:
1. The condensing section shall be equipped with vertical discharge axial flow direct drive fans. Direct drive fans shall be directly connected to and supported by the motor shaft.
2. The condenser coils shall be sloped at least 30 degrees to protect the coils from damage.
3. Condenser coils shall be copper tubes with aluminum fins mechanically bonded to the tubes.
4. Condenser coils to be sized for a minimum of 10°F of refrigerant sub-cooling.

P. Filter section shall have prefilter with 2-inch- thick, fiberglass, throwaway with an ASHRAE efficiency of 30%, 4” with 85% efficient filters, clogged filter switch and direct dial reading magnehelic gauge mounted in the control compartment.

Q. Evaporator Coils:
1. Evaporator coils shall be copper tube with aluminum fins mechanically bonded to the tubes.
2. Evaporator coil drain pan(s) shall be fabricated of 304 stainless steel.
3. Evaporator coils shall have galvanized steel end casings.
4. Evaporator coils shall have equalizing type vertical tube headers.
5. Evaporator coils shall be furnished with a thermostatic expansion valve.
6. Evaporator coils shall be furnished with a double sloped drain pan for the positive drainage of condensate.
7. A drain connection shall be provided on each side of the unit. The manufacturer shall provide a P-trap condensate drain fitting for field installation to the drain connections.

R. Modulating Gas Heater shall be clamshell or drum and tube type, minimum 81% efficient, type 304 or 321 stainless steel construction for corrosion resistance against condensing flue gases, with 25 year warranty. Unit digital controls shall modulate gas valve and the speed of the induced draft fan to control heat output. Minimum turndown shall be 30% of maximum rated capacity. Unit shall include a factory wired supply air temperature sensor, to be field mounted in the supply ductwork. On a call for heating, the digital controller shall modulate gas valve and speed of induced draft blower to maintain a constant supply air temperature setpoint that is set using a DIP switch on the digital controller. The supply air temperature can...
be reset to a supply air temperature reset setpoint using a field provided 0-1 OVDC reset input signal and another DIP switch on the digital controller. Controls shall provide Discharge Air Override to prevent excessive temperature swings. Supply air temperature sensor and thermostat are wired to the heat terminals. If the supply air temperature falls below the determined setpoint, heat is energized to prevent cold outside air introduction to the space. Controls shall include a timer to adjust the amount of time the heater will operate before the space thermostat initiates a call for heat. Gas heater shall be provided with vented gas regulator (2psi) pressure regulator fitted with a vent tube that will exhaust to the exterior of the unit in the event of a diaphragm rupture.

S. Roof curbs shall be galvanized steel with two-inch by four-inch nailer strip. All air openings shall be gasketed. Curb shall be provided with Knocked down for easy assembly. Curb shall be manufactured to National Roofing Contractors Associated guidelines. Curbs shall be a minimum of 24-inches in height and fully insulated.

T. Energy Recovery Wheel

1. General
   a. Refer to unit schedules to identify units that require wheels.
   b. Furnish and install the I3 energy recovery wheel, to be manufactured by Innergy Tech Inc. or equal by Thermotech Inc. or approved equal.
   c. The energy recovery wheel shall transfer both sensible and latent energies between outgoing and incoming air streams in a counter flow arrangement.
   d. The energy recovery wheel shall be labeled for rotation direction and airflows (Outdoor air & Exhaust air).
   e. The energy recovery wheel manufacturer must have at least ten (10) years of experience in the manufacturing of energy recovery components.
   f. The energy recovery wheel shall carry a full parts and labor 5 years warranty from the date of shipment. An optional 10 years warranty shall be available as a separate option.

2. Quality Assurance
   a. The wheel shall bear the AHRI 1060 certified label. Wheels tested in independent laboratories, whether according to AHRI Standard 1060 or not, are not acceptable unless actually certified by AHRI. Wheel manufacturer membership in AHRI is not an acceptable substitute for AHRI certified performance.
   b. The energy recovery wheel shall be a UR recognized component and bear the UR label.
   c. The energy recovery wheel shall comply with the requirements of UL723. The media shall have a flame spread of less than 25 and a smoke developed of less than 50 when rated in accordance with ASTM E87.
   d. The energy recovery wheel shall comply with the IBC Certification and OSHPD Seismic Qualifications.
   e. The manufacturer’s quality procedures shall be ISO 9001–2008 certified.

3. Performances (Effectiveness, Pressure drop, EATR & OACF)
   a. Sensible, latent and total effectiveness along with pressure drop, EATR and OACF ratings, shall be clearly documented in the AHRI 1060 Certified Product Directory.
   b. The energy recovery wheel, without purge, shall achieve an EATR rating of 0% (no cross-leakage) at 5” WC pressure differential. The result shall be clearly shown in the AHRI 1060 directory.
   c. To reduce fan operating costs, the energy recovery wheel shall not exceed an OACF of 1.15 for rotors of up to 70” (1778mm) and 1.08 for rotors of up 120” (3048mm) at 5” WC pressure differential when no purge is used. The results shall be clearly shown in the AHRI 1060 directory.

4. Rotor Media & desiccant
a. The rotor media shall be made of 2 mils minimum thickness aluminum. The media shall be coated to prohibit corrosion and shall be suitable for seacoast application. Non-metallic substrates made from paper, plastic, synthetic or glass fiber media are not acceptable.

b. All surfaces shall be coated with a non-migrating desiccant specifically developed for water transfer in vapor phase. Etched or oxidized surfaces are not acceptable.

c. Desiccant must be a polymer hygroscopic or 3 angstroms molecular sieve (3A).

d. Desiccant shall be bactericide and non-corrosive.

e. The rotor shall be constructed of equal width, alternate layers of corrugated and flat aluminum sheet material to create a flat and smooth surface and insure laminar flow thus preventing any dust or particles accumulation inside the rotor.

f. Corrugation pattern shall be of closed triangular shape to prevent any cross-leakage between airstreams. Open type corrugations or embossments, since they increase fan operating costs, are not acceptable.

g. Dry particles up to 800 microns shall freely pass through the media to minimize air pressure drops and pre-filtering requirements.

5. Seals

a. The rotor shall be supplied with labyrinth seals facing the media, polymer contact seal along the depth of the wheel and “S” type labyrinth seal along the wheel's periphery. Wheel using less effective seals like brush seals or standard 4 pass labyrinth seals are not acceptable.

b. The labyrinth seals shall be installed with no gap between the seal and media. Labyrinth seals that require an installation gap or seals that will damage the media if they come in contact with it are not acceptable.

c. All seals shall be designed to withstand pressure differentials of up to 10"WC.

d. The labyrinth seals shall be factory adjusted. Field adjustments shall be possible using common tools.

6. Bearings and center shaft

a. The rotor shall be supported by two pillow block bearings which can be maintained or replaced without removal of the rotor from its casing or the media from its spoke system. Inboard type bearings are not acceptable. Grease fittings shall be easily accessible.

b. Bearings shall be rated for a minimum L10 life of 220,000 hours.

c. The center shaft shall be machined as to provide a shoulder against the bearing and prevent any axial movement of the rotor.

d. The center shaft shall use black oxide and oil coating to prevent rust. Center shafts using oil only are not acceptable.

7. Purge & Cassette Assembly

a. The unit shall be provided with a factory set & field adjustable purge section to prevent any cross-leakage (0% EATR) starting for pressure differentials as low as 0.5"WC.

b. The rotor shall be provided with a structural frame which limits the deflection of the rotor due to air pressure drops to less than 1/32".

c. The framing shall be made of a heavy-duty welded tubular steel assembly.

d. Framing shall be primed with a rust inhibitor phenolic primer and painted with a high durability synthetic industrial paint.

e. The cover panels shall be made of galvanized steel (minimum thickness of 1/16”) to prevent corrosion.

f. When the top-bottom & side plate option is selected, the cassette shall be equipped with removable cover panels for side service access to the motor assembly.

g. For easier parts inspection and maintenance, all major components (motor assembly, driving belt, seals) shall be easily accessible from at least one side of
the wheel within the airstream. The components shall not require the removal of sheet metal for a visual inspection. Wheels with face plates on both sides are not acceptable.

h. The wheel shall be supplied with removable corner bracings (bolted) for easy replacement of media sections from both faces of the wheel if ever required.

8. Rotor assembly
   a. Rotor spoke system shall be of segmented design to allow for field erection or replacement of one section at a time without requiring side access. Wheels up to 62” in diameter shall be made of 4 sections and wheels larger than 62” shall be made of 8 sections.
   b. The rotor spoke system shall be made of strong aluminum material providing the structural integrity required at design pressure differentials.
   c. The rotor hub shall be made of machined, extruded aluminum (no welding), for reduced tolerance and increased stiffness.
   d. All rotor parts shall be made of aluminum or stainless steel. Galvanized steel parts are not acceptable.

9. Drive system
   a. The rotor shall be perimeter driven with a multilink V-belt made of high-tech polyurethane/polyester composite material for easier installation and replacement.
   b. V-belt shall be easily adjustable without the use of tools.
   c. The belt shall be tensioned with a heavy-duty belt tensioner. Gravity tensioned assemblies are not acceptable.
   d. An A/C inverter duty motor shall drive the rotor.
   e. The wheel shall be supplied with a speed reducer resulting in a rotation speed of 20RPM without the use of a VFD. Wheels with rotation speed higher than 20RPM are not acceptable due to increased fan energy consumption.
   f. Speed reducer and belt tensioner shall be permanently lubricated and maintenance free.

10. Controls
    a. The VFD shall be supplied with a NEMA 1 enclosure and located in the electrical compartment. The VFD shall be by ABB, no exceptions.
    b. The VFD standard communication protocol shall be: S-422/485 MEMOBUS/Modbus at 115.2 kbps (BACnetTM optional).
    c. VFD to be supplied with LCD display screen for easy monitoring of VFD parameters, inputs and outputs.
    d. Communication Capabilities: VFD software to enable building automation system (BAS) to monitor temperatures, control discharge set point, wheel rotation speed and display alarms.

T. Factory Installed DDC Controls by Other.

U. The units shall be Trane Climate Changer, AAON RM/RN, McQuay MPS, Addison TRS, or approved equal.
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23 82 00 TERMINAL UNITS

23 82 01 UNIT HEATERS

A. Furnish and install unit heaters of types, arrangements, and capacities as indicated on the drawings.

B. Cabinet type units shall include a 16 gauge furniture steel casing, inclined blade type inlet and discharge grilles, removable panels, 120/1/60 fan motors, quiet operating centrifugal fans, electric heating coils, throwaway filters, vandal proof fasteners, and air vent tappings. The heaters shall be arranged for mounting as indicated. Heater casings shall be finished in baked enamel with colors as selected by the Architect/Engineer. The units shall be Markel, Trane Force Flow, Sterling, Airtherm, McQuay, Engineered Air or equivalent.

C. Propeller type units shall have a heavy gauge enameled steel casing, deep pitch propeller fan direct connected to a resiliently mounted capacitor start squirrel cage induction motor 120/1/60, adjustable discharge louvers, fan guard, non-ferrous hot water heating coil with supply and return connection in rear of unit, arranged for hanging from top side hanger rod connections, and finished in the manufacturer's standard color baked enamel finish. The propeller units shall be Trane Model S, Airtherm Model HU, or Vulcan Model HV, Sterling Model HS.

23 82 02 RADIATOR PANELS

D. Contractor shall furnish steel panel radiator elements of lengths and in locations as indicated, and of capacities, style and having accessories as scheduled. The heating panel radiation shall be of one-piece all-welded steel construction, consisting of flattened water tubes welded to headers at each end. The radiator shall include an integral heavy gauge (0.09” minimum) all-welded perforated top grille. Units shall have steel corrugated fins welded to the rear side of the water tubes to increase the convective output of the unit. There shall be no less than 32 fins per foot. Fins shall start within 1” of the headers, and shall be spot-welded three times per tube.

E. The radiator’s headers shall include all necessary inlet, outlet and vent connections as required. Standard connection sizes are ½” NPT tapered thread for supply and return piping, and 1/8” for the vent connection. Internal baffling is provided where required for proper water flow. Optional ¾” connections shall be available at an additional cost.

F. Appropriate wall mounting brackets or optional floor post mounting shall be provided with the radiation. Panel radiation expansion shall not exceed 1/64” per foot of radiation at 215°F. The installer shall provide adequate expansion compensation for each radiator.

G. Pressure ratings for the radiation shall be a working pressure-85 PSI maximum, Test Pressure-125 PSI maximum.

H. The radiator shall be finish painted with a gloss powder coat finish. The color shall be selected from the manufacturer's custom color line and selected by the architect at the time of equipment submittal review. Color samples shall be provided with the submittal.

I. Contractor shall provide ribbed pipe trim to cover inlet and outlet piping as required.

J. Units shall be manufactured by Runtal North America, Inc.
A. Unit casing shall be welded, galvanized steel. Leak rate shall be not more than 1% of rated capacity at 4" wg. Interior surface of unit casing shall be acoustically and thermally lined with 1/2 inch thick, minimum of 1.5 lb./cu. ft. density glass fiber with high density facing. Insulation shall be UL listed and meets NFPA-90A and UL 181. Factory mounted, removable panel on bottom of unit providing access to air valve and entering airside of coil. Straight flange or slip and drive rectangular discharge duct connection.

B. Proportional, modulating electric coils shall be supplied and installed on the terminal by the terminal manufacturer. Elements shall be 80/20 nickel chrome, supported by ceramic isolators a maximum of 3.5" apart, staggered for maximum thermal transfer and element life, and balanced to ensure equal output per step. The integral control panel shall be housed in a NEMA 1 enclosure with hinged access door for access to all controls and safety devices.

C. Air valve shall be a 90° rotational damper flow control device with factory installed direct digital controls (DDC). All controls shall be furnished under Division 25 and mounted and wired in the factory by unit manufacturer. Manufacturer shall provide multiple point averaging flow sensing ring with high and low pressure pneumatic tubes compatible with DDC velocity pressure sensor. A calibration chart shall be provided on each unit.

D. At the Contractor’s option Division 25 may field mount controls at no additional cost to the Owner.

E. Electric coils shall contain a primary automatic reset thermal cutout, a secondary manual reset thermal cutout, proportional electronic airflow sensor for proof of flow, and line terminal lock. The proportional electronic airflow sensor shall be totally independent of the duct static pressure and shall adjust the heater capacity according to the available airflow. The heaters shall deliver maximum heating when needed with normal minimum airflow, reduce heating with lower than minimum airflow and stop heating with no airflow. Unit shall include an integral door interlock type disconnect switch which will not allow the access door to be opened while power is on. Noninterlocking type disconnects are not acceptable. All individual components shall be UL listed or recognized.

F. Heaters shall be equipped with a proportional SCR controller to modulate the heater load according to the temperature control signal. The electronic controller shall be compatible with the following input signals:
   1. Variable voltage signal 0-10 VDC
   2. Pulse width modulation AC or DC

G. Units shall have primary over temperature protection, secondary over temperature protection, and overcurrent protection all mounted in an enclosed control cabinet mounted on the units.

H. Units shall be as manufactured by Titus, Anemosstat, Carnes, Enviro-Tech, Krueger Metal Aire, Nailor, Price, Tuttle and Bailey.

23 82 04 TERMINAL UNIT COIL HOOK UP

A. Contractor to provide valves and specialties specified herein and in section 20 10 13 Valves (not valves from a HVAC hose kit manufacturer). Two service valves and a manual balance valve are required regardless of memory function of balance valves.

B. One of the following piping and specialty configurations is acceptable (piping components installed in the order listed):
1. Supply service valve, balance valve, tee with integral drain, hard pipe or hose to coil, hard pipe or hose from the coil, tee with integral vent, control valve, service valve.

2. Supply service valve with integral drain (on coil side), balance valve, hard pipe or hose to coil, hard pipe or hose from the coil, control valve, service valve with integral vent (on coil side).

C. When hoses are used at the contractor’s option, they shall meet the following:

1. Internal diameter of the hose shall be not less than 90% of the ID of copper pipe, for the pipe size on the drawings feeding the unit. Hose inner liner shall be EDPM rubber and shall be covered with stainless steel braid. Pressure rating shall not be less than 200 psig.

2. Hoses shall have one fixed end male NPT connection and one swivel end. The swivel shall be a gasket-less JIC 37°F flared female connection, with companion flare x NPT fitting. Connections shall be stainless steel or brass. Hose kits shall be 24” long. Hoses using gaskets or o-rings are not acceptable. Hoses shall be Twin City Hose, ACE Hose, Hosecraft USA, Chamflex, or approved equivalent meeting the above specifications.

D. Specialty Valves incorporating auxiliary ports for p/t, drain, vent, etc. may be utilized provided the arrangement meets the flow diagram and the products do not contain unions, gaskets, or o-rings. Valves shall be dezincification resistant brass and shall be rated for 200psig minimum at 200°F.

1. Service valve with integral drain /vent – Webstone Ball Drain, Cimberio Valve model 630B less strainer basket, or approved equivalent.

2. Service valve with NPT tapping, plus separate drain cocks – Apollo 7B-100, Cimberio 200MC, or approved equivalent.

3. Tee with integral drain /vent – Webstone T-drain, or approved equivalent.

END OF SECTION

23 00 00
24 00 00 AIR DISTRIBUTION

24 00 01 GENERAL

1. This Section specifies air distribution systems.
2. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Divisions 20 - 29 of the Specifications.
3. Provisions and conditions cited in this Section shall apply to Work for other sections of Divisions 20 - 29 of these Specifications.

24 00 02 REFERENCES, REGULATORY REQUIREMENTS:

A. Work for this section of the specifications shall be performed in accordance with the Codes, Standards, etc. as identified in Division 20 in addition to the following:

4. ASTM A525-91b, “Spec for General Requirements for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process”.
5. ASTM A527/A527M-90, “Spec for Steel Sheet, Zinc-Coated (Galvanized) by Hot-Dip Process, Lock Forming Quality”.
9. UL 555, “Fire Dampers and Ceiling Dampers.”
10. UL 181, “Factory Made Air Ducts and Connectors.”

24 00 03 REFERENCES, RELATED SECTIONS OF THE SPECIFICATIONS

Requirements of the following Sections of the Specifications apply to Work for this Section:

A. Division 20 - Basic Mechanical Conditions and Basic Mechanical Materials & Methods
B. Division 23 – HVAC Piping and Equipment
C. Division 25 - Temperature Control

24 00 04 DEFINITIONS

A. The size of the ducts shown on the drawings and in this Section of the Specifications shall be the outside dimension of the ductwork which will take into account any internal acoustical lining thickness specified for duct system or sub-system.
B. The term “supply air” where used in this Section of the Specifications shall mean downstream of a coil.
C. The term “outdoor air” where used in this Section of the Specifications shall mean ambient air that has not been conditioned.
D. The term “return air” where used in this Section of the Specifications shall mean conditioned air that is returned from the space.

E. The term “mixed air” where used in this Section of the Specifications shall mean air streams that are a mixture of “outdoor air” and “return air”.

F. The term “relief air” where used in this Section of the Specifications shall mean excess return air that relieved from the building.

G. The term “exhaust air” where used in this Section of the Specifications shall mean air that is removed due to contaminates, odors, or heat.

24 00 05 WORK INCLUDED

Furnish material, labor and services necessary for and incidental to the installation of the following systems where shown on the Plans and as hereinafter specified. Include all necessary considerations in the related sections of the Specifications (Sub-section 20 30 03) to perform the Work completely.

A. Sheet metal ducts, sheet metal plenums, duct linings, flexible ductwork, dampers and accessories.

B. Air devices including adjusting the pattern controllers.

C. Louvers, louvered penthouses, intake/relief hoods.

D. Installing accessories specified in referenced sections above.

E. Smoke stopping of all penetrations of ductwork, and firestopping of the same through fire rated partitions as shown on the Architectural drawings including, but not limited to stairways, shafts, corridors, floors, roofs, and required exits (Refer to Section 20 10 20).

F. Contractor shall coordinate his work with the work of other trades, and with the architectural and structural drawings.

24 00 06 SUBMITTALS

A. The Contractor shall submit the following for approval in accordance with Subsection 20 00 43, Duties of Contractor - Submittals.

B. Contractor shall submit coordination drawings to the Engineer for review prior to any fabrication or installation (Refer to Section 20 10 50).

C. Submittals shall include drawings showing joining methods, location of duct transverse joints, and duct support locations.

D. Submittals shall be required for all shop fabricated balancing dampers.

E. At the completion of the project, submit a letter stating all materials are asbestos free, and meet the specified ASTM E-84 flame/smoke rating of 25/50, and that all piping and duct penetrations are smoke or fire stopped as required by the Code.

24 00 07 SPECIAL REQUIREMENTS

A. Contractor shall inspect each component of the heating and air conditioning system to eliminate rattles, air whistles, vibration, and mechanical system sound transmission. Rough
edges in ducts, insecure dampers, turning vanes, fire dampers, etc., shall be corrected to assure no recurrence of the noise source. Each vibration isolator and flexible connector shall be adjusted to limit transmission of sound to the occupied space.

B. Where Ductwork and accessories installed under this section of the specification tie-in to existing systems, Contractor shall verify existing for: sizes, direction of flow (via pressure or physical tracing of ductwork, not labels), materials, and elevations before installing new work. Contractor shall notify Architect/Engineer upon discovery of discrepancy. Work performed prior to verification will be corrected at no cost to Owner.

24 00 08 AIR DISTRIBUTION CLEANLINESS

A. Contractor shall implement procedures to maintain an "Advanced Level" of ductwork cleanliness per the latest addition of the SMACNA Duct Cleanliness for New Construction Guidelines.

1. Production and Site Delivery:
   a. Self-adhesive labels for part of identification are to be applied to the external surfaces only.
   b. During transportation, ductwork and air distribution components shall be sealed either by blanketing or capping the duct ends, bagging small fittings, surface wrapping or shrink wrapping.

2. Site Storage:
   a. Temporary storage shall be located away from high dust generating processes such as masonry, tile cutters, saws, drywall sanding, mortar and plaster mixers, roof pitch kettles, portable electric generators, and main walkways that will be constantly broom swept.
   b. Temporary storage shall include pallets or blocking to keep ductwork and air distribution components above floor surface to prevent water damage.
   c. Coverage should be used to protect stored materials at all times.
   d. Duct open ends and air side of air distribution components shall be securely sealed at all times.
   e. Seals shall be visually examined and if damaged, resealed with an appropriate material.

3. Installation:
   a. Before installation of individual duct sections and air distribution components, they are to be inspected to ensure that they are free from debris and shall be wiped clean if debris exists.
   b. The working area shall be clean, dry, and the airside of ductwork and air distribution components protected from dust and moisture.
   c. Protective coverings shall only be removed immediately before installation and inspected to determine if additional wipe down is necessary.
   d. Open ends on completed ductwork shall be sealed immediately if left for an extended period of time (work breaks, overnight, etc.).
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24 31 00 SHEETMETAL DUCTWORK

24 31 01 MATERIAL

A. All ducts unless specified otherwise shall be constructed from sheets or rolls of G-90 or better-galvanized steel, LFQ, Chemtreat. Fiberglass ductboard is prohibited.

B. Exhaust ducts for showers and all exterior ducts, etc., shall be constructed from 3003-H14 Series aluminum. Shower exhaust where tied to general exhaust shall be aluminum from the air device to the point indicated on the drawings.

C. All supply ductwork, unless specified otherwise, shall be constructed of gauges and reinforcement to 4” w.g. static pressure in SMACNA Duct Construction Standard – Latest Edition.

D. All return, exhaust, outdoor air, relief, and supply ductwork downstream of terminal units shall be constructed of gauges and reinforcement to 2” w.g. static pressure in SMACNA Duct Construction Standard – Latest Edition. Panels in all ducts 12” and larger shall be cross-broken or beaded on 12” centers.

E. Where local code requires gauges heavier than required by SMACNA then the local code shall govern.

F. Round ductwork where scheduled, or indicated on the plans shall be K-27 double wall internally insulated for sound control and/or thermal performance. All diameters and dimensions shown on the plans are the outside (pressure shell) dimension of the duct. Fitting shall also be double wall, tack welded, and sealed. Duct and fittings shall be labeled on the inside to reduce preparation for painting. Duct manufactured by McGill Airflow, Eastern Sheet Metal, United Sheet Metal, or equivalent.

   Pressure shell: Spiral lockseam, Paintable Galvanized Steel

   Insulation: 1” thick, 1 pound per cubic foot density, duct liner.

   Inner Liner: Spiral lockseam, Solid Galvanized Steel

24 31 02 CONSTRUCTION

A. All ductwork shall be neatly constructed, stiffened, on the outside surfaces where necessary to prevent perceptible vibration or buckling. All ducts, housings, etc., shall be fabricated as detailed on the drawings and in the SMACNA Duct Construction Manual – Latest Edition.

B. All rectangular ducts unless specified otherwise shall be “Pittsburgh Lock” longitudinal joints. Snaplock is not acceptable.

C. All round ducts and flat oval ducts shall have spiral seams or continuously welded longitudinal seams.

D. All transverse joints in rectangular ductwork 24” and larger shall be Ductmate, SMACNA T-25, or approved equivalent. All flanged ductwork, regardless of pressure class, shall use gaskets, corner closures, and be TEK screwed or riveted on 10” centers with a minimum of two (2) per side. Transverse joints in rectangular ductwork smaller than 24” shall be made in accordance with SMACNA suitable with the pressure class.
E. All transverse joints in round and oval ductwork 24" and larger shall be Ductmate, or approved equivalent. Transverse joints in round and overall ductwork smaller than 24" shall be beaded sleeve joints.

F. Ducts shall be securely supported in accordance with SMACNA Duct Construction Manual – Latest Edition and in no case less than double thickness 1" x #24 gauge galvanized metal. Cable hangers are not allowed.

G. Ducts that are to be externally insulated shall not be supported on unistrut channel unless it required based upon loading. Hanger rods for trapeze bars shall be spaced to allow for insulation installation.

24 31 03 SEALING

A. Duct sealant shall be flexible, water-based, adhesive sealant designed for use in 4” static pressure systems. Sealer shall be UL listed and conform to ASTM E84. Sealer shall be equal to Ductmate PROseal, United McGill Uni-Mastic, Duro-Dyne DSW, or equivalent.

B. All supply ductwork unless specified otherwise shall be SMACNA’s seal class A.

C. All return, exhaust, outdoor air, relief and supply ductwork downstream of terminal units shall be SMACNA’s seal class B.

24 31 04 DUCTWORK LEAKAGE TESTING

A. Installed ductwork on systems greater than 5HP shall be tested prior to installation of access door, take-offs, or other specialties.

B. A testing shall be scheduled for witness per the general conditions.

C. The supply trunk duct for each system shall be tested in whole or up to 100’ in length whichever is lesser.

D. The return trunk duct for each system shall be tested from 50’ upstream of the fan inlet to the unit plenum box.

E. Exhaust ductwork for each fan shall be tested from 50’ upstream of the fan inlet to the point of discharge.

F. Outdoor air and relief air ducts for each fan system shall be tested in whole.

G. Ductwork shall be tested as follows:
   1. Ductwork shall be tested in accordance with SMACNA 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 design airflow for the portion of the duct to be tested.
   5. Determine the allowable leakage (cfm) for the 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.
H. The following Leak Class and Duct Pressure Class shall be used to determine the Leakage Factor in cfm/100 S.F. Duct. Ducts shall be tested at the design pressure class. Max. leakage = Leak Class x (design pressure) ^ 0.65

1. **Rectangular Duct Pressure Class**  \[ \text{Leak Class} \]
   All  \[ \text{6} \]
   (i.e. 4” duct systems shall be tested at 4” and the leakage shall not exceed 14.8 cfm/100 S.F. duct and 2” duct systems shall be tested at 2” and the leakage shall not exceed 9.4 cfm/100 S.F. duct).

2. **Round Duct Pressure Class**  \[ \text{Leak Class} \]
   All  \[ \text{3} \]
   (i.e. 4” duct systems shall be tested at 4” and the leakage shall not exceed 7.4 cfm/100 S.F. duct and 2” duct systems shall be tested at 2” and the leakage shall not exceed 4.7 cfm/100 S.F. duct).

### 24 31 05 SURFACE PREPARATION FOR PAINTED DUCTWORK

A. Contractor shall inspect all exposed ductwork for damage, dents, and out of roundness. Replace all imperfect ductwork.

B. Ductwork shall be sealed, tested (where applicable) and cleaned thoroughly prior to painting.

C. Galvanized ductwork that is to be painted shall be installed with paintgrip galvanized finish.

### 24 31 06 FITTINGS

A. Rectangular duct branch take-offs, or rectangular to round, shall be 45°-boot fittings, spin in fittings are not acceptable.

B. Rectangular duct proportional splits shall be made the sizes as shown on the drawings. Where duct sizes are changed from the original design, Contractor shall proportion split equal to the split in airflow.

C. Rectangular duct changes in direction:
   1. 90 degree elbows, refer to plans, shall be mitered with turning vanes; or radiused with centerline radius to width ratio of 0.75 (inside radius/width ratio 0.25 with curve ratio 0.585) with 2 splitter vanes.
   2. 45 degree and less elbows shall be mitered without vanes.
   3. Elbows other than above shall be radiused with centerline radius to width ratio of 1 without splitter vanes.

D. Round or Oval elbows and changes in direction shall have a minimum centerline radius of 1-1/2 that of duct size. Round or oval branch take-off shall be 45 degree booted style similar to McGill Airflow Lo-Loss Tee.

E. When approved by the Engineer ducts may be notched at structural steel. The converging angle shall be no greater than 30°, the diverging angle shall be no greater than 15°.

F. When approved by the Engineer objects may penetrate a duct. An airfoil shape shall be placed around the object to minimize turbulence.
24.31.07 PLENUMS

A. Sheetmetal plenums shall be constructed of a minimum of 18 ga. or greater as determined by the pressure class of the plenum. Sheetmetal and shall be braced and reinforced to support the weight of a 200-lb. person. Tie rods shall not be used.

B. Plenums shall be constructed without air turning vanes.

C. Plenums shall have access doors as sized on drawings, where no size is shown provide a minimum size of 18" x 36".

24.31.08 AIR THERMOMETERS

A. Air thermometers shall be provided and in the supply air, coil discharge of all air handling unit coils, return air, mixed air, and outside air of the air handling units.

B. Airstream thermometers shall be bimetal type, with an accuracy of ±1°F throughout the range with 5" dial size, 12" stem length, ½" N.P.T. back side connector with plain slip ring case of 304 stainless steel, and recalibrator. Thermometer shall be Trerice Model No. B85212 or approved equal as manufactured by Weksler, Marsh, or Marshalltown Instruments. Thermometers for use in the mixed air shall have flexible averaging elements strung with the mixed air temperature sensor and freezestat sensor elements. Mixed air thermometers shall be Trerice No. V80445 with bulb number 4-3-1.

C. Range shall be as follows:

<table>
<thead>
<tr>
<th>Air Type</th>
<th>Range</th>
</tr>
</thead>
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<tr>
<td>Outdoor air</td>
<td>-40-160°F</td>
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<tr>
<td>Mixed air</td>
<td>0-100°F</td>
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<tr>
<td>Supply air</td>
<td>25-125°F</td>
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<td>Return air</td>
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<tr>
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<td>Reheat coil discharge</td>
<td>25-125°F</td>
</tr>
<tr>
<td>Chilled water coil discharge</td>
<td>25-125°F</td>
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24.31.09 DUCT AND FLUE ROOF CURBS

A. All roof mounted duct and flues that penetrate the roof require a duct roof curb.

B. Standard Roof duct curbs shall be a fully insulated and constructed of galvanized steel. Curbs are to be sloped with the pitch of the roof. Mechanical contractor is to coordinate roof slope with each curb location. Insulated duct curbs shall be by Thycurb, Curbs Plus, Roof Products, Inc. or approved equal.

24.31.10 ROOF STACK GUY WIRES AND ROOF SUPPORTS

A. All stacks extending above the roof shall be secured with a minimum of 3 guy wires.

B. Guy wire supports shall be anchored to the roof structure and shall be manufactured by Thaler, Model ARS-302 or approved equal. Coordinate fastening method with structural steel. Install guy wire roof supports per the manufacturer's instructions.

24.31.11 ROOF MOUNTED DUCTWORK – ROOF SUPPORTS

A. Provide premanufactured duct support system anchored to roof deck for all roof mounted ductwork.
B. All pedestals shall include cant and be anchored to the deck. Coordinate cant size with roofing contractor.

C. Ductwork supports shall be spaced using the guidelines in division 20 10 42.

D. Refer to detail on drawings for more information.
24 33 00 AIR DISTRIBUTION ACCESSORIES

24 33 01 BALANCING DAMPER

A. Furnish and install volume dampers at each main branch take-off and in such other locations where required to properly balance the air distribution systems.

B. All dampers, except those located downstream from terminal units used to adjust individual grilles, shall have frames and bearings and shall have quadrant lock regulators with thread screw to allow damper to be securely locked into place.

C. Balancing dampers downstream from terminal units that are contractor fabricated or apart of manufactured branch fitting shall be a minimum of 18-ga. plate, 3/8" continuous shaft with locking quadrant handle equal to Duro Dyne model Quadline.

D. Rectangular dampers up to size 24" x 12" shall be Ruskin MD25, Nailor 1870, Arrow, Air Balance, NCA, or shop fabricated equal, approved by the Engineer.

E. Round dampers up to size 20" diameter shall be Ruskin MDRS25, Nailor 1890, Arrow, Air Balance, NCA or shop fabricated equal, approved by the Engineer.

F. Rectangular dampers larger than 24" x 12" shall be Ruskin MD35, Nailor 1820 or equivalent manufactured damper by NCA.

G. Where volume dampers are to be adjusted through walls or ceilings, such dampers shall be operated by regulators designed for recessed installation and provided with a cover plate which shall be flush to the surface of the wall or ceiling. Concealed regulators, as manufactured by Duro Dyne Corporation or Elgen shall be of the indicator type. Regulator shall be provided with a spring washer for non-binding adjustment and hex lock nut in addition to wedge pin which shall be installed to prevent damper rattle. Cast alloy regulator housing, with “open to shut” range positioning markers, shall be secured with removable cover to expose regulator for adjustments.

H. All automatic dampers and control dampers shall be as specified in Division 25, “Temperature Control”. Dampers shall be furnished under Division 25 for installation under Division 23 30 00.

I. Control Damper Installation
   a. Dampers installed in walls shall be installed with wall sleeves to allow direct coupled actuator installation.
   b. Large damper installations with multiple actuators shall be installed with 8" sheetmetal blank-off/spacers between them to allow direct coupled actuator installation. Provide structural supports as required for a straight, true, level and square installation.
   c. Dampers shall be attached with fasteners on 6” centers with a minimum of 2 per side.

24 33 02 FIRE DAMPERS

A. Fire dampers shall be provided as indicated on the plans. Dampers shall be U.L. 555 listed under N.F.P.A. Pamphlet #90-A. Dampers for rectangular ductwork shall be Style B, round or oval ductwork shall be Style C. In both cases the curtain shall be located outside of the airstream. Factory wall sleeves are not permitted. Closure springs shall be furnished for both horizontal and vertical installations.
B. Dampers rated for installation in up to 2-hour fire resistive construction shall be Ruskin Type IBD2, Nailor model 0120/0130, Air Balance model 119, Greenheck model FD-150, or approved equivalent. Fire dampers rated for installation in greater than 2-hour fire resistant construction shall be Ruskin Type IBD23, Nailor model 520/530, Air Balance model 319, Greenheck model FD-350, or approved equivalent.

C. Diffusers and returns in two (2) hour rated floor/ceiling assemblies shall be equipped with ceiling fire/radiation dampers suitable for this application. Ceiling radiation dampers shall be Ruskin type CFD-2 for damper areas up to 324 square inches and in CFD-4 for areas between 324 square inch minimum and 576 square inch maximum. Dampers shall have 2” x ½” x 16 gauge galvanized steel frame. Damper must be classified and approved under UL Fire Resistance Directory, 1985 Edition. Similar products by National Controlled Air, and Prefco Products, Inc., will be considered for approval. Where volume dampers are indicated on the air device schedule along with ceiling radiation dampers, provide a fusible volume adjustment on the radiation damper blades equal to Ruskin CFD-2A, CFD-4A or Nailor as identified above.

D. Dampers are to be witness tested by the Owner. The Contractor shall remove the fusible link and demonstrate that the damper closes freely. After acceptance by the Owner, the Contractor shall reset the damper and replace the fusible link.

24 33 03 AIR TURNING VANES

A. Furnish and install directional air turning vanes in ductwork at all 90 degree mitered elbows and 90 degree radiused elbows.

B. Mitered 90 degree elbows vanes shall be:
   1. Single rolled type with a radius of 2” with 1.5” spacing.
   2. Single rolled type with a radius of 4-1/2” with 3.25” spacing.
   3. Double thickness type with a radius of 4-1/2” with 3.25” spacing. Double thickness 2” radius is not allowed.
   4. Tie rods shall be used to limit the maximum unsupported width per the type of vane used per SMACNA.
   5. Vanes shall be solidly installed and rattle-free locked into each slot of preformed vane guide rails as manufactured by Duro Dyne Corporation or Elgen. Rails shall be constructed of 24 gauge galvanized steel, specially embossed for extra strength and sturdiness.

C. Radiused 90 degree elbows shall have 2 vanes. Vanes shall be single thickness, Splitter Vanes for radius elbows shall be fabricated based on the “SMACNA HVAC Systems Duct Design Manual” using the appropriate curve ratio.

24 33 04 FLEXIBLE CONNECTORS

A. Furnish and install flexible connections at the connections to air handling equipment as indicated on the plans. Flexible connections shall be U.L. listed fabric that meets NFPA 90A. It shall weigh not less than 24 oz per sq. yd and have a tensile strength of not less than 500 psi. Flexible connections shall be preassembled “Super Metal-Fab” with 6” fabric attached to 3” metal on either side by means of “Grip-Loc” seam. At least one inch of slack shall be allowed when making connection to insure that no vibration is transmitted from fan to ductwork. The flexible connectors shall be fastened to ductwork and equipment by screws, rivets or spot welding. Flexible connectors shall be No. MF6N as manufactured by Duro Dyne Corporation, or equivalent by Vent-Fabrics or Elgen.
24 33 05  ACCESS DOORS AND PANELS

A. Access panels shall be provided at all duct mounted automatic control dampers, fire dampers, multizone dampers, and as shown on drawings.

1. 2” Pressure Class: Door shall be SMACNA Standard, 12” x 12”, double skin, 1” fiberglass insulation, with underside duct to frame gasket for reduced leakage.

   Solid without window Ruskin ADH22, Nailor 08SH, Greenheck HAD-10, Ductmate FDH, or equivalent.

2. 4” and Higher Pressure Class: Oval shape, ultra low leakage at 8” w.c.

   Solid without window Nailor 0800, Greenheck RAD, Ductmate Sandwich, or equivalent.

B. Access doors in casings and housings shall be fabricated double skin doors with 1” thick insulation between inner and outer surface as detailed in the SMACNA Duct Manual. Provide two compression latches equal to Ventlok #260 on each door. Where access doors provide for personnel entry into the system, they must be provided with inside/outside latch hardware. Provide access doors at all locations indicated on the drawings and into the mixing chamber of all air handling units. Size shall be 18 x 36, unless indicated otherwise on the drawings. Ruskin GPAD or equivalent.

C. For access panels required in ceiling, walls, etc. of the building construction, see Section 20 10 10.

24 33 06  FLEXIBLE DUCTWORK

A. Flexible duct shall be factory fabricated units constructed of corrosion resistant coated steel spiral, permanently bonded to fabric covering. The units shall have an inside bending radius of 3/4 of the inside dimension of the pipe, and the entire installed unit, using manufacturer’s apparatus and installation methods, shall be flexible duct assemblies shall be rated for working pressures of 6” w.g. positive and 1” w.g. negative. Flexible duct assemblies shall be U.L. 181, Class I air duct listed and shall meet fire resistive standards of NFPA 90A. Flexible ducts shall be factory insulated with 1” thick glass fiber insulation with flame resistant, metallic vapor barrier finish.

B. Flexible duct length shall not exceed 8’ for diffusers and 3’ at VAV box inlets.

C. Support flexible duct on 4’ centers maximum.

D. Flexible duct shall be attached with zinc plated or stainless steel worm drive duct hose clamps.

E. Flexible duct connections at diffusers shall utilize FlexRight or an equivalent product for support.

F. Flexible duct shall be Flexmaster Type 8M, Thermaflex M-KE, or equivalent.
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**24 33 50 INTERNAL ACOUSTICAL DUCT LINING**

**24 33 51 MATERIALS**

A. Duct liner shall be tested in accordance with test method ASTM C423, Type ‘A’ mounting and have absorption coefficient performance equal to or greater than the table below:

<table>
<thead>
<tr>
<th>Thickness</th>
<th>125 HZ</th>
<th>250 HZ</th>
<th>500 HZ</th>
<th>1000 HZ</th>
<th>2000 HZ</th>
<th>4000 HZ</th>
</tr>
</thead>
<tbody>
<tr>
<td>½</td>
<td>.03</td>
<td>.10</td>
<td>.25</td>
<td>.40</td>
<td>.53</td>
<td>.69</td>
</tr>
<tr>
<td>1</td>
<td>.07</td>
<td>.25</td>
<td>.54</td>
<td>.73</td>
<td>.83</td>
<td>.95</td>
</tr>
<tr>
<td>1-1/2</td>
<td>.17</td>
<td>.39</td>
<td>.72</td>
<td>.88</td>
<td>.95</td>
<td>.95</td>
</tr>
<tr>
<td>2</td>
<td>.24</td>
<td>.53</td>
<td>.83</td>
<td>.95</td>
<td>.95</td>
<td>.95</td>
</tr>
</tbody>
</table>

B. Acceptable products are: Armaflex AP Coilflex, no exceptions.

**24 33 52 INSTALLATION**

C. Internal duct areas shall be completely covered with duct liner. Each ductwork section shall be covered with a single sheet per side of ductwork, scraps or pieces shall not be used. Longitudinal joints in corners shall be overlapping butt joints. Transverse joints shall be coated with adhesive at the shop prior to shipping the ductwork to the job site and at the time of installation the joints shall be recoated to adhere to one another. Metal nosing and longitudinal joint sealant shall be applied to the first four (4) sections of ductwork at the fan discharge.

D. Acoustical lining shall be a single layer of the thickness scheduled with 90% adhesive coverage applied to the ductwork and the liner applied mat face up.

E. Mechanically welded pins with push on metal heads shall be used on ducts larger than 12” x 12”. Pins shall be copper or shall be as corrosion resistant as the G-90 coated galvanized steel. Spacing around the perimeter shall be 4” from longitudinal liner edges and at intervals not exceeding 12”. Transversely the spacing shall be 3” from transverse joints and at intervals not exceeding 18”.

F. At all locations of branch fittings, the edges of the main duct liner and the start of branch duct liner shall be sealed with duct liner adhesive.

G. All rips, tears, or other damaged liners shall be repaired by coating the damaged area with liner adhesive. Sections that are not repairable shall be scraped and refabricated.

H. Ductwork with internal lining shall be protected during shipping and at the job site to prevent the liner from getting wet. Ductwork shall not be stood on end or lay directly on the floor of buildings which are not weathertight. In the event that the liner becomes wet it shall be dried in accordance with the manufacturer’s instructions.

**24 33 53 SCHEDULE**

A. Internal insulation shall be applied with the thickness as scheduled below:
<table>
<thead>
<tr>
<th>System</th>
<th>Service</th>
<th>Config.</th>
<th>Liner</th>
<th>Insulation</th>
<th>Location</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>MAU-1</td>
<td>Exhaust</td>
<td>Rect.</td>
<td>None</td>
<td>None</td>
<td>From Room to Energy Recovery Wheel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Exhaust</td>
<td>Rnd.</td>
<td>None</td>
<td>None</td>
<td>From Room to Energy Recovery Wheel</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply Duct</td>
<td>Rect.</td>
<td>None</td>
<td>1&quot; GF3</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>AHU-1</td>
<td>Supply Duct</td>
<td>Rect.</td>
<td>None</td>
<td>1&quot; GF3</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply Duct</td>
<td>Round</td>
<td>None</td>
<td>1&quot; GF3</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Return Duct</td>
<td>Rect.</td>
<td>None</td>
<td>None</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transfer Ducts</td>
<td>Rect.</td>
<td>1&quot;</td>
<td>None</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>AHU-2</td>
<td>Supply Duct</td>
<td>Rect.</td>
<td>None</td>
<td>1&quot; GF3</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Supply Duct</td>
<td>Round</td>
<td>None</td>
<td>1&quot; GF3</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Return Duct</td>
<td>Rect.</td>
<td>None</td>
<td>None</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transfer Ducts</td>
<td>Rect.</td>
<td>1&quot;</td>
<td>None</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>RLF-1</td>
<td>Inlet Duct</td>
<td>Rect.</td>
<td>None</td>
<td>None</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>RLF-2</td>
<td>Inlet Duct</td>
<td>Rect.</td>
<td>None</td>
<td>None</td>
<td>All</td>
<td></td>
</tr>
<tr>
<td>EF-1</td>
<td>Inlet Duct</td>
<td>Rect.</td>
<td>None</td>
<td>1&quot; GF3</td>
<td>10' within building exterior</td>
<td></td>
</tr>
<tr>
<td>EF-2</td>
<td>Inlet Duct</td>
<td>Rect.</td>
<td>None</td>
<td>None</td>
<td>All</td>
<td></td>
</tr>
</tbody>
</table>
24 34 00 FANS

.1 General

.11 All fans shall be licensed to bear the AMCA Performance Air and Sound Certified Ratings Seal. Fan air performance ratings shall be based on test conducted in an AMCA registered laboratory in accordance with AMCA 210 Air Performance Testing and AMCA 300 Sound Performance Testing. Fan curve families (tables will not be accepted) and octave band sound data shall be furnished with submittal data.

.12 All fans shall have premium efficiency open dripproof motor unless indicated otherwise. Fans with variable speed drives shall have inverter duty motors. All fans with V-belt drives shall be equipped with adjustable pitch sheave rated for 1.5 times the motor horsepower, shall have sliderail base, and shall have a belt-guard.

.13 All fan shafts shall be designed so that the first critical speed is at least 20% over the maximum operating speed. Bearings shall be self-aligning, grease lubricated, anti-friction, pillow block bearings with a minimum life (L50) of 200,000 hours.

.14 Where fans are other than scheduled the following criteria shall apply: Fans shall be picked at the scheduled flow and static pressure, fan efficiency shall not be more than 5% less efficiency than scheduled fan, fan motor shall not be larger than scheduled motor (manufacturer shall notify Contractor of any larger motor sizes, Contractor can pursue equipment substitution as required in subsection 20 00 52), the fan rpm shall not be within 15% of the maximum or minimum allowable rpm, and in general the fan selections shall be based upon maximum energy efficiency but in no case shall the fan wheel be smaller than what is scheduled. Where selection point is within 15% of the maximum allowable rpm of the fan class, provide a higher fan class.

24 34 01 CENTRIFUGAL FANS

.1 Centrifugal fans shall be provided where shown and shall have capacities and minimum wheel diameters, wheel type, and class as indicated on the schedule. Each fan shall be of the non-overloading centrifugal type with deep drawn inlet rings, streamlined housing continuously welded and scroll, blades continuously welded to the flange, solid backplate, full curved shroud, and flanged discharge collar. Where Class II construction is required, wheels shall be reinforced with a welded intermediate ring. Fans shall be statically and dynamically balanced. Provide drain openings at the bottom of fan scroll. Fans shall be spark resistance Type C. Fans and motors shall be Arrangement 10 mounted on structural steel bases of continuously welded sections to form a rigid chassis. The bases shall be supported on isolation mountings equipped with built-in leveling devices and sound attenuating rubber pads. The isolation medium shall be steel springs with 1-1/2” deflection and shall be Korfund Type “L” with seismic restraints or equivalent by Mason Industries, Vibration Eliminator Company, Acme Engineering, or fan manufacturer.

.2 Air Foil fans shall be Cook CA, Greenheck AF Series 41, ACME 8100, or approved equal.

.3 Back Incline fans shall be Cook CPS, Greenheck USF-BI Series, ACME 3000, or approved equal.

24 34 02 ROOF EXHAUSTERS
.1 Furnish and install where indicated on the drawings centrifugal roof exhaust fans of the sizes and capacities as scheduled. Centrifugal impeller is to be of heavy aluminum construction with backward inclined or curved hollow airfoil blades. Hoods shall be constructed of aluminum with rolled bead for additional strength and shall be easily removable for servicing. Overall height from the curb shall not exceed that of the models scheduled. Motor and drive assembly shall be vibration isolated from the base and housing. All units shall have U.L. wired safety disconnect switch, sound attenuating roof curb and backdraft damper, in addition to any other accessories listed in the schedule.

.2 Contractor shall install a vinyl coated steel cable from the motor cover to the base to allow the motor cover to be removed for service but will not permit the cover to be blown away. Cable shall have eyelet or swagged ends with aluminum or galvanized fasteners.

.3 Units shall be Cook ACE-B, Greenheck GB, Penn-Barry, Domex, ACME PNN or approved equal.
24 37 00 AIR DEVICES

24 37 01 GENERAL

A. Furnish and install diffusers, grilles, and registers as shown on the drawings and specified herein.

B. Air devices shall be installed in the orientation and the pattern controllers adjusted as indicated on the plans, as indicated on the shop drawing, or through supplemental information.

C. Submittal data for all distribution devices shall contain the following information:
   1) Room Number
   2) Model Number
   3) Flow Rate
   4) Size: Neck and where applicable
   5) Throw in feet: Based on 50-fpm velocity
   6) Air patterns: Such as one-way, two-way opposite, corner, four-way, etc.
   7) Pressure drop in inches of water
   8) Sound rating
   9) Airflow factor: Such as K factor or as required for airflow rate measurements.
  10) Accessories: Such as volume dampers, deflectors, etc.
  11) Three-color charts and balance instructions shall be furnished with submittal data.

D. Devices described below and indicated on the drawings are based on Titus. Similar design characteristics as manufactured by Price, Carnes, Metal Aire, Nailor, or Tuttle & Bailey will also be acceptable. Such substitute equipment shall be sized on the basis of ADPI performance, and shall be selected for a maximum of 0.05 inches w.c. static pressure drop and a maximum noise criterion curve of NC30. Return or exhaust devices shall not be smaller than sizes shown.

E. Ceiling diffusers shall be of the type, service, size, and finish as scheduled on the drawings. Border types shall be coordinated by the Contractor to be suitable for ceiling types in which diffusers will be installed.

24 37 02 LOUVERED CEILING DIFFUSERS

A. In dry areas diffusers shall be steel construction, Titus TDCA or equivalent. In wet areas diffusers shall be aluminum construction, Titus TDCA-AA or equivalent.

B. Return or exhaust diffusers shall be similar to the supply air diffusers less the adjustable pattern controllers. In dry areas diffusers shall be steel construction, Titus TDC or equivalent. In wet areas diffusers shall be aluminum construction, Titus TDC-AA or equivalent.

24 37 03 SIDEWALL GRILLES - REMOVABLE CORE

A. Sidewall supply air grilles (SAG) shall be adjustable double deflection type with removable core with a separate mounting frame with a gasketed one-inch wide flange as scheduled. Sidewall grilles shall be similar to Titus Model 1700 with optional 07 directional blades. Sidewall return or exhaust grilles shall be single deflection to match sidewall supply grilles in
appearance. Where registers are required (SAR or RAR), include a key operated opposed blade volume control.

24 37 04 SIDEWALL GRILLES

A. Sidewall return/transfer grilles shall have fixed fins set at 38°/0° angle, separate one inch wide gasketed mounting flange frame. Returns/transfers shall be similar to Titus Model 33RL/30RL.

24 37 05 PLENUM SLOT DIFFUSER

A. Plenum slot diffusers shall be series as scheduled; Titus TBDI for supply with internal insulation plenum and adjustable pattern controllers, and Titus TBR for return with non-insulated plenum. Furnish multi-slot diffusers with white T-bars between slots.

24 37 06 CEILING

A. Perforated diffusers shall be Titus PAS/R-AA or equivalent.
24 41 00 FILTER ASSEMBLIES

A. Furnish and install for supply fan systems, filters and side loading filter housings of the types, quantity, and arrangement scheduled (or otherwise indicated on the plans).

24 41 01 FILTERS

A. 2” and 4” filters shall be dust spot efficiency on ASHRAE Test Standard 52.1 and MERV 8 on ASHRAE Test Standard 52.2. The filter media shall be a self-extinguishing, non-woven cotton and synthetic fabric, UL Class 2. The enclosing frame shall be a rigid, heavy duty, moisture resistant, high wet strength beverage board die cut for dimensional accuracy with diagonal support members. The pleated media pack shall be bonded to the inside of the frame on all four edges to prevent leakage. The media support shall be a welded wire grid bonded to the filter media to reduce media oscillation. The media support shall be contoured shape allowing total use of the filter media for longer life.

1. 2” filters shall not have less than 14 pleats per linear foot and not less than 17 square feet of effective media (based on 24” x 24”). Filters shall be as manufactured by Camfil-Farr Filter model 30/30, American Air Filter model 300X, or approved equivalent.

2. 4” filters shall not have less than 21 pleats per linear foot and not less than 27 square feet of effective media (based on 24” x 24”). Filters shall be as manufactured by Camfil-Farr Filter model 30/30, American Air Filter model 300X, or approved equivalent.

B. Second stage filters shall be high-efficiency pleat-in-pleat V-bank disposable type. Filter media shall be microfine glass formed into uniformly spaced pleats separated by fiberglass thread separators and formed into a minipleat pack design. Each minipleat pack shall be assembled into a V-bank configuration. Filter shall be rated as UL Class 2.

1. 12” deep 65% dust spot efficiency on ASHRAE Test Standard 52.1 and MERV 11 on ASHRAE Test Standard 52.2. Filters shall have not less than 200 square feet of effective media based on 24” x 24” size. Filters shall be as manufactured by Camfil-Farr Filter model Durafil ES, American Air Filter model VariCel VXL, or approved equivalent.

2. 12” deep 95% dust spot efficiency on ASHRAE Test Standard 52.1 and MERV 14 on ASHRAE Test Standard 52.2. Filters shall have not less than 200 square feet of effective media based on 24” x 24”. Filters shall be as manufactured by Camfil-Farr model Durafil ES, American Air Filter model VariCel VXL, or approved equivalent.

C. Each filter assembly shall have a gauge arranged to measure pressure across each filter type in housings containing more than one filter. Provide all necessary pressure taps, tubing, fittings, valves, and mounting hardware. Gauges shall be Dwyer Model 2001 or equivalent (0-1” range for single stage 30% filters) (0-2” range for 65% or greater filters or multiple stages).

Each filter assembly shall have an engraved plastic plate indicating what the final change-out pressure is for each type of filter.
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SECTION 25 00 00 - CONTROL SYSTEMS

1.01 SUMMARY

A. University of Missouri Controls Specification.

B. This section contains requirements for pneumatic, electric and digital control systems as indicated on the contract drawings.

C. Contractor is responsible for providing, installing and connecting all sensors, pneumatic actuators, control valves, control dampers, electrical components and all interconnecting pneumatic tubing and electrical wiring between these devices and up to the Direct Digital Controller (DDC).

D. DDC systems consist of Johnson Controls METASYS controllers. Contractor shall provide and install control enclosures. Owner will provide controllers for contractors to install. After all equipment has been installed, wired and piped, Owner will provide controller programming. Contractor will be responsible for all termination connections at the DDC controller’s and for checking, testing, and start-up of the control system. Contractor must be on site at start-up to make any necessary hardware adjustments as required.

E. Once each mechanical system is completely operational under the new control system, contractor shall make any final connections and adjustments. For controls renovation jobs, contractor shall remove all unused sensors, operators, panels, wiring, tubing, conduit, etc. Owner shall have the option of retaining any removed pneumatic controls.

1.02 RELATED SECTIONS

A. Drawings and general provisions of Contract, including General and Special Conditions apply to work of this section.

1.03 QUALITY ASSURANCE

A. Contractor's Qualifications:
   1. Contractor shall be regularly engaged in the installation of digital control systems and equipment, of types and sizes required. Contractor shall have a minimum of five years' experience installing digital control systems. Contractor shall supply sufficient and competent supervision and personnel throughout the project in accordance with General Condition’s section 3.4.1 and 3.4.4.
B. Codes and Standards:
   1. Electrical Standards: Provide electrical components of control systems which have been UL-listed and labeled, and comply with NEMA standards.
   2. NEMA Compliance: Comply with NEMA standards pertaining to components and devices for control systems.
   3. NFPA Compliance: Comply with NFPA 90A "Standard for the Installation of Air Conditioning and Ventilating Systems" where applicable to controls and control sequences.

1.04 SUBMITTALS

A. Shop Drawings: Submit shop drawings for each control system, containing the following information:

B. Product data for each damper, valve, and control device.

C. Schematic flow diagrams of system showing fans, pumps, coils, dampers, valves, and control devices.

D. Label each control device with setting or adjustable range of control.

E. Indicate all required electrical wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

F. Provide details of faces on control panels, including controls, instruments, and labeling.

G. Include written description of sequence of operation.

H. Provide wiring diagrams of contractor provided interface and I/O panels.

I. Provide field routing of proposed network bus diagram listing all devices on bus.

2.01 MATERIALS AND EQUIPMENT

A. Air Piping:
   1. Copper Tubing: Seamless copper tubing, Type M or L, ASTM B 88; wrought-copper solder-joint fittings, ANSI B16.22; except brass compression-type fittings at connections to equipment.
   2. Flex Tubing: Virgin Polyethylene non-metallic tubing, ASTM D 2737, with flame-retardant harness for multiple tubing. Use compression or push-on polyethylene fittings. Tubing used above suspended ceilings to be plenum rated per NFPA 90A. See section 3.1.b for locations where flex tubing can be used.
   3. Copper to polyethylene connections shall be compression barbed fittings or solder barbed fittings.

B. Conduit and Raceway:
   1. Electrical Metallic Tubing: EMT and fittings shall conform to ANSI C80.3.
   2. Surface Metal Raceway and Fittings: Wiremold 500, Ivory, or approved equal.
   3. Flexible Metal Conduit: Indoors, per National Electric Code for connection to moving or vibrating equipment.
   4. Liquid tight Flexible Conduit: Outdoors, per National Electric Code for connection to moving or vibrating equipment.
C. **Control Valves:** Provide factory fabricated pneumatic or electric control valves of type, body material, and pressure class as indicated on the drawings. Butterfly style control valves are not acceptable except for two position applications. Equip control valves with heavy-duty actuators, with proper shut-off rating for each individual application.

1. **Steam and Hot Water**
   a) Manufacturer: Do not allow KMC valves and actuators.
   b) Water Service Valves: Equal percentage characteristics.
   c) Steam Service Valves: Equal percentage characteristics.
   d) Single Seated Valves: Cage type trim, providing seating and guiding surfaces for plug on "top and bottom" guided plugs.
   e) Valve Trim and Stems: Polished stainless steel.
   f) Packing: Spring-loaded Teflon, self-adjusting.
   g) Control valves should have a minimum 100 psi close-off rating for chilled water applications.

2. **Hydronic Chilled Water and Heating Water**
   a) At minimum, hydronic control valves shall be pressure independent. High performing energy monitoring control valves may be considered depending on the project. The flow through the valve shall not vary more than ±5% due to system pressure fluctuations across the valve in the selected operating range. The control valve shall accurately control the flow from 1 to 100% full rated flow.
   b) The valve bodies shall be of cast iron, steel or bronze and rated for 150 PSI working pressure. All internal parts shall be stainless steel, steel, Teflon, brass, or bronze.
   c) DeltaP Valves manufactured by Flow Control Industries, Belimo, Danfoss Series, or approved equal.
   d) The valves shall have pressure taps across the valve for measuring the pressure drop across the valve. The pressure taps shall have ½-inch extensions for accessibility.
   e) Control valves shall be installed with unions or flanges as necessary for easy removal and replacement.
   f) Valve Tag shall include the model number, AHU being served, design flow, and maximum flow for that valve.
   g) The control valves shall be delivered preset to the scheduled design flow and should be capable of reaching 110% of the design flow to allow for field adjustment for capacity changes.

D. **Control Dampers:** Ruskin CD-50 or approved equal.

1. Provide dampers with parallel blades for 2-position control.
2. Provide opposed blades for modulating control.
3. Dampers shall be low leakage design with blade and edge seals.
4. Provide multiple sections and operators as required by opening size and sequence of operations, as indicated on the contract drawings.

E. **Electric Actuators:** Johnson Controls, Bray, Belimo, TAC or approved equal. KMC actuators are not approved. Size electric actuators to operate their appropriate dampers or valves with sufficient reserve power to provide smooth modulating action or 2-position action as specified. If mixed air AHU has return air, exhaust air and outside air dampers that are not mechanically linked then static safety switch must be installed and wired to safety circuit. Spring return actuators should be provided on heat exchanger control valves or dampers or as specified on the drawings. Control signal shall be 0 to 10 VDC unless otherwise specified on drawings. Actuators with integral damper end switch are acceptable. For VAV reheat valves, actuators shall have a manual override capability to aid in system flushing, startup, and balancing.
F. Air and Hot Water Electronic Temperature Sensors:
   1. All electronic temperature sensors shall be compatible with Johnson METASYS systems.
   2. Sensors shall be 1,000 ohm platinum, resistance temperature detectors (RTDs) with two wire connections. Duct mounted sensors shall be averaging type. Contractor may install probe type when field conditions prohibit averaging type, but must receive permission from Owner’s Representative.
   3. Coordinate thermowell manufacturer with RTD manufacturer. Thermowells that are installed by the contractor, but are to have the RTD installed by owner, must be Johnson Controls Inc. series WZ-1000.

G. Electronic Temperature Sensors and Transmitters:
      a) General: The RTD/Temperature Transmitter/Thermowell assembly shall come as a complete assembly from a single manufacturer. The Assembly shall be suitable for use in the accurate measurement of Chilled/Tower/Hot Water and steam temperatures in a mechanical room environment.
      b) Calibration: Each RTD must be match calibrated to the Transmitter via NIST traceable calibration standards. Results are to be programmed into the transmitter. Results are to be presented on report as after condition at the specified calibration points. Assembly shall not be approved for installation until Owner has received all factory calibration reports.
      c) RTD:
         (1) RTD type: 2-wire or 3-wire 100 ohm platinum class A
         (2) Outside Diameter: 0.25 inch
         (3) Tolerance: +/- 0.06% Type A
         (4) Stability: +/- 0.1 % over one year.
         (5) TCR: 0.00385 (ohm/ohm/°C).
         (6) RTD shall be tip sensitive.
         (7) Resistance vs. Temperature table for the RTD must be provided to the Owner.
      d) Transmitter:
         (1) Transmitter shall be match calibrated to the RTD and assembled as a matched pair.
         (2) Type: 2 wire (loop powered)
         (3) Input: 2 or 3 wire 100 ohm platinum class A or class B RTD
         (4) Output: Output shall be a 4-20 mA signal linear to temperature
         (5) Calibrated Span:
            (a) Chilled Water: 30 °F to 130 °F.
            (b) Tower Water: 30 °F to 130 °F.
            (c) Hot Water: 100 °F to 250 °F.
            (d) Steam: 150 °F to 450 °F
         (6) Calibration Accuracy, including total of all errors, of the Transmitter & RTD matched pair over the entire span shall be within +/- 0.2% of the calibrated span or +/- 0.18 °F, whichever is greater.
         (7) Supply Voltage: 24 VDC.
         (8) Ambient Operating Temp.: 32 to 122 °F
         (9) Epoxy potted for moisture resistance.
         (10) Mounting: Transmitter shall be mounted in the RTD connection head.
      e) Thermowell
         (1) Thermowell shall be suitable for immersion in chilled/hot water and steam.
         (2) Thermowell shall be reduced tip.
         (3) Thermowell shall be one piece stainless steel machined from solid bar stock.
         (4) Thermowell shall have 1/2” NPT process connection to pipe thread-o-let.
(5) Thermowell Insertion depth shall be ½ the inside pipe diameter but not to exceed 10".

f) Assembly:
   (1) Assembly configuration: Spring loaded RTD with thermowell-double ended hex-connection head.
   (2) Connection head shall be cast aluminum with chain connecting cap to body, have 1/2” NPT process and 3/4” NPT conduit connections, and a sealing gasket between cap and body.

g) RTD/Temperature Transmitter/Thermowell assembly shall be the following or approved equal:
   (1) Manufacturer: Pyromation, Inc.
   (2) Chilled Water: RAF185L-S4C[length code]08-SL-8HN31,TT440-385U-S(30-130)F with calibration SMC(40,60)F
   (3) Tower Water: RAF185L-S4C[length code]08-SL-8HN31,TT440-385U-S(5130)F with calibration SMC(55,85)F
   (4) Hot Water: RAF185L-S4C[length code]08T2-SL-8HN31,TT440-385U-S(100-250)F with calibration SMC(140,180)F
   (5) Steam: RAT185H-S4C[length code]08T2-SL-8HN31,TT440-385U-S(150-450)F with calibration SMC(300,350)F

H. Occupant Override: Provide wall mounted occupant override button in locations shown on drawings.

I. Low Limit Controllers: Provide unit-mounted low limit controllers, of rod-and-tube type, with an adjustable set point and a manual reset. Capillary shall be of adequate length to horizontally traverse face of cooling coil every 12”. Multiple low limit controllers may be required for large coils. Controller shall have an extra set of contactors for connection to control panel for alarm status. Locate the thermostat case and bellows where the ambient temperature is always warmer than the set point.
   1. Freeze Stats: Johnson Controls model A70HA-1 or approved equal.

J. Humidistats: Humidistats must be contamination resistant, capable of ±2% RH accuracy, have field adjustable calibration and provide a linear proportional signal.
   1. HD20K-T91 or equivalent.

K. Humidity High Limit
   1. Multi-function device that can function as a high limit or proportional override humidity controller, as stand-alone proportional controller, or a stand-alone two-position controller.
      a) Johnson Controls TRUERH HL-67N5-8N00P or approved equal.

L. Carbon Dioxide Sensor:
   1. Wall Mount: ACI Model ESENSE-R.
   2. Duct Mount: ACI Model ESENSE-D.

M. Fan/Pump Status: Status points for fan or pump motors with a VFD must be connected to the terminal strip of the VFD for status indication.
   Current switches: Current switches are required for fan and pump statuses that are not connected to a VFD. The switches must have an adjustable trip setpoint with LED indication and be capable of detecting broken belts or couplings. Units shall be powered by monitored line, UL listed and CE certified, and have a five year warranty.
   1. Kele, Hawkeye or approved equal.

N. Relays Used for Fan and Pump Start/Stop: Must have LED indication and be mounted...
externally of starter enclosure or VFD.
1. Kele, RIBU1C or approved equal.

O. Power Supply Used to Provide Power to Contractor-Provided Control Devices: Shall have adjustable DC output, screw terminals, overload protection and 24 VAC and 24 VDC output.
1. Kele, DCPA-1.2 or approved equal.

P. Pressure Differential Switch:
1. Fans: NECC model DP222 or approved equal.

Q. Differential Pressure Transmitter: Provide units with linear analog 4-20mA output proportional to differential pressure, compatible with the Johnson METASYS Systems.
1. Water: Units shall be wet/wet differential pressure capable of a bi-directional pressure range of +/- 50 psid. Accuracy shall be +/- 0.25% full scale with a compensated temperature range of 30 to 150 deg F and a maximum working pressure of 250 psig.
2. Install transmitter in a pre-manufactured assembly with shut off valves, vent valves and a bypass valve.
   a) Setra model 230 with Kele model 3-VLV, three valve manifold or approved equal.
3. Air: Units shall be capable of measuring a differential pressure of 0 to 5 in. WC. Accuracy shall be +/- 1.0% full scale with a compensated temperature range of 40 to 149 deg F and a maximum working pressure of 250 psig.
   a) Setra model 267, or approved equal.
b) Shall be installed in control panel and piped 2/3 down the duct unless shown otherwise or approved by owners representative.

R. Building Static Pressure: Transducer shall utilize a ceramic capacitive sensing element to provide a stable linear output over the specified range of building static pressure. Transducer shall be housed in a wall-mounted enclosure with LCD display. Transducer shall have the following capabilities:
1. Input Power: 24 VAC
2. Output: 0-10 VDC
3. Pressure Range: -0.25 to +0.25 inches w.g.
4. Display: 3-1/2 digit LCD, displaying pressure in inches w.g.
5. Accuracy: +/- 1.0% combined linearity and hysteresis
6. Temperature effect: 0.05% / deg C
7. Zero drift (1 year): 2.0% max
8. Zero adjust: Push-button auto-zero and digital input
9. Operating Environment: 0 to 140 deg F, 90% RH (non-condensing)
10. Fittings: Brass barbs, 1/8” O.D.
11. Enclosure: High-impact ABS plastic
12. Outside Air Sensor Pickup Port: UV stabilized thermoplastic or aluminum “can” enclosure to shield outdoor pressure sensing tube from wind effects. BAPI ZPS-ACC10-rooftop mount, wall mount, or equivalent.
13. Transducer shall be Veris Industries Model PXPLX01S, equivalent from Setra, or approved equal.

S. High Static Pressure Limit Switch: Provide pressure high limit switch to open contact in fan circuit to shut down the supply fan when the inlet static pressure rises above the set point. Provide with an adjustable set point, a manual reset button, 2 SPST (normally closed) contacts, and ½” compression fittings.
1. Kele model AFS-460-DDS, or approved equal.

T. AIRFLOW/TEMPERATURE MEASUREMENT DEVICES
1. Provide airflow/temperature measurement devices where indicated on the plans. Fan inlet measurement devices shall not be substituted for duct or plenum measurement devices indicated on the plans.

2. The measurement device shall consist of one or more sensor probe assemblies and a single, remotely mounted, microprocessor-based transmitter. Each sensor probe assembly shall contain one or more independently wired sensor housings. The airflow and temperature readings calculated for each sensor housing shall be equally weighted and averaged by the transmitter prior to output. Pitot tubes and arrays are not acceptable. Vortex shedding flow meters are not acceptable.

3. All Sensor Probe Assemblies
   a) Each sensor housing shall be manufactured of a U.L. listed engineered thermoplastic.
   b) Each sensor housing shall utilize two hermetically sealed, bead-in-glass thermistor probes to determine airflow rate and ambient temperature. Devices that use “chip” or diode case type thermistors are unacceptable. Devices that do not have 2 thermistors in each sensor housing are not acceptable.
   c) Each sensor housing shall be calibrated at a minimum of 16 airflow rates and have an accuracy of +/−2% of reading over the entire operating airflow range. Each sensor housing shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
      (1) Devices whose accuracy is the combined accuracy of the transmitter and sensor probes must demonstrate that the total accuracy meets the performance requirements of this specification throughout the measurement range.
   d) The operating temperature range for the sensor probe assembly shall be -20° F to 160° F. The operating humidity range for the sensor probe assembly shall be 0-99% RH (non-condensing).
   e) Each temperature sensor shall be calibrated at a minimum of 3 temperatures and have an accuracy of +/−0.15° F over the entire operating temperature range. Each temperature sensor shall be calibrated to standards that are traceable to the National Institute of Standards and Technology (NIST).
   f) Each sensor probe assembly shall have an integral, U.L. listed, plenum rated cable and terminal plug for connection to the remotely mounted transmitter. All terminal plug interconnecting pins shall be gold plated.
   g) Each sensor assembly shall not require matching to the transmitter in the field.
   h) A single manufacturer shall provide both the airflow/temperature measuring probe(s) and transmitter at a given measurement location.

4. Duct and Plenum Sensor Probe Assemblies
   a) Sensor housings shall be mounted in an extruded, gold anodized, 6063 aluminum tube probe assembly. Thermistor probes shall be mounted in sensor housings using a waterproof marine grade epoxy resin. All wires within the aluminum tube shall be Kynar coated.
   b) The number of sensor housings provided for each location shall be as follows:
      (1) Area (sq.ft.)  Sensors
          <2
          2 to <4  6
          4 to <8  8
          8 to <16 12
          >=16   16
   c) Probe assembly mounting brackets shall be constructed of 304 stainless steel. Probe assemblies shall be mounted using one of the following options:
      (1) Insertion mounted through the side or top of the duct.
      (2) Internally mounted inside the duct or plenum.
(3) Standoff mounted inside the plenum.

d) The operating airflow range shall be 0 to 5,000 FPM unless otherwise indicated on the plans.

5. Fan Inlet Sensor Probe Assemblies
a) Sensor housings shall be mounted on 304 stainless steel blocks.
b) Mounting rods shall be field adjustable to fit the fan inlet and constructed of nickel plated steel.
c) Mounting feet shall be constructed of 304 stainless steel.
d) The operating airflow range shall be 0 to 10,000 FPM unless otherwise indicated on the plans.

6. Transmitters
a) The transmitter shall have a 16 character alpha-numeric display capable of displaying airflow, temperature, system status, configuration settings and diagnostics. Configuration settings and diagnostics shall be accessed through a pushbutton interface on the main circuit board. Airflow shall be field configurable to be displayed as a velocity or a volumetric rate.
b) The transmitter shall be capable of independently monitoring and averaging up to 16 individual airflow and temperature readings. The transmitter shall be capable of displaying the airflow and temperature readings of individual sensors on the LCD display.
c) The transmitter shall have a power switch and operate on 24 VAC (isolation not required). The transmitter shall use a switching power supply fused and protected from transients and power surges.
d) All interconnecting pins, headers and connections on the main circuit board, option cards and cable receptacles shall be gold plated.
e) The operating temperature range for the transmitter shall be -20° F to 120° F. The transmitter shall be protected from weather and water.
f) The transmitter shall be capable of communicating with the host controls using one of the following interface options:
   (1) Linear analog output signal: Field selectable, fuse protected and isolated, 0-10VDC and 4-20mA (4-wire).
   (2) RS-485: Field selectable BACnet-MS/TP, ModBus-RTU and Johnson Controls N2 Bus.
   (3) 10 Base-T Ethernet: Field selectable BACnet Ethernet, BACnet-IP, ModBus-TCP and TCP/IP.
   (4) LonWorks Free Topology.
g) The transmitter shall have an infra-red interface capable of downloading individual sensor airflow and temperature data or uploading transmitter configuration data to a handheld PDA (Palm or Microsoft Pocket PC operating systems).

7. The measuring device shall be UL listed as an entire assembly.

8. The manufacturer’s authorized representative shall review and approve placement and operating airflow rates for each measurement location indicated on the plans. A written report shall be submitted to the consulting mechanical engineer if any measurement locations do not meet the manufacturer’s placement requirements.

9. Manufacturer
a) Primary flow elements, sensors, meters and transducers shall be EBTRON, Inc. Model GTx116-P and GTx116-F or approved equal.
b) The naming of any manufacturer does not automatically constitute acceptance of this standard product nor waive their responsibility to comply totally with all requirements of the proceeding specification.

U. Electrical Requirements: Provide electric-pneumatic switches, electrical devices, and relays that are UL-listed and of type which meet current and voltage characteristics of the project. All devices shall be of industrial/ commercial grade or better. Residential types will be rejected.
1. EP Switches: Landis & Gyr Powers, Inc. Series 265 - Junction Box Type or approved equal.
2. Relays: Relays shall have an LED status indicator, voltage transient suppression, Closed-Open-Auto switch, plastic enclosure, and color coded wires. Kele model RIBU1C or approved equal.

V. Magnetic Flowmeter for Chilled Water, Tower Water, Make Up Water:
1. The Magnetic Flowmeter flow tube and computer/transducer shall come as a complete system assembled by a single manufacturer. The flowmeter shall be suitable for use in the accurate measurement of Chilled Water flow, Cooling Tower Water flow, or Make Up water flow for process control and/or utility metering, in a mechanical room environment, with a Johnson Controls EMCS system.
2. The flowmeter shall consist of a pulsed DC electromagnetic coil incorporating Faraday’s Law utilizing the flowing Water as the conductor. The flowmeter shall provide proper grounding for use in Schedule 40 steel pipe, Schedule 10S stainless steel pipe, or copper pipe as application requires.
3. The flowmeter element should be sized to maintain maximum accuracy over the flow range of the application while keeping flow tube velocity below 15 fps at max flow. The flowmeter element shall be the flow tube, spool piece type with a non-conductive lining and no intrusions into the flow path. The flowmeter flow tube shall be suitable for direct mounting to standard ANSI flanges.
4. The flowmeter shall have a local LCD display that indicates flow in GPM and/or Total gallons from the totalizer. The flowmeter shall be programmable/configurable via local push buttons. The flowmeter computer/transducer shall be remote mounted. The flow tube shall have a direct mounted junction box for wiring connections.
5. The flowmeter shall have the capability to be calibrated inside to verify proper operation and accuracies.
6. The flowmeter shall also meet the following specifications:
   a) Measures Bi-directional flow.
   b) Zero-point stability.
   c) Flow tube can withstand a full vacuum on an intermittent basis.
   d) Normal obstructions, partially opened valves, 90° or 45° elbows, and pump discharges shall require no more than 5 pipe diameters upstream and 3 pipe diameters downstream of straight pipe run for specified performance.
   e) Auto re-start after electrodes have lost wetness.
   f) Computer/transducers shall be interchangeable to multiple flow tubes without affecting the published accuracies of the meter.
   g) Computer/transducer internal electronic components, including power supply and output boards, shall be field interchangeable/exchangeable.
   h) Calibration: NIST Traceable, certificate provided with each meter.
   i) Electrode Pressure Rating: Equivalent to flow tube flange rating
   j) Minimum Conductivity: 5 S/cm for fluid to be measured
   k) Transmitter Ambient Temp.: 122 °F
   l) Flow Tube Process Temp.: 32 °F to 140 °F for Chilled Water applications
   m) Flow Tube Process Temp.: 32 °F to 140 °F for Make Up Water applications
   n) Flow Tube Process Temp.: 32 °F to 311 °F for Hot or Dual Water applications
   o) Flow Range: +/- 0 to 30 fps
   p) Accuracy (velocity <= 1.0 fps): +/- 0.5% of reading or +/- 0.005 fps
   q) Accuracy (velocity > 1.0 fps): +/- 0.5% of reading
   r) Analog Output: 4-20 mA, linear to flow in GPM
   s) Analog Output Accuracy: +/- 0.05% of span
   t) Repeatability: +/- 0.1%
   u) Stability: +/- 0.1%
v) Ambient Temperature Effect: <1% per 100°F
w) Vibration Effect: 0.1% (remote mounted transducer)
x) Low Flow Cutoff: settable to 0.04 fps or lower
y) Low Flow Cutoff Analog Output: Analog output shall be 4.0 mA at flows below the low cutoff.
z) Humidity Limits: 5-90% RH
aa) Power Supply: 115 VAC
bb) Power Consumption: 20 W maximum
c) Enclosures: NEMA 4
d) Flow Tube working pressure: 150 psi
e) Flanges: Carbon steel, ANSI Class 150#
f) Electrodes: Corrosion resistant Alloy C
g) Cable Length: As required per plans
h) Cable shall be capable of empty pipe detection.
i) All cable shall be provided by the meter manufacturer.

7. The flowmeter shall be Siemens Magflo Mag 6000 with Mag 5100W or approved equal.

8. Bids/Submittals: All bids and/or submittals must include published specifications, specific model number configurations, and operation & maintenance manuals.

9. Warranty: All parts and components as needed for the specified operation and performance shall be covered under warranty for a period of not less than two years.

W. Ultrasonic Level Transmitter for Cooling Tower Basin Water: Furnish and install, where indicated on plans, a device for measuring the tower basin water level. The level transmitter shall meet the following specifications:
   1. Make: Flowline
   2. Model: EchoSpan LU83-51-01
   3. Range: 8" to 26.2 feet
   4. Accuracy: 0.2% of span in air
   5. Resolution: 0.039"
   6. Beam width: 3"
   7. Dead band: 8"
   8. Display type: 6 digit LCD
   9. Display units: Inch, cm, %
   10. Memory: Non-volatile
   11. Supply voltage: 12-28 VDC
   12. Loop resistance: 500 Ohms @ 24 VDC
   13. Signal output: 4-20 mA two-wire
   14. Signal invert: 4-20 mA or 20-4 mA
   15. Calibration: Push button
   16. Fail-safety: Selectable 4 mA, 20 mA, 21 mA, 22 mA, or hold
   17. Process temperature: -4 °F to 140 °F
   18. Temp. Comp.: Automatic
   19. Electronics temp.: -40 °F to 160 °F
   20. Pressure: 30 psi @ 25 °C, derated @ 1.667 psi/°C above 25 °C
   21. Enclosure rating: NEMA 4X (IP65)
   22. Enclosure vent: Water tight membrane
   23. Enclosure material: PC/ABS FR
   24. Trans. Material: PVDF
   25. Process mount: 2" NPT
   26. Mounting gasket: Viton
   27. Conduit entrance: Dual, ½" NPT
28. Classification: General purpose
29. CE compliance: EN 61326 EMC
30. Level transmitter shall be Flowline EchoSpan LU83-51-01 or equivalent.

3.01 INSTALLATION OF CONTROL SYSTEMS

A. General: Install systems and materials in accordance with manufacturer’s instructions, roughing-in drawings and details shown on drawings.

B. Control Air Piping:
   1. All control air piping shall be copper. Exception: Flexible Tubing may be used for a maximum of two (2) feet at connections to equipment [except for steam control valves] and inside control cabinets.
   2. Provide copper tubing with a maximum unsupported length of 3'-0".
   3. Pressure Test control air piping at 30 psi for 24 hours. Test fails if more than 5 PSI loss occurs.
   4. Fasten flexible connections bridging cabinets and doors, neatly along hinge side, and protect against abrasion. Tie and support tubing neatly.
   5. Number-code or color-code tubing, except local individual room control tubing, for future identification and servicing of control system.
   6. All control tubing at control panel shall be tagged and labeled during installation to assist owner in making termination connections at control panel.
   7. Provide pressure gages on each output device.
   8. Paint all exposed control tubing to match existing.

C. Raceway: Raceway is to be installed in accordance with the National Electric Code. Use of flexible metal conduit or liquid-tight flexible conduit is limited to 36” to connect from EMT to devices subject to movement. Flexible raceway is not to be used to compensate for misalignment of raceway during installation.

D. Control Wiring: Install control wiring in raceway, without splices between terminal points, color-coded. Install in a neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code.
   1. Install circuits over 25-volt with color-coded No. 12 stranded wire.
   2. Install electronic circuits and circuits under 25-volts with color-coded No. 18 stranded twisted shielded pair type conductor.
   3. N2 communications bus wire shall be 18 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, described as 18-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
      a) Metastat wiring shall be minimum 20 AWG, plenum rated, stranded, 8 conductor stranded wire.
   4. FC communications bus wire shall be 22 AWG, plenum rated, stranded twisted shielded, 3 conductor, with blue outer casing, described as 22-03 OAS STR PLNM NEON BLU JK distributed by Windy City Wire, constructed by Cable-Tek, or approved equivalent.
      a) Network sensor wiring (SA Bus) shall be 22 gauge plenum rated stranded twisted wire, 4 conductor.
   5. All control wiring at control panel shall be tagged and labeled during installation to assist owner in making termination connections at control panel. Label all control wires per bid documents.

E. All low voltage electrical wiring shall be run as follows:
   1. Route electrical wiring in concealed spaces and mechanical rooms whenever possible.
   2. Provide EMT conduit and fittings in mechanical rooms and where indicated on drawings.
   3. Low voltage electrical wiring routed above acoustical ceiling is not required to be in conduit, but wire must be plenum rated and properly supported to building structure.
4. Provide surface raceway, fittings and boxes in finished areas where wiring cannot be run in concealed spaces. Route on ceiling or along walls as close to ceiling as possible. Run raceway parallel to walls. Diagonal runs are not permitted. Paint raceway and fittings to match existing conditions. Patch/repair/paint any exposed wall penetrations to match existing conditions.

F. All devices shall be mounted appropriately for the intended service and location.
   1. Adjustable thermostats shall be provided with base and covers in occupied areas and mounted 48" above finished floor to the top of the device. Tubing and/or wiring shall be concealed within the wall up to the ceiling where ever possible. Surface raceway may only be used with approval of Owners Representative. Wall mounted sensors such as CO2, RH, and non-adjustable temperature sensors shall be mounted 54" above finished floor. Duct mounted sensors shall be provided with mounting brackets to accommodate insulation. Mounting clips for capillary tubes for averaging sensors are required.
   2. All control devices shall be tagged and labeled for future identification and servicing of control system.
   3. Preheat and mixed air discharge sensors must be of adequate length and installed with capillary tube horizontally traversing face of coil, covering entire coil every 24 inches bottom to top.
   4. All field devices must be accessible or access panels must be installed.

G. Install magnehelic pressure gage across each air handling unit filter bank. If the air handling unit has a prefilter and a final filter, two magnehelic pressure gages are required.

3.02 ADJUSTING AND START-UP

A. Start-Up: Temporary control of Air Handling Units shall be allowed only if approved by the owner’s representative to protect finishes, etc., AHUs may be run using caution with temporary controls installed by contractor early in the startup process. All safeties including a smoke detector for shut down must be operational. Some means of discharge air control shall be utilized and provided by the contractor such as a temporary temperature sensor and controller located and installed by the Contractor.

B. The start-up testing, and adjusting of pneumatic and digital control systems will be conducted by owner. Once all items are completed by the Contractor for each system, Contractor shall allow time in the construction schedule for owner to complete commissioning of controls before project substantial completion. This task should be included in the original schedule and updated to include the allotted time necessary to complete it. As a minimum, the following items are required to be completed by the Contractor for Owner to begin controls commissioning.
   1. Process Control Network
      a) The control boards and enclosures need to be installed in the mechanical rooms.
      b) The fiber optic conduit and box for the process control network needs to be installed. Once in place, Owner needs to be contacted so the length of the owner provided fiber cable can be determined and ordered, if required. Coordinate with Owner to schedule the pull in and termination of the fiber cable. Power should be in place at that time. (Fiber for the process control network is required to allow metering of utilities prior to turn on.)
   2. Heating System
      a) Pumps, heat exchangers, steam pressure reducing station, piping, control valves, steam and/or hot water meter, feeder conduit and wire, VFDs, control panels and control wiring installed in the mechanical room. The house keeping pads must be poured before pump operation. All must be in place in working order (pumps aligned, VFDs set up by vendor, motors checked for rotation, steam regulators set to required pressure, condensate pumps operational, heating system ready to
circulate (all piping pressure tested, flushed, and insulated) with differential pressure sensors in place.

3. Cooling System
   a) Pumps, heat exchangers, piping, control valves, chilled water meter, feeder conduit and wire, VFDs, control panels and control wiring installed in the mechanical room. The house keeping pads must be poured before pump operation. All must be in place in working order (pumps aligned, VFDs set up by vendor, motors checked for rotation, cooling system ready to circulate (all piping pressure tested, flushed, and insulated) with differential pressure sensors in place.

4. VAVs-First Pass
   a) Power, (FC or N2 bus), and control wire installed before owner can make first commissioning pass. First pass includes installation of VAV controller, termination of power, control and network communication wiring.

5. Air Handlers
   a) Prior to owner commissioning, at a minimum, the following items shall be complete: Power wiring, motor rotation check, fire/smoke dampers open, control wiring including all safeties, IO cabinet, air handler cleaned, and filters installed as required. To protect the systems from dirt, outside air with no return will be used until the building is clean enough for return air operation.

6. VAVs-Second Pass
   a) After the air handlers are running and under static pressure control and the heating water system is operating, a second pass can be made on the VAVs to download the control program and commission controllers to verify the VAV dampers, thermostat, and reheat control valves are working properly.

7. Exhaust and Energy Recovery Systems
   a) Exhaust fans need to be operational and under control before labs can be commissioned.

8. Lab Air Controls
   a) Lab Air Controls vendor will have the same requirements as stated above for VAVs.

9. Some balance work can be done alongside the control work as long as areas are mostly complete and all diffusers are in place.

3.03 CLOSEOUT PROCEDURES

A. Contractor shall provide complete diagrams of the control system including flow diagrams with each control device labeled, a diagram showing the termination connections, and an explanation of the control sequence. The diagram and sequence shall be framed and protected by glass and mounted next to controller.

B. Contractor shall provide as built diagram of network bus routing listing all devices on bus, once wiring is complete prior to scope completion.

END OF SECTION
25 00 00
DIVISION 26 - ELECTRICAL

26 00 00 ELECTRICAL

26 00 01 GENERAL

A. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Division 26 of the Specifications.

B. Provisions and conditions cited in this Section shall apply to Work for other sections of Division 26 of these Specifications.

C. The organization of the Specifications into Divisions, Sections and Subsections, and the arrangement of the Plans shall not in and of itself divide the Work among the Contractors and Subcontractors nor establish the Work to be performed by any trade. The “Scope of Work” and “Work Included” under each respective sectional heading, nevertheless, attempts to segregate the Work by known contracting activities. In the final analysis, the General Contractor shall be responsible for scoping the work for each trade based on local practice to include all the Work of a given type in the related proposal, regardless of where and how identified in the Bid Documents.

26 00 02 SCOPE OF WORK

A. This project is for a new approximately 27,000 square foot Primary Care Clinic for the University of Missouri Health System located at 7115 East St. Charles Road, Columbia, MO 65202. The design, defined by the Project Documents, provides for a Primary Care Clinic.

B. The Electrical Work for this project shall include all material, labor and services necessary for and incidental to providing the following systems (respective Sections of the Specifications are noted in the right hand column):

1. Basic Electrical Requirements 26 00 00
2. Common Work Results for Electrical 26 05 00
3. Instrumentation and Control for Electrical Systems 26 09 00
4. Low Voltage Electrical Transmission 26 20 00
5. Facility Electrical Power Generating and Storing Equipment 26 30 00
6. Electrical Protection 26 40 00
7. Lighting 26 50 00
8. Communications and Systems 27 00 00
9. Electronic Safety and Security 28 00 00
REFERENCES, RELATED SECTIONS of the SPECIFICATIONS

A. The Plans, the general provisions of the of the Contract, including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Division 26 of the Specifications.

B. All provisions and conditions cited in this Section shall apply to Work for all other sections of Division 26 of these Specifications.

C. Requirements of the following Sections of the Specifications apply to Work for this Section:

1. Division 27 – Communications
2. Division 28 – Electronic Safety and Security

REFERENCES, REGULATORY REQUIREMENTS

A. All material and equipment shall be listed, labeled or certified by Underwriters Laboratories, Inc., where relevant standards have been established (see also Paragraph 26 00 60). Material and equipment, which are not covered by UL Standards, will be acceptable provided they meet safety requirements of a nationally recognized testing laboratory. Products which no nationally recognized testing laboratory accepts, lists, labels, certifies or determines to be safe will be considered if inspected or tested in accordance with national industrial standards such as NEMA or ANSI. Evidence of compliance shall include test reports and definitive submittals.

B. Definitions:

1. “Listed”: A product is “listed” if of a kind mentioned in a list which: Is published by a nationally recognized laboratory which makes periodic inspections of such production. States that such product meets nationally recognized standards or has been tested and found safe for use in a specified manner.

2. “Labeled”: The product is “labeled” if: It embodies a valid label or other identifying mark of a nationally recognized testing laboratory such as UL, Inc. Production is inspected periodically by a nationally recognized testing laboratory. The labeling indicates compliance with nationally recognized standards or tests to determine safe use in a specified manner.

3. “Certified”: The product is “certified” if: The product has been tested and found by a nationally recognized testing laboratory to meet nationally recognized standards or to be safe for use in specific manner. Production is inspected periodically by a nationally recognized testing laboratory. The product bears a label, tag or other record of certification.

DEFINITIONS

A. The term “Work” used in this Division shall be the furnishing of material, labor and/or services necessary for and reasonably incidental to providing specific component(s), consideration(s)
and/or system(s) of the design for the mechanical facilities for this Project as hereinafter defined by the Project Documents.

B. The term “Project Documents” used in this Division shall be the compilation of the Specifications, the Plans and any Attachment and Addendum which collectively define the design and the intent of the Work to construct the Project.

C. The terms “Architect” and “Engineer” as used in this Division of the Specifications shall be the professional individual and/or company developing the respective portion(s) of the Project Documents and administering the responsibility for the adherence to the intent of these documents. The “Architect/Engineer” is the agent of the “Owner” and shall represent and discharge authority on all matters unless the matter is referred to the Owner or the Owner elects to perform in their own behalf.

D. The term “General Contractor, Construction Manager, or Prime Contractor” as used in Division 26 shall mean the Contractor who has the prime contract with the Owner and who is responsible for general conditions of the project and is responsible for seeking experienced and qualified Trade Subcontractors to perform the Work.

E. The terms “Contractor” and “Subcontractor” where used in this Division shall mean any Company, regularly in business, to perform the type of work for which the Contract was sought, who has contracted with the Owner or General Contractor to perform the work included in and defined by this section and any other section or sections of this Division.

F. The term “submittal” as used in this Section of the Specifications shall be construed to be information in various forms compiled by the Contractor to transmit to the Architect/Engineer for review, comment and/or approval and return same to the Contractor with notice to react. The information shall support and/or substantiate that the given product complies with the intent of the Project Documents, should be incorporated in the Work and therefore, warrants approval to permit proceeding with that Work. The information may be any form or accepted practice of shop drawings, data, published catalogs, etc. that sufficiently provide the Architect/Engineer with basis of making a determination.

G. The term “unfinished space” as used in Division 26 - 28 of the Specifications shall be a mechanical or electrical equipment room. These are rooms that are generally unpainted and accessible only to building maintenance personnel.

H. The term “finished space” as used in Division 26 - 28 of the Specifications shall mean any space not defined as “unfinished space” (i.e. occupied rooms, corridors, stairways, closets, etc.).

I. The term “exterior” or “outdoors” as used in Division 26 - 28 of the Specifications shall mean exposed to atmospheric weather conditions.

J. The term “interior” or “indoors” as used in Division 26 - 28 of the Specifications shall mean not exposed to atmospheric weather conditions.
K. The term “concealed” as used in Division 26 - 28 of the Specifications shall mean anything that is not visible in a “finished space”.

L. The term “inaccessible” as used in Division 26 - 28 of the Specifications shall mean located within walls or above non-lay-in ceiling (i.e., drywall, plaster).

M. The term “packaged” as used in Division 26 - 28 of the Specifications shall be construed to be a factory manufactured piece of equipment for which all components are totally assembled, pre-piped and prewired within its own structure and ready to operate when connected to proper external mechanical and electrical services.

26 00 06 CODES, STANDARDS, etc.

A. The material, workmanship and systems for Work of this Division shall comply with all applicable codes, standards, regulations and laws of the legal governmental jurisdiction at the project site.

B. Should the Contractor perform any work that does not comply with the requirements of the applicable codes, standards, regulations, statutes, laws, acts, or which does not receive the approval of the responsible inspection authority, Contractor shall bear all costs arising in correcting the deficiencies.

C. Applicable requirements of the current and accepted edition of the following codes shall apply to the Work for Divisions 26 - 28

- International Building Code 2018
- International Mechanical Code 2018
- International Plumbing Code 2018
- International Fire Code 2018
- International Fuel Gas Code 2018
- National Electrical Code, 2011 & 2017
- NFPA 110 – 2016
- NFPA 101 – 2012
- NFPA 99 – 2012
- NFPA 96 – 2017
- NFPA 90A – 2015
- NFPA 45 – 2015
- NFPA 20 – 2016
- ASHRAE 90.1 – 2016
- ASME A17.1
- Americans with Disabilities Act – Standards for Accessible Design 2010
- Facility Guidelines Institute - 2014
D. Applicable requirements of the current and accepted edition of the following industry standards, codes and specifications shall apply to the Work for Division 26-28:

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ANSI</td>
<td>American National Standards Institute</td>
</tr>
<tr>
<td>ASTM</td>
<td>American Society of Testing and Materials</td>
</tr>
<tr>
<td>IEEE</td>
<td>Institute of Electrical &amp; Electronic Engineers</td>
</tr>
<tr>
<td>IPCEA</td>
<td>Insulated Power Cable Engineers Association</td>
</tr>
<tr>
<td>NIST</td>
<td>Institute of Science and Technology</td>
</tr>
<tr>
<td>NEC</td>
<td>National Electric Code, including amendments by local authority having jurisdiction</td>
</tr>
<tr>
<td>NEMA</td>
<td>National Electrical Manufacturers Association</td>
</tr>
<tr>
<td>NIOSH</td>
<td>National Institute of Occupational Safety and Health</td>
</tr>
<tr>
<td>OSHA</td>
<td>Occupational Safety and Health Act</td>
</tr>
<tr>
<td>UL</td>
<td>Underwriters Laboratory, Inc.</td>
</tr>
</tbody>
</table>

E. Applicable requirements of all the relevant Federal laws including current and accepted edition of the Americans with Disabilities Act (ADA).
26 00 10  CONDITIONS, BID

26 00 11  REQUEST for PROPOSAL

A. The terms for Contractor's proposal shall be as described in the General Conditions, Supplementary and/or Special Conditions and Specification Sections of Division 1.

26 00 12  TAXES

A. The respective Contractor or Subcontractor shall pay all sales and/or use taxes or other applicable charges coincidental with the purchase of material and equipment for the fulfillment of their respective Work, unless otherwise described in the General Conditions, Supplementary and/or Special Conditions and Specifications Sections of Division 1.

26 00 13  FREIGHT

A. The respective Contractor or Subcontractor shall pay all shipping and/or freight charges coincidental with the purchase of material and equipment for the fulfillment of their respective Work.
26 00 20  CONDITIONS, JOBSITE

26 00 21  TEMPORARY FACILITIES

A. General

In general, the General Contractor or the Owner to the extent as described in Division 1 of the Specifications will provide temporary facilities. However, if that is not the case, the specific conditions of this project are identified as follows:

B. CONSTRUCTION ELECTRIC POWER and LIGHTING:

1. The General Contractor shall provide 120 volt, 60 Hz, single phase electric service to a single distribution panel at the job site and shall provide minimal temporary lighting throughout the Project. Electrical Contractor shall provide work necessary to meet this requirement as directed by General Contractor.

C. TEMPORARY TOILETS and WATER:

1. The General Contractor shall be responsible for providing temporary toilets and water for contractor’s use during construction.

D. JOB SITE SECURITY:

1. The Contractor shall cooperate with the General Contractor in the procedures and requirements for opening and securing the job site for each workday.

E. JOB SITE PARKING:

1. Contractor shall park in only the designated areas assigned to them for use by the General Contractor and shall not park in No Parking Areas, on lawns, or unpaved areas and shall not block access to loading docks, fire hydrants, etc.

26 00 22  REQUIREMENTS TO PURSUE THE WORK

A. Work space: The respective Contractors and Subcontractors shall be assigned areas at the job site for construction trailers, lay-down, storage and work spaces as arranged with the General Contractor. All spaces shall be accessible to the Architect/Engineer. All material and equipment shall be protected during the course of construction against weather, dirt,
comprehensive damage and theft. All items subject to water damage shall be adequately protected. Damage occurring or defects detected before acceptance shall be repaired or replaced at no additional compensation.

B. **Tools:** The Contractors and Subcontractors shall provide their own tools and services to perform their respective Work. Rented or leased services shall have proper and adequate insurance.

C. **Temporary storage:** The Contractors and Subcontractors shall be responsible for any requirements to temporarily store material and equipment until it is incorporated into the Project.
26 00 30  PROJECT DOCUMENTS

26 00 31  GENERAL

A. The Plans and the Specifications are intended to define complete and satisfactorily functioning systems. The Contractor shall be responsible for providing all necessary material, labor and services to provide the completed, operating systems at no additional compensation even though each and every element thereof is not specifically identified.

B. The Plans are diagrammatic and indicate general arrangements, approximate sizes and relative locations of principal equipment and materials to provide for the design and intent of the Electrical Work and shall be followed as closely as actual building and site conditions and work of other trades will permit. The Work shall conform to the requirements and intent of the Project Documents. Because of the scale of the drawings, the Plans do not represent every offset, fitting, accessory, etc. that may be required for the conduit or other appurtenances, nor is it implied that all conflicts between elements of the Work or building components have been resolved. The Contractor shall prepare details and/or coordination drawings where it may be required and submit to the Architect/Engineer for approval before proceeding with the Work.

C. To the extent contained in the Project Documents, elevations, sections, typical details, and schematic diagrams are included for instructions to the craftsperson. If any additional diagrams are desired and/or required for further instruction to the craftsperson, for permit applications, or for any other reason, the Contractor shall develop the drawings.

D. Significant discrepancies and/or changes required to accomplish the intent of the Project Documents, in the opinion of the Contractor, shall be identified and submitted to the Architect/Engineer for approval before proceeding with the Work in question. Changes originated by the Architect/Engineer shall be processed under the subsection heading “Changes in the Work”.

E. The Plans and the Specifications are mutually complementary. Work required by one, but not the other, shall be performed as if required by both.

F. In the event of conflict between the Plans and the Specifications, the Contractor shall notify the Engineer for clarification. Prior to clarification, the Contractor shall assume that the stricter requirements apply.

26 00 33  SPECIFICATIONS

A. Referenced sections of other Divisions whether attached or in separate volumes or binders shall be a part of the Contract Documents.

26 00 34  ADDENDA
A. The Architect/Engineer may issue revisions, modifications, attachments or other documentation in the form of addenda to the Project (Bid) Documents during the bidding phase only to change, detail or clarify the scope of the Work.

B. The addenda shall become a part of the Contract Documents.

26 00 35 INTERPRETATIONS

A. The electrical Engineer shall be the sole source of interpretation of the electrical design and intent of the Project Documents.

26 00 36 CONSTRUCTION SCHEDULE

A. The Contractor shall furnish sufficient manpower as the schedule dictates and is required to maintain the overall project schedule. Manpower or overtime to meet the project schedule including, but not limited to, premium time, inefficiencies associated with longer days/hours, inefficiencies associated with additional manpower, or other labor burdens shall be included in the Contract Sum.

B. The Contractor shall coordinate with their Subcontractors to develop an overall project schedule.

26 00 37 AS-BUILT DRAWINGS

A. The Contractor shall maintain a separate set of plans at the jobsite, and mark thereon as an As-Built of Work as the construction proceeds. These As-Built, “redline” drawings shall include exact locations and relevant details (i.e. elevations, sizes, dimensions related to building lines, etc.) of all underground work, concealed feeders, pull/junction boxes, cable tray, all considerations requiring periodic attention and access thereto.

B. At the completion of the project, the Contractor shall provide the “redline”, As-Built drawings and/or scanned color PDF of the As-Built, flattened to the Engineer.

C. At the completion of the project, the Architect/Engineer will provide PDF drawings (including all issued revisions to the Contract) for the Contractor’s use to transfer all of the information from the As-Built drawings to a final, clean set.

D. At the completion of the project, the Architect/Engineer will provide Contractor CAD files for the Contractor’s use to transfer the information on the drawings to CAD. The layering system on the drawings provided shall be strictly adhered to. The Contractor for their representation and accuracy of the final installation conditions shall certify these As-Built drawings. The As-Built CAD drawings shall be submitted to the Engineer digitally via thumb drive, shared cloud drive, etc. for review.
26 00 40  DUTIES OF CONTRACTOR

26 00 41  GENERAL (Pursuit of Work)

A. The Contractor shall thoroughly examine all Bid Documents before submitting a bid/proposal for the Work. If, in the opinion of the Contractor, there are any deficiencies in the Documents, that might impact the intent or the scope of the work, the Contractor shall bring the matter to the attention of the Architect/Engineer for clarification. If in the judgment of the Architect/Engineer clarification is warranted, an addendum to the Documents will be issued. If the Contractor fails to request clarification or otherwise submits a bid without qualifications, the Contractor thereby agrees to install a complete and functional system with no change in the contract price.

B. The Contractor shall be responsible for changes required for compliance with codes, standards, regulations, ordinances, etc. and implementing any such change at no change in contract price. In the event of conflict with the Project Documents or other requirements, the more stringent shall apply. The Contractor shall promptly notify the Architect/Engineer of any discrepancy.

C. The Contractor shall perform the Work to comply with all terms, conditions and intentions, whether explicit or implicit, of this Section and applicable requirements of other Sections of Division 26, the Plans and any other documentation so identified. Should the Contractor perform any Work that does not comply with the Project Documents or is not in accordance with common trade practices, the Contractor shall bear all costs, at no change in contract price, arising in correcting the Work.

D. The Contractor shall be responsible for all aspects of the Work for their respective contractual agreement. The Work of the respective suppliers and subcontractors shall be administered properly to assure that all elements thereof have been provided for complete and functioning system(s).

26 00 43  SUBMITTALS for APPROVAL

A. All shop drawings must be submitted prior to the receipt of the second partial payment request. No further payment will be made until shop drawings have been submitted.

B. The Contractor shall forward the quantity required for distribution within a reasonable time following the award of the contract. Prior to submitting shop drawings, Contractor shall verify equipment delivery for compliance with the overall project schedule. Any delays due to delivery or due to submittals being late, inadequate, or incorrect and therefore rejected by the Architect/Engineer shall be the responsibility of the Contractor making said submittal. The Contractor shall bear all cost for expediting charges or obtaining materials from another vendor to meet the overall project schedule.

C. The Engineer may take up to two (2) weeks to review a complete and properly processed submittal from the time it arrives at the Engineer’s office until the time it is returned to the
Architect. Resubmittals will be reviewed within two (2) weeks for a complete and properly processed resubmittal from the time they arrive at the Engineer’s office until the time they are returned to the Architect.

D. The submittals shall include shop drawings, engineering data and support information to sufficiently substantiate compliance with the Project Documents. All submittals must include the following information in order to be considered for review. Submittals found to be lacking may be rejected without review.

1. Shop drawing shall be derived from manufacturers original documents. Reproductions shall be of sufficient quality to accommodate a review.

2. Stamped date of receipt by the Contractor(s).

3. Identification of the project name and/or Owner’s project number.

4. Indication that the Contractor has reviewed the submittal and is satisfied that it complies with the Project Documents.

5. Identification of the Specification section or subsection that specifies the submitted item.

6. Identification of the submitted item by the same description that is used in the Project Documents.

E. Submittals shall be delivered to the Engineer digitally via email, thumb drive, shared cloud drive, or other agreed upon means for review. Submittals or submittal notices that are emailed shall be sent to CA@mcclureeng.com at a minimum.

F. The approval of the submittal shall not relieve the Contractor from complying with all of the terms and conditions of the Project Documents. The Contractor shall be responsible for all physical and performance requirements of equipment provided, including any differences in the cost of installation for variations from these requirements.

G. Include the manufacturer's installation instructions and maintenance manual with the equipment submittal for approval for inclusion in the Operations and Maintenance Manuals as specified in Subsection 26 00 46.

H. In general, all items purchased by Contractor for installation where a make and model is specified shall require submittals. Items required for the Work such as screws, bolts, clips, etc. which are not specified are not required to be submitted unless specifically requested.

I. The following shall be submitted under this Division of the specifications:

1. List of subcontractors and equipment supplier.

2. Payment breakdown.

3. Construction Schedule.
4. Detailed submittals.
5. Catalog Data
6. Operating and maintenance manuals.
7. As-built drawings.
8. Contractor developed details and coordination drawings (when applicable).
9. Proposed substitution (when applicable).

Division 26
1. Wiring Devices
2. Seismic, Sway Bracing, Anchorage Details/Drawings
3. Floor Boxes/ Poke Through Devices
4. Cable Tray Systems
5. Fire Stopping
6. Main Switchboard
7. Disconnect Switches
8. Dry-Type Transformers
9. Distribution Panelboards
10. Circuit Breaker Panelboards
11. Surge Protective Devices
12. Metering Devices and Accessories
13. Fuses
14. Motor Starters / RIB (relay in a box) / Contactors
15. Variable Frequency Drives
16. Light Fixtures
17. LED Drivers
18. LED Lighting Inverters
19. Lightning Protection
20. Low Voltage Lighting Control Systems
21. Occupancy Sensors / Digital Timers

**Division 27**
1. Voice/Data/Video Systems and Accessories

**Division 28**
1. Fire Alarm System
2. Access Control
3. CCTV – Security Camera System

J. At the completion of the project provide a single PDF document containing only those shop drawings that were approved and incorporated into the project.

**26 00 44 CHANGES IN WORK**

A. The only condition under which a change in the contract price will be considered is if there is to be a change in the scope of intent of the project requirements. Such changes would be limited to revisions in the project initiated by the Owner. The Architect/Engineer will issue a proposal for the new scope of work for the Contractor to prepare a price. After approval, the Architect/Engineer will prepare change order or change orders to adjust the contract sum and/or the contract time as necessary to carry out the changes.

B. No claim for an addition to the Contract Sum will be valid unless authorized as aforesaid in writing by the Owner. Any work completed by the Contractor outside the original project scope without written approval from the Owner will be deemed as a waiver by the Contractor for additional compensation for said work.

C. No requests for change orders will be reviewed or considered for approval that are not submitted with all of the following information. No cost associated with labor burden or manpower inefficiencies will be approved for a change order without documentation of the present labor burden, manpower requirements, and the critical path nature of the scope change.

1. A complete and detailed line item takeoff of materials and equipment.
2. A unit cost identified for each line item with material cost, labor hours, and labor rate identified separately for each line item.
3. All fringes and mark-ups identified separately.
D. Where major subcontracts are involved, the respective subcontractor's calculation, including all of the above data, shall be included with the Contractor's request.

E. Where there are net differences, the above data shall be included for all items added and for all items deducted with the net calculation clearly identified. Mark-ups shall be applied only after net differences are calculated.

F. The overhead charged by the Contractor shall be considered to include, but not limited to, performance bond, insurance, job site office expense, normal hand tools, man-lifts, incidental job supervision, field supervision, safety training, general office overhead, and cost associated with the preparation of design documents, layout drawings, shop drawings, or as-built drawings.

G. In evaluating the value of the contractor's request, for comparison purposes, the Architect/Engineer may use cost and unit data from the current edition of the R. S. Means Company's Cost Data, or information from appropriate suppliers or vendors of the respective materials or equipment.

H. Any requests submitted without the above details will be returned without review for resubmittal in the proper form.

26 00 45 COMPLETION and ACCEPTANCE

A. If, at the Owner's direction, a portion of the building is to be occupied or a portion of the Electrical System is utilized for beneficial use by the Owner prior to completion and acceptance of the Project, the start of the warranty shall begin with the "beneficial use" of the related Work.

B. The Engineer shall inspect the portion of the system for approval prior to acceptance of the system or subsystem.

C. The Contractor shall prepare a certificate of acceptance for approval by the Owner for that portion of the Work and submit a copy to the Architect/Engineer for record purposes.

26 00 46 OPERATIONS AND MAINTENANCE MANUALS

A. As a part of the contractual agreement, the Contractor shall submit and receive approval for the following to receive payment beyond 75% of the contract amount. This information shall be submitted as soon as practical and while the Contractor is on site.

1. Provide digital PDF documents containing information on installation operation and maintenance for each piece of equipment supplied. Operation and Maintenance Manuals shall be the manufacturers original PDF documents.

2. The Electrical Operations and Maintenance Manuals shall be submitted as separate files per specification section to the Engineer digitally via thumb drive, shared cloud drive, etc. for review.
3. The information shall list any maintenance requirements and schedule for required maintenance.

4. The information shall show all parts and part numbers of available replacement parts available for each piece of equipment.

5. A cross-index of material and equipment furnished containing:
   a. An alphabetical listing of material and equipment.
   b. An alphabetical listing by manufacturer's name, address and contact person of the local sales representative.
   c. An alphabetical listing of all subcontractors including name, address, contact person, and specific work performed.

26 00 48 CLOSE-OUT REQUIREMENTS

A. As a part of the contractual agreement, the Contractor shall submit and receive approval for the following before final payment will be released. This information shall be submitted prior to project completion:

1. Equipment tag list.
2. Installed Arc-Flash Labels
3. Equipment Name Plates
4. Operation and Maintenance Manuals
5. As-built drawings.
6. At the completion of the project, all contractors/subcontractors shall submit a letter stating all materials are asbestos free, and meet the specified ASTM E-84 flame/smoke rating of 25/50, and that all penetrations are smoke or fire stopped as required by the Code.

26 00 49 GUARANTEE

A. The Contractor shall guarantee all material, equipment and workmanship provided for this project to be free from defects for a period of one (1) year after final acceptance. The guarantee shall include replacement of the defective part(s) and related labor. Manufacturer's written guarantees shall be provided where it is published.

B. Any obvious defects shall be corrected before final acceptance. For additional defects after final acceptance, the Owner shall advise the Contractor in writing, unless the situation is urgent, to address the deficiency or malfunction. The Contractor shall respond promptly and with no additional compensation for a valid guarantee claim.

C. Longer guarantee periods of time or special conditions may be specified. See particular specifications for these requirements.

D. If a written guarantee is offered for conditions or period exceeding specified requirements; this guarantee shall be included in the “Close-out” specifications of Subsection 26 00 48.
E. The Contractor shall not qualify the guarantee with requirements placed upon the Owner. If the Contractor has concerns with maintenance of a piece of equipment then Contractor shall allow for making periodic inspections, adjustments, etc. during the warranty period.
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26 00 50 PAYMENTS

A. See General Conditions Article – Payment to the Contractor, and General Conditions Article – Contractor’s Payment to the Subcontractor.
26 00 60 MATERIAL AND EQUIPMENT

A. All equipment and materials furnished and installed by Contractor shall be new. The equipment to be furnished and installed shall be standard cataloged products of manufacturers regularly engaged in the production of this type of equipment and shall be of the latest design. Equipment of the same general type shall be of the same make throughout the Project.

B. Manufacturers shall have been in business for two (2) consecutive years operating under the same name.

C. Products shall be in production at time of the bid date. A scheduled release of a new product during construction is not acceptable. Prototype, alpha or beta products shall not be used.

D. Products for which fewer than 100 units have been produced and which have been in service for less than one year shall be submitted in writing to the Engineer for approval prior to the bid date.

E. The Contractor shall be responsible for the physical fit and configuration of the equipment to suit the space available and the intent of the Work. Due consideration shall be included for external connections and service maintenance access to the equipment.

F. The Contractor shall verify in the course of preparing the submittal that the respective material and equipment comply with the following criteria of the Project Documents:

G. The performance ratings meet the specified requirements.

H. The mechanical and electrical physical characteristics meet the specified requirements.

I. The identification of the material or equipment to catalog data is correct and proper.

J. Confirm (or establish) the quantity required.

K. The application of the material or equipment is acceptable to the manufacturer and to the intent of the scope of Work.

L. Any inability of material and/or equipment to comply with the aforementioned criteria shall be promptly brought to the attention of Architect/Engineer.

26 00 61 EQUIPMENT MANUFACTURERS

A. The equipment manufacturer may be specified in any one of the following manners. Equivalent shall mean, equivalent in the opinion of the Engineer. Where equipment is scheduled on the drawings, the scheduled manufacturer is what the design is based upon:

1. Single manufacturer named, "No substitution allowed":

2. **Single manufacturer named followed by “or approved equivalent”**:  
The design has been based on this particular make and model for acceptable physical characteristics, performance and quality. Any other comparable and equivalent product may be substituted in accordance with procedures for submittals and approvals (Subsection 26 00 43) and conditions of Subsection 26 00 62, Equipment substitution.

3. **Limited multiple manufacturers named**:  
The design has been based on the first named manufacturer for acceptable physical characteristics, performance and quality. Any one of the other limited named manufacturers is equally acceptable in quality and may be substituted in accordance with procedures for submittals and approvals (Subsection 26 00 43) and conditions of Subsection 26 00 62, Equipment substitution.

4. **Limited multiple manufacturers named followed by “or approved equivalent”**:  
The design is based on the first named manufacturer for acceptable physical characteristics, performance and quality. Any one of the other limited named manufacturers is equally acceptable in quality and along with other comparable and equivalent product may be substituted in accordance with procedures for submittals and approvals (Subsection 26 00 43) and conditions of Subsection 26 00 62, Equipment substitution.

5. **List of “Acceptable Manufacturers”**:  
Where a specific product from a manufacturer is listed along with the words “Acceptable Manufacturers” and a list of manufacturers this equal product(s) of any of the limited list may be submitted without concern from Subsection 26 00 62.

B. The Contractor shall follow the option specified from above as applied to each respective material and equipment specification subsection. The Contractor shall indicate within the options allowed the respective supply source(s) for the listing requested in Subsection 26 00 43. The Contractor shall assume all responsibilities and liabilities of “or equivalent” substitutions (see Subsection 26 00 62).

C. The Contractor shall prepare and transmit submittals for approval, even for the option of Subsection 26 00 61.1.

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**26 00 62 EQUIPMENT SUBSTITUTION**

A. General: As previously stated, the design has been based on a single manufacturer and model. Substitution, where permitted (as described above), may cause consequential effects that may impact on the Project. These effects may take various forms and may require changes in the design. These changes and any additional costs associated therewith are the responsibility of the Contractor proposing the substitution; no additional compensation shall be provided to the Contractor.
B. A possible change in design may result from the proposed substitution from one or more of, but not limited to, the following conditions:

1. **Architectural**: different physical configuration, size or fit, aesthetics effected.
2. **Structural**: different bearing or heavier loading.
3. **Capacity**: different performance, lesser output is unacceptable.
4. **Mechanical**: change in flow rates (air, water, etc.), different configuration and size of external piping or ductwork connections.
5. **Electrical**: different horsepower requirements, effect on distribution.
6. **Controls**: interconnections with control devices and equipment, additional requirements.
7. Impact on environmental or energy efficiency issues.
8. Departure from intent of original design or Project Documents.

C. Changes in loading, sizing and/or performance of the proposed substitution shall consider the total requirements served or needed by the particular equipment. A revised design to accommodate the substitution shall be extended to the point where the change has no effect on the parameters used in the original design.

D. An equipment substitution requiring a change in the design shall be processed as follows:

1. The Contractor shall prepare and submit to the Architect/Engineer for review, a proposal to provide a substitution that shall require a change in the design. Substantiate that the substitution complies with the intent of the Project Documents and include sufficient information of the changes required so that a judgment may be rendered.
2. Proposal shall include an original drawing originated by the Contractor, and shall not be a catalog cut, assembly manual, or other generic documented printed by the manufacturer or their representative. The design shall show the intended installation to the same level of detail as that of the original design.
3. Prior to submitting the proposal, the Contractor shall notify all other contractors whose work may be affected and request details and pricing for their respective changes. This information along with the Contractor's details shall be transmitted to the Architect/Engineer for approval.
4. The Contractor in preparing the proposal recognizes that they shall compensate other trades that are affected by said proposal.
5. If the proposal and the substitution are acceptable, the Architect/Engineer will approve the submittal and initiate a change order, at no additional compensation, and a notice to proceed.

E. Equipment that was listed as a multiple manufacturer with a model number shall be submitted as a shop drawing. Contractor shall be responsible for all other provisions of Section 26 00 52. If, and only if, the material or equipment substitution requires no design change, the Work shall proceed in accordance with the Product Documents.
F. Equipment that is being proposed as ‘or equivalent’ or was listed as a multiple manufacturer without a model number shall be in the form of a written proposal before the shop drawing phase. ‘Or equivalent’ shall mean or equivalent in the opinion of the Architect/Engineer and they shall have sole discretion to determine whether or not a proposed substitute manufacturer and/or model is to be considered as acceptably equivalent and may be submitted in the form of shop drawings. If, and only if, the material or equipment substitution requires no design change, the Work shall proceed in accordance with the Project Documents.

G. If changes are in fact required or a delay in work occurs because of the material or equipment substitution which were not properly processed, the Contractor initiating the substitution shall be liable for all consequential effects and expenses to accommodate the change or delay.

26 00 63 MOTORS

A. The following are basic minimum requirements for all motors. Additional motors, more detailed and specific requirements may be specified with the respective equipment.

B. Single-phase motors shall be provided for all motors 1/2 HP or less, except as specified or scheduled otherwise and shall be of the permanent split capacitor (PSC) type.

C. Polyphase motors shall be provided for all motors 3/4 HP or larger, except as specified or scheduled otherwise with a minimum power factor of .85 at 65% of full load or shall be power factor corrected.

D. Multi-speed motors shall have dual windings wound to the speeds scheduled or specified.

E. Torque characteristics shall be sufficient to satisfactorily accelerate the driven load(s) with low in rush current.

F. Motor horsepower sizes shall be large enough so that the driven load shall not require the motor to operate in the service factor range.

G. Temperature rating: Rated for 40 deg. C environment with maximum temperature rise for continuous duty at full load of 40°C for open dripproof motors, 50°C for splash proof motors, and 55°C for totally enclosed motors (Class B insulation). Motors used with variable frequency drives/inverters shall have a Class B temperature rise with Class F insulation design to resist transient spikes, high frequencies, and short rise time pulses produced by inverters.

H. Starting capability: Frequency of starts as specified by the automatic control system. For manually controlled motors, not less than five (5) evenly time spaced starts per hour.

I. Service factor: 1.15 for polyphase motors and 1.35 for single-phase motors.

J. Motor construction:
   1. NEMA standard frame sizes, general-purpose open dripproof (unless otherwise specified), continuous duty, Design “B” (unless “C” is required for high starting torque). Motor frame,
end bells and conduit box shall be cast iron; stator windings shall be copper. Aluminum is unacceptable for any parts. Provide grounding lug in motor terminal box.

2. Motors located outdoors or otherwise exposed to water, dust, etc where an open motor would not be suited, shall be totally enclosed fan-cooled (TEFC).

3. **Bearings:** Ball or roller bearings with inner and outer shaft seals. Externally accessible inlet/outlet grease fittings. Where motors are enclosed within equipment, extend grease tubing to exterior of the enclosure. Bearings designed to resist thrust loading for drives producing lateral or axial thrust. Fractional horsepower, light duty motors may have sleeve bearings.

4. **Overload protection:** Built-in thermal overload protection.

5. **Noise rating:** Motors shall meet IEEE, Standard 85.

6. **Efficiency:** Motors shall be NEMA Premium Efficiency per NEMA Standards Publication MG 1-2003, Table 12-12 and 12-13.

7. **Nameplate:** Indicate full identification of manufacturer's name, model number, serial number, horsepower, speed, voltage, characteristics, construction, special features, etc. Nameplates in harsh environments such as for cooling towers, or in pool equipment rooms, etc. shall be suited to the specific application.

K. **Acceptable manufacturers:** Baldor, General Electric, Gould, Marathon, Magnetek, Reliance, Siemens, Toshiba, and U.S. motors.

26 00 64 ACCESS DOORS

A. Openings in building components for access to concealed mechanical work shall be furnished by the Contractor and installed with the building construction work. Access doors shall be located as indicated on the Plans or as strategically required for inspection, maintenance, and service. The model and style shall fit the building construction, fire rating requirements and provide adequate size and function.

B. Access doors shall be sized as shown on the drawings or shall be a minimum size of 18” x 18” and otherwise shall be large enough for purpose intended and shall be fabricated of heavy gauge steel frames and door panels with double action concealed spring hinges, 1/4 turn flush screwdriver operated cam locks and prime coat paint finish. Access doors for various applications shall be as follows:

<table>
<thead>
<tr>
<th>Building Construction:</th>
<th>Milcor Access Door:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flush door in dry wall construction (walls and ceilings)</td>
<td>Style DW</td>
</tr>
<tr>
<td>Flush door in masonry or tile walls with exposed frame flange</td>
<td>Style M (steel), Style MS (stainless)</td>
</tr>
<tr>
<td>Flush door in plaster construction (walls and ceilings)</td>
<td>Style K</td>
</tr>
<tr>
<td>Recessed door in acoustical plaster ceiling</td>
<td>Style AP</td>
</tr>
<tr>
<td>Recessed door in suspended drywall ceiling</td>
<td>Style CT (aluminum - wet locations)</td>
</tr>
<tr>
<td>Flush door in suspended drywall ceiling</td>
<td>Style CF (aluminum - wet</td>
</tr>
</tbody>
</table>
C. Access doors are not required for Work above lay-in panel ceilings.

D. Submittals shall indicate schedule of locations, sizes, types, adjacent building construction, finish, fire rating including thickness and type of insulation, conformance to UL requirements and associated labeling, metal and gauge of fabrication. Access door shall be as manufactured by Karp Associates, Milcor, or Higgins Mfg. Company.
26 00 70  BASIC ELECTRICAL METHODS - GENERAL

26 00 71  COORDINATION OF WORK

A. The Contractor shall compare the electrical drawings and specifications with the site conditions, drawings and specifications of other trades and shall report any discrepancies between them to the Architect and obtain from him written permission for changes necessary in the electrical work. The Contractor at no addition to the contract price shall perform any such changes required. The electrical work shall be installed in cooperation with other trades installing interrelated work. Before installation, the Contractor shall make proper provisions to avoid interference in a manner approved by the Architect. All changes required in the work of the Contractor caused by his neglect to properly coordinate the work shall be made by him at his own expense.

B. In new construction, anchor bolts, sleeves, inserts and supports required for the electrical work shall be furnished under the same Section of the Specifications as the respective items to be supported; and they shall be installed, except as otherwise specified, by the trade furnishing them in cooperation with the trade furnishing and installing the material in which they are to be located. It shall be the responsibility of the Contractor who locates the anchor bolts, sleeves, inserts and supports to also ensure that they are properly and safely installed.

C. Slots, chases, openings, and recesses through floors, walls, ceilings, partitions, and roofs shall be provided as the building is erected. It shall be the responsibility of the Contractor or trade requiring and providing the opening to verify the size and location of openings required and to furnish necessary sleeves, boxes, etc., for the equipment to be supplied. Patching of oversize openings and finished thereof shall be the responsibility of the trade or Contractor requiring the opening. All patching and finishing shall be done to match the adjacent materials as described in other respective divisions and sections of the specifications. No openings shall be cut in structural members without prior written approval of the Architect.

D. Locations of conduits, electrical raceways, switches, panels, equipment, fixtures, etc., shall be adjusted to accommodate the work to interferences anticipated and encountered. The Contractor shall determine the exact route and location of each conduit, duct and electrical raceway prior to fabrication. If the Contractor fails to do so, any relocation and reinstallation required will be directed by the Architect and must be implemented by the Contractor at no cost to the Owner.

E. Right-of-way: Lines which pitch shall have the right of way over those which do not pitch. Lines whose elevations cannot be changed shall have the right of way over lines whose elevations can be changed. Offsets, transitions and changes in direction in pipes and buss ducts shall be made as required to maintain proper head room and pitch of sloping lines whether or not indicated on the drawings. The Contractor shall furnish and install all elbows, pullboxes, turns, fittings, supports, etc., as required to effect these offsets, transitions and changes in direction.

26 00 72  STORAGE AND INSTALLATION OF EQUIPMENT AND ACCESSORIES
A. Equipment and materials shall be delivered to the site, stored in location(s) approved by the Architect, and suitably sheltered from the weather, but readily accessible for inspection by the Owner. All items subject to moisture damage shall be stored in dry, heated spaces. All equipment shall be covered and protected against dirt, water and chemical or mechanical injury in a manner approved by the manufacturer and against theft, during storage, installation, and construction. Damage or defects developing before acceptance of the work shall be made good at the Contractor's expense.

B. Manufacturer's directions shall be followed completely in the delivery, storage, protection and installation of all equipment and materials. The Contractor shall promptly notify the Architect in writing of any conflict between any requirement of the contract documents and the manufacturer's directions. They shall obtain the Architect's written instruction before proceeding with the work. In case of a difference between the installation instructions of the manufacturer and the instructions in the contract documents, the most stringent shall govern. Any costs related to changes required due to manufacturer's instructions differing from the contract documents shall be borne by the Contractor at no cost to the Owner.

C. Should the Contractor perform any work that does not comply with the manufacturer's directions, any written instructions from the Architect, or which shall cause a significant deviation from the drawings which has not been by the Architect they shall bear all costs arising in correcting the deficiencies in a manner directed by the Architect.

D. Where switchgear, motor controls, transformers, or other electrical equipment is located in a space with a concrete or other type of paved flooring, it shall be set on a raised concrete pad. Unless otherwise noted on drawings or elsewhere in these specifications, concrete pads and bases shall be furnished and installed by the Contractor furnishing the equipment. This Contractor shall establish sizes and location of the various concrete bases required and shall provide all necessary anchor bolts together with templates for holding these bolts in position. Anchor bolts shall be placed in steel pipe sleeves to allow for adjustment, with a suitable plate at bottom end of sleeve to hold the bolt. Each concrete base shall be not less than 9" high, unless noted otherwise, which shall project 1-1/2" beyond the equipment on all sides.

E. Where equipment is located in a space where it does not rest on a concrete or similar paved floor, it shall be supported from or on the available structure on a structural frame made of suitable channels, wide flange members or angles. The structural frames shall allow no deflection with the loads imposed and the respective supporting points, shall distribute the load equally to two or more major building structural elements, and shall be designed to carry all loads into the major building structural members, creating no measurable deflection on these members nor importing any vibration into the building structure.

F. All machinery which contains rotating or reciprocating parts or which is connected to other machinery with such parts shall be provided with vibration isolation mounts which shall be selected at a maximum transmissibility of 0.03 (isolation efficiency of 97%) at the lowest anticipated operating speed of the device.
G. The Contractor shall support plumb, rigid and true-to-line all work and equipment furnished under each section. The Contractor shall study thoroughly all general, structural, mechanical and electrical drawings, shop drawings and catalog data to determine how equipment, fixtures, etc., are to be supported, mounted or suspended and shall provide steel bolts, inserts, pipe stands, brackets, and accessories for proper support whether or not shown on drawings. When directed by the Architect, the Contractor shall submit drawings showing supports for approval.

H. All conduit connecting to switchgear, panels, motors, and other equipment shall be installed without strain at the connections. The Contractor may be required, as directed, to disconnect conduits piping to demonstrate that they have been so connected.

I. The Contractor shall install all electrical work to permit removal (without damage to other parts) of switches, contactors, motors, drawout circuit breakers, belt guards, sheaves and drives and all other parts requiring periodic replacement and maintenance. The Contractor shall provide conduits, pullboxes, junction boxes, bus ducts, switchgear, raceways and equipment to permit ready access to components and to clear the openings of swinging and overhead doors and of access panels.

J. The Contractor shall change the routing of conduits and buss ducts when required to meet job conditions. The Contractor shall secure approval of Owner prior to fabrication of equipment requiring such changes.
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BASIC ELECTRICAL METHODS – RELATED WORK

LUBRICATION

A. This Contractor shall provide all oil for the operation of all equipment furnished by him until acceptance. Run in all bearings, and after they are run in, drain all oil from the bearings, flush out all bearings, and refill with new oil. The Electrical Contractor and Subcontractors shall be held responsible for all damage to bearings while the equipment is being operated by them up to the date of acceptance of the equipment. Protect all bearings during installation and thoroughly grease steel shafts and other unpainted steel surfaces to prevent corrosion. All motors and other equipment shall be provided with covers as required for proper protection during construction.

EXCAVATION AND BACKFILL

A. General:

1. This sub-section shall supplement Section 02200 – Earthwork for excavation, trenching, and backfilling required to install the work of Divisions 20 - 29.

2. In the event of a conflict between this sub-section and Section 02200, the more stringent shall apply.

B. Definitions:

1. Topsoil: shall be friable, free from clay lumps, grass, brush, roots, stumps, toxic substances, litter, gravel, stains greater than 1-½" diameter, or other foreign material. Topsoil shall not contain plant parts of Nutsedge, Johnson Grass, Nimblewill, Bermuda Grass, Bindweed, or other noxious weeds. Topsoil shall have the following composition by percent volume: sand (9% - 30%), silt (30% - 70%), clay (10% - 27%), organic matter (1.5% minimum) with a P.H. between 5.5 and 7.0.

2. Unsuitable Soil Materials: are defined as those complying with ASTM D2487, soil classification groups GC, SC, ML, MH, CL, CH, O, OH, and PT.

3. Suitable Soil Materials: are defined as those complying with ASTM D2487 soil classification groups GW, GP, GM, SW, SP, and SM; free of rock or gravel larger than 2" diameter, debris, waste, frozen materials, vegetation and other deleterious matter.

4. Subsoil: Earth, clay, loose stone, hard pan, abandoned piping, concrete and masonry rubble, broken paving and other materials capable of being removed with standard power driven excavating equipment.

5. Rock: Solid, natural mineral material with a volume of over 1 cubic foot and other matter (e.g.- abandoned foundations, broken paving and rubble) that cannot be removed with standard 100 HP power driven excavating equipment without drilling.
6. Common Fill: Suitable soil as determined by geotechnical testing and/or as approved by the Architect/Engineer; free from wood, debris, organic matter or other deleterious materials.

7. Granular Fill: Naturally or artificially graded mixture of natural or crushed stone, and natural or crushed sand, ASTM D2940; except with 100 percent passing a 1” sieve and not more than 8 percent passing a No. 200 sieve.

8. Drainage Fill: Washed, narrowly graded mixture of crushed stone, or crushed or uncrushed gravel; ASTM D448; coarse aggregate size 57; with 100 percent passing a 1 ½ sieve and 0 to 5 percent passing a No. 8 sieve.


10. Bedding: Natural or crushed sand.

C. The Contractor shall include the following Work:

1. Contractor shall become familiar with location of underground utilities and structures which may be encountered or affected by Work.

2. Locations of underground utilities and structures shown on Drawings are based upon available owner’s records such underground facilities or by others, and were used by engineer to prepare Contract Documents, but are not guaranteed to be complete or correct, and are given only to assist in making determination of location of underground utilities and structures.

3. Contractor shall contact the state’s One Call System for public utilities and the Owner with 72 hours notice for all private underground utility locates.

4. Where there are active utilities within 8 feet of excavation the Contractor shall locate utilities using a hydrovac. Where the excavation is parallel or near parallel with the active utility perform hydrovac location at 100 feet intervals.

5. Excavate or trench “subsoil” material in accordance with the Project Documents to depths required for the installation of underground equipment and/or piping in his respective scope of work.

6. Establish the location, routing, invert elevations, slope percentages, trench contours and perform the necessary surveying work for the excavation and trenching of his respective requirements.

7. Be responsible of protecting excavations and trenching as necessary with shoring, bracing, sheathing, sheet piling, underpinning or other methods required to prevent cave-ins, damage to adjacent improvements and injury to personnel. The requirements of OSHA shall be met.

8. Maintain the excavation and/or trenching during the progress of the Work to keep it free from water and to provide for the uninterrupted flow of surface water adjacent to and around the open ground.

9. Provide “bedding” material for uniform support of the equipment/piping in the bottom of the excavation/trench to an elevation as hereinafter specified.

10. Identification of underground utilities with marker tape, refer to Section 20 10 96
11. Backfill and compact the excavation and trenching with “common fill”, “granular fill”, and “topsoil” in a manner hereinafter specified or as otherwise noted in the respective section of the Specifications of Divisions 20 - 29.

12. Remove any existing and functioning surface improvements necessary to perform the excavation and/or trenching work, and replace to a condition equal to that prior to the removal, unless noted otherwise.

13. Protect and maintain any existing or uncovered functioning piping and/or utility services in the excavation/trenching. Any damage caused by the activity of this Contractor shall be corrected or repaired at no additional compensation.

14. Remove excess and/or “unsuitable soil materials” and backfill materials determined by the Architect/Engineer, and leave the site in a condition not imposing on subsequent work.

D. Work Not Included:

1. The Contractor shall not be responsible for removal of material defined as “rock”. In the event this requirement occurs, a change order shall be issued based on a unit price, if so requested in the proposal, or shall be negotiated. Payments for rock removal shall be limited to 8” below the invert elevation of the pipe and 18” wider than the pipe diameter.

E. Trenching, Bedding and Backfilling:

1. Trenching shall be open cut from the surface. The bottom of the trench shall be not less than 8” or more than 16” wider than the outside diameter of the pipe to be laid therein. The bottom elevation shall be clean of loose matter and shall provide for a bedding 4” deep below the piping (or conduit).

2. The “bedding” material shall extend the full width of the trench and to a height of 4” above the piping. The pipe and/or conduit shall be supported uniformly by the compacted bedding. Place and shape the bedding to support the piping over the entire length and to allow for making-up joints properly. Thoroughly compact (95% modified proctor) the bedding material along the sides of the piping for the full height of the bedding while maintaining the alignment of the pipe.

3. After pressure testing and acceptance of the underground installation by the Architect/Engineer, continue to backfill and compact (95% modified proctor) the trench as follows:
   a. For piping inside the building backfill material shall be “granular fill” in layers of 6” and compact (95% modified proctor) between layers.
   b. For piping under sidewalks, under parking lots, or under roadways backfill material shall be “granular fill” in layers of 6” and compact (95% modified proctor) between layers.
   c. For piping outside the building and not listed above then the backfill material may be “common fill” or “granular fill” placed and compacted (95% modified proctor) from the aforementioned elevation to 12” below finish grade in layers not exceeding 8”. The final 12” shall be backfilled with “topsoil”.

F. Miscellaneous:

1. Trenching shall not interfere with normal 45 degree bearing splay of foundations.
2. Exterior trenches (to the building) for utility services and pipes containing water shall provide for a depth of burial of not less than (insert local frost depth) from the top of the pipe to finished grade, unless noted otherwise.

3. Provide adequately designed and sized concrete anchor/thrust blocks at all changes in direction and end points.

4. The underground piping shall be identified with marking tape laid in the trench in accordance with Subsection 20 00 19.

G. AS-BUILT Drawings:

1. Before backfilling is commenced, the Contractor shall measure and record vertical elevations and horizontal locations of all underground equipment and piping. This information shall be recorded on "record" drawings and submitted to the Architect/Engineer as part of the "As-Built" drawings for the Project, and shall be a requisite for final payment.
26 00 90  TESTING AND ADJUSTING

26 00 91  INSTRUCTIONS OF OWNER'S REPRESENTATIVE

A. Instruct the designated representative of the Owner in the proper operation and maintenance of all elements of the electrical systems. A competent representative of the Contractor shall provide such formal instruction and shall spend such additional time as directed by Architect/Engineer to fully prepare Owner to operate and maintain the electrical systems.

26 00 92  TESTING AND ADJUSTING

A. Contractor shall, at the conclusion of the project, performance test and adjust all of the electrical systems to provide performance of all systems and subsystems installed and in all areas of the building. All power systems, communication systems, control systems and other related devices and subsystems shall be operated by the Contractor for a period of no less than seventy-two (72) hours and shall be systematically tested for proper sequencing, control, connection, phasing, rotation and calibration of control devices.

B. Testing shall be systematic and thorough, and the results of these tests shall be submitted to the Architect/Engineer prior to final acceptance of the work. The format of this testing and adjusting effort, including all measurement techniques and methods, shall be submitted sixty (60) days prior to the completion of the work. After agreement with the Architect/Engineer on the format of the testing and adjusting work, the Contractor shall perform the work and resolve any and all deficiencies as they appear during the testing. It shall be the responsibility of the Contractor to provide any and all devices required for the successful testing and adjusting of the system.
26 05 00 COMMON WORK RESULTS FOR ELECTRICAL

A. Extent: The work in this division consists of furnishing material and labor required to completely execute the electrical work for this project as per drawings and as specified herein.

C. Interface with Other Trades: This contractor shall connect some items furnished in place by others such as prewired mechanical control assemblies. This will require coordination and cooperation with the other contractors. The extent of the required electrical work is shown on the drawings.

26 05 19 LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

A. Material

1. Provisions for Wiring: Wire and cable of the sizes and types shown on the plans and/or hereinafter specified shall be furnished and installed by the Contractor. All wire and cable shall be new soft drawn copper and shall conform to all the latest requirements of the National Electrical Code IPCEA, and meet the specifications of the ASTM.

2. Power Conductors: All feeder and branch circuit wire shall be 600V 90°C insulated of the THHN & THWN-2 type unless shown or specified to be otherwise No wire less than No. 12 AWG shall be used except for control circuits or low voltage wiring. All wire sizes shown are American Wire Gauge sizes.

   a. 20A Branch Circuit Homeruns shall be sized as follows:
      120V: 0 – 100 feet shall be #12AWG wire minimum
            101 – 200 feet shall be #10AWG wire minimum
            In excess of 200 feet shall be #8AWG wire minimum
      277V: 0 – 250 feet shall be #12AWG wire minimum
            In excess of 250 feet shall be #10AWG wire minimum

3. Control Conductors: Control circuit wiring shall be No. 12 AWG or smaller stranded wire. Stranded control wire shall be provided with crimp type spade terminators. Control circuit wiring shall be color-coded or numbered using an identical number on both ends of the conductor.

B. Installation

1. All 120V and 277V single phase circuits require a dedicated neutral conductor. The neutral conductor shall be numbered and identified with associated phase conductor at the panelboard as well as all junction boxes.

4. Where circuit runs are combined, upsize conduit and conductors to accommodate for conduit fill and conductor derating respectively.

3. Metal Clad (MC) Cable
a. All type MC cable must be hospital grade. Type MC cable is permitted for wiring the final portion of light fixture branch circuits from fixture to fixture within a room or area. The MC cable may be supported by the light fixture bracing wires but shall not be supported by the ceiling grid support wires. Type MC cable is permitted for wiring from local distribution junction boxes to devices or equipment in nearby walls or ceiling space. The local distribution junction boxes should be located within 20 feet of the device or equipment served. Conduit and wiring shall be used for branch circuiting between the local distribution junction boxes and for the "homeruns" from the panels. Type MC cable is permitted to route from receptacle to receptacle through walls and through the ceiling space for the final portion of branch circuit wiring between receptacles in adjacent walls of the same room or area. Type MC cable shall not be installed where exposed.

b. Type MC cable shall contain an insulated copper equipment grounding conductor.

4. BX/AC Cable
   a. Type BX/AC cable is not permitted.

26 05 26 GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

A. Material
   1. Contractor shall install 1) a system grounding system and 2) an equipment grounding system in accordance with the National Electrical Code and shall use only UL listed grounding clamps and connectors.

B. Installation
   1. The grounding system grounding electrode conductor shall be connected to the neutral bar inside the main panel.

   2. The equipment grounding system shall consist of a continuous conduit installation and a green insulated equipment grounding conductor. This grounding conductor shall be installed in every conduit or raceway with the feeder or branch circuit conductors. **This grounding conductor shall be extended from the housing of every electrical load, through panelboard equipment grounding busses, to the equipment grounding bus in the main panel. The grounding bus shall be bonded to the grounded neutral bar inside the main panel using a Main Bonding Jumper.**

   3. When transformers are used to provide a separately derived system, the Contractor shall connect the grounding electrode conductor to the neutral bar (grounded system conductor) inside the transformer. The system bonding jumper shall also be installed inside the transformer.
4. The transformer cover shall not be installed until the Engineer has inspected the transformer grounding. Provide pictures to engineer if this does not work with project schedule.

26 05 33 RACEWAY FOR ELECTRICAL SYSTEMS

A. General Requirements

1. Minimum conduit size shall be ¾” trade size for branch circuits except for switch legs which may be ½” trade size.

2. A bushing shall be used where conduit enters a panel box or equipment enclosure.

3. Grounding Bushings shall be used to bond conduits entering a panel box or equipment that are not mechanically connected.

4. Expansion fittings shall be provided at all conduits across building expansion joints. Fittings shall be Type “AX” or “TX” as made by O-Z Electric Company, or approved equal. Provide copper bonding jumper at each expansion fitting.

5. Conduit bends shall be made with standard benders of proper size; radius of bends to be at least 6 times the diameter of the conduit. Runs between outlets shall not contain more than the equivalent of three 90-degree bends. Conduit runs shall be continuous from outlet to outlet, outlet to cabinet, etc.

6. All exposed conduits shall be installed parallel or perpendicular to the building walls or floors.

7. Conduits shall be securely fastened to or supported from the building structure. Conduits not fastened directly to building structure shall be supported by a rigid assembly, free of sway and adequately braced, connected directly to the building structure. The use of ‘pencil’ wire, ceiling wire, and cable hangers shall not be permitted.

8. Anchor or stake down all direct burial conduits to prevent shifting during grading and concrete pours. Spacers shall be provided for trenches with 2 or more conduits with any conduit 2” or larger. No conduit will be allowed to be embedded in a concrete slab. All conduits below a slab must be a minimum of 12” below concrete slabs.

9. Install #12AWG pull wires for tracing for all underground non-metallic empty conduits with a minimum of 12 inches of slack on each end. Pull strings shall be used for empty above grade or metallic conduits.

10. All raceways installed within 1½” of the roof deck shall be GRS or IMC. Boxes shall be offset below the 1½”.


11. All exposed raceways installed in a finished space will be painted to match the background, unless noted otherwise. Finished spaces include all areas open to the general public. Spaces such as storage, mechanical, IT, and electrical rooms and other similar areas only accessible to qualified personnel are considered unfinished.

12. All penetrations through not rated walls shall be sealed for draft stopping with caulk, putty, etc. designed for this use.

13. Fire / Smoke seals:
   a. All penetrations through fire rated walls and floors shall be fire sealed in accordance with ASTM E814/UL1479 or manufacturer’s recommendations.
   b. Materials and installation details shall be submitted for approval.

B. Electrical Metallic (EMT) Conduit
   1. EMT conduit shall be installed for all work concealed in partitions or in concrete block walls and for all conduits run in ceiling plenums and exposed runs, except where noted otherwise. EMT conduit shall not be used outdoors, in wet locations, in floor crawl spaces, or below 7’ AFF.
   2. EMT couplings and connectors shall be steel or diecast, compression type.

C. Galvanized Rigid Steel (GRS) Conduit
   1. Galvanized rigid steel conduits shall be installed for all exposed outdoor conduit, and for all indoor medium voltage cable runs, and for entry into underground building walls and manholes.
   2. All GRS couplings and threaded hubs shall have no less than five threads of the coupling engaged. Running threads shall not be used. All GRS conduits shall be reamed.
   3. All GRS conduits shall have two locknuts and a bushing at each termination outlet box, junction box, etc., except where terminated in a threaded hub.
   4. GRS conduit shall be installed where underground conduits and duct banks enter through building foundation, tunnel walls, and drilled holes in manhole walls. The heavy wall conduit shall enter through core drilled holes and the annular space between the conduit and wall sealed using Thunderline Corp. “Link-Seal” Catalog No. 10-LS-300-C seals. This catalog number is for a 4 inch heavy wall steel conduit and requires a 6 inch I.D. core drilled hole. Refer to the manufacturer’s installation requirements prior to drilling holes and for other conduit sizes. Seals as manufactured by Innerlynx Model C and Flexicraft Type E are acceptable equivalents.
D. Rigid Aluminum Conduit

1. Rigid aluminum conduits shall be installed for all exterior conduits supplying cooling towers.

E. Polyvinyl Chloride (PVC) Conduit

1. Conduits installed underground shall be schedule 40 PVC and a minimum size of ¾” trade size. Rigid galvanized steel elbows shall be used for all stub-ups through or out of concrete slabs or through underground wall penetrations.

2. All PVC fittings shall be connected with PVC primer and glue.

F. Metal Clad (MC) Cable

1. All type MC cable must be hospital grade. Type MC cable is permitted for wiring the final portion of light fixture branch circuits from fixture to fixture within a room or area. The MC cable may be supported by the light fixture bracing wires but shall not be supported by the ceiling grid support wires. Type MC cable is permitted for wiring from local distribution junction boxes to devices or equipment in nearby walls or ceiling space. The local distribution junction boxes should be located within 20 feet of the device or equipment served. Conduit and wiring shall be used for branch circuiting between the local distribution junction boxes and for the “homeruns” from the panels. Type MC cable is permitted to route from receptacle to receptacle through walls and through the ceiling space for the final portion of branch circuit wiring between receptacles in adjacent walls of the same room or area. Type MC cable shall not be installed where exposed.

2. Type MC cable shall contain an insulated copper equipment grounding conductor.

G. BX/AC Cable

1. Type BX/AC cable is not permitted.

H. Jacketed Flexible Steel Conduit

1. Jacketed flexible steel conduit (‘Sealtite’) shall be used in wet areas where flexible conduit connections are required and on all motorized equipment and motors in all locations.

I. Flexible Steel Conduit

1. Flexible steel conduit (‘Greenfield’) shall be used where vibration isolation is required, including all transformers and uninterruptible power systems.

J. High Density Polyethylene (HDPE)
1. Type HDPE Schedule 40 to be used for all directional boring applications. Provide UL listed coupling fitting where transitioning from HDPE to PVC/GRC.

K. PVC coated Galvanized Rigid Steel Conduit

1. PVC coated galvanized rigid steel conduits shall be installed for all exposed outdoor conduit.

2. All PVC coated GRS couplings and threaded hubs shall have no less than five threads of the coupling engaged. Running threads shall not be used. All PVC coated GRS conduits shall be reamed.

3. All PVC coated GRS conduits shall have two locknuts and a bushing at each termination outlet box, junction box, etc., except where terminated in a threaded hub.

4. Patch all damaged areas of coating protection upon completion of installation.

L. MI Cable – Not used

M. Surface Mounted Raceway – Not Used

26 05 34 BOXES FOR ELECTRICAL SYSTEMS

A. Outlet Boxes, Junction Boxes, Fittings

1. Mounting: Outlets must be centered with regard to paneling, furring, trim, etc. Outlets shall be set plumb or horizontal and shall extend to finished surface of wall, ceiling, or floor without projecting beyond or behind finished surface. Outlet boxes shall not be installed “back-to-back”.

2. Attaching: Boxes shall be attached by fastener designed for the purpose and shall provide adequate mechanical strength for future maintenance.

   a. Boxes installed in metal stud partitions shall be secured to the metal studs using appropriate clips, fasteners, hangers, or supports as required, and shall provide adequate far side box support to fulfill the intent of all applicable codes.

3. Pull boxes and junction boxes shall be installed where indicated on the drawings or where required to facilitate wire installation.

   a. Size: Outlet, junction, and pull boxes not dimensioned shall be 4 inch square by 2-1/8” deep minimum and comply with sizing as required by Article 314 of the National Electrical Code.
4. In fire rated drywall walls, 24” spacing must be maintained between boxes on opposite sides of walls. Moldable fire protective putty pads, firestopping coverplate gaskets, internal fire rated pads or other acceptable fire sealing means shall be installed on outlet boxes where the 24” spacing cannot be maintained.

5. Steel faceplates must be used on fire rated drywall walls and painted to match device color. Faceplates shall be Mulberry Metal Products or equivalent.

6. All outdoor junction boxes and condulets shall be gasketed.

7. Handholes shall be installed where indicated on the drawings or where required to facilitate wire installation.
   a. Handholes not dimensioned shall be 12 inch by 12 inch by 12” deep minimum with open bottom and comply with sizing as required by Article 314 of the National Electrical Code. Handhole to be gasketed. Install on a minimum 6” gravel base with top of handhole flush with grade. Manufactured by Quazite or equivalent.
   b. Bolted style cover with gasket to match handhole. Include with “Electric” logo, unless noted otherwise.
   c. Handhole and handhole cover to be rated as Tier 15 loading.

8. Manholes shall be installed where indicated on the drawings.
   a. Manholes to be precast concrete and rated for H-20 structural load rating (medium duty)
   b. Manholes to be 6'-0" x 12'-0" x 8'-0" deep with 36" opening, unless noted otherwise.
   b. Cover to be solid, constructed of cast iron. Include with “Electric” logo, unless noted otherwise.
   c. Manhole accessories to include galvanized cabling racking and pulling irons on all four sides, sump pump pit and hook ladder.

26 05 36 CABLE TRAYS FOR ELECTRICAL SYSTEMS

26 05 36 Wire Basket

A. Cable tray shall be electro-plated zinc sized as indicated on the drawings.

1. Cable tray shall be installed in such a manner and with proper parts to maintain an equipment ground path. Bond cable tray where non-continuous. Bond tray to the nearest effectively grounded material.

2. Furnish cable tray with all required accessories for a complete installation.

3. Supports shall be wall brackets or center hangers as indicated on the drawings. Adequate bracing shall be provided to prevent twisting of the tray when loaded.

4. Bond wire basket cable tray where non-continuous. Bond tray to the nearest effectively grounded material.
5. Cable tray shall be B-Line Flextray, Hubbell Wire Basket Tray System, Cablofil Wire Basket Tray, Monosystems Mono-Mesh or equivalent.

6. Wire basket cable tray shall have a 2 inch minimum usable loading depth by 8 inches wide.

B. Submittal

1. Catalog Cutsheets including all accessories, parts, and components for a complete installation.

2. Installation instructions.

3. Shop drawings to include Manufacturer’s layout in PDF or CAD DWG.

26 05 48 SEISMIC RESTRAINT

A. All materials and workmanship shall specifically comply with the above listed Building Code with respect to seismic requirements for the support and anchorage of all electrical, communications and electronic safety and security systems and equipment as installed on this project. Lateral forces to be restrained shall be as required by IBC Section 1621 Architectural, Mechanical, and Electrical Component Seismic Design Requirements and ASCE 7-02 Section 9.6 Architectural, Mechanical, and Electrical Components and Systems with the following design parameters with the design parameters as shown on the drawings:

Site Class as Defined in the IBC: C.
Assigned Seismic Use Group or Building Category as Defined in the IBC: II.

C. All conduit support and restraint details and practices shall conform to the publication “Seismic Restraint Systems Guidelines” by Cooper B-line-TOLCO.

D. Seismic restraint submittals shall be provided for engineer review and include, but not be limited to, detailed drawings showing seismic restraint types, anchor type and attachment details, calculations and spacing requirements of unique equipment and conduit for this specific project. Submittals shall include floor plan drawings indicating equipment, ductwork and piping to be restrained, restraint locations and restraint component types. All submittals and floor plan drawings shall bear the seal of a licensed structural engineer of the State of Missouri.

26 05 73 ARC FLASH HAZARD ANALYSIS, SHORT CIRCUIT AND SELECTIVE COORDINATION

A. The contractor shall furnish an Arc Flash Hazard Analysis Study for all distribution equipment downstream of ‘MSB’, including but not limited to control panels, starters, disconnects, etc. per
the requirements set forth in the current version of NFPA 70E. The arc flash hazard analysis shall be performed according to the IEEE Standard 1584 – 2002.

B. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the responsible charge and approval of a Registered Professional Electrical Engineer, licensed in the State of Missouri, and skilled in performing and interpreting the power system studies.

C. The studies shall be performed using the latest version of SKM Systems Analysis PowerTools for Windows (PTW) software program.

D. Short Circuit Analysis:

1. Transformer design impedances shall be used when test impedances are not available.

2. Provide the following:

   a. Calculation methods and assumptions
   b. Selected base per unit quantities
   c. One-line diagram of the system being evaluated that clearly identifies individual equipment buses, bus numbers used in the short-circuit analysis, cable and bus connections between the equipment, calculated maximum short-circuit current at each bus location and other information pertinent to the computer analysis. Labeling of components shall match the one-line and floorplans.
   d. The study shall include input circuit data including electric utility system characteristics, source impedance data, conductor lengths, number of conductors per phase, conductor impedance values, insulation types, transformer impedances and X/R ratios, motor contributions greater than 10HP, and other circuit information as related to the short-circuit calculations.
   e. Tabulations of calculated quantities including short-circuit currents, X/R ratios, equipment short-circuit interrupting or withstand current ratings and notes regarding adequacy or inadequacy of the equipment rating.
   f. Results, conclusions, and recommendations. A comprehensive discussion section evaluating the adequacy or inadequacy of the equipment must be provided and include recommendations as appropriate for improvements to the system.

3. For solidly-grounded systems, provide a bolted line-to-ground fault current study for applicable buses as determined by the engineer performing the study.

E. Protective Device Coordination Analysis:
1. Protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.

2. Include on each TCC graph, a complete title with descriptive device names.

3. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.

4. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.

5. Plot the following characteristics on the TCC graphs, where applicable:
   
a. Medium and low voltage fuses including manufacturer’s minimum melt, total clearing, tolerance, and damage bands
   
b. Low voltage equipment circuit breaker trip devices, including manufacturer’s tolerance bands
   
c. Transformer full-load current, magnetizing inrush current, inrush/full load current multiplier, and ANSI through-fault protection curves
   
d. Medium voltage conductor damage curves
   
e. Ground fault protective devices, as applicable
   
f. Pertinent motor starting characteristics and motor damage points, where applicable
   
g. The largest feeder circuit breaker in each motor control center and applicable panelboard.

6. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.

7. Final overcurrent device settings as identified by the protective device coordination study shall be implemented by the installing contractor.

F. Arc Flash Hazard Analysis:

1. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in the latest version of NFPA70E, Annex D. The arc flash hazard analysis shall be performed in conjunction with the short-circuit analysis and the protective device time-current coordination analysis.

2. The flash protection boundary and the incident energy shall be calculated at significant locations in the electrical distribution system (switchboards, switchgear, motor-control
centers, panelboards, busway and splitters) where work could be performed on energized parts.

3. Working distances shall be based on IEEE 1584. The calculated arc flash protection boundary shall be determined using those working distances.

4. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.

5. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location in a single table. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum. Conversely, the maximum calculation will assume a maximum contribution from the utility. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable as well as any stand-by generator applications.

6. The Arc-Flash Hazard Analysis shall be performed utilizing mutually agreed upon facility operational conditions, and the final report shall describe, when applicable, how these conditions differ from worst-case bolted fault conditions.

7. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors should be decremented as follows:

8. Fault contribution from induction motors should not be considered beyond 5 cycles.

9. For each piece of ANSI rated equipment with an enclosed main device, two calculations shall be made. A calculation shall be made for the main cubicle, sides, or rear; and shall be based on a device located upstream of the equipment to clear the arcing fault. A second calculation shall be made for the front cubicles and shall be based on the equipment’s main device to clear the arcing fault. For all other non-ANSI rated equipment, only one calculation shall be required and it shall be based on a device located upstream of the equipment to clear the arcing fault.

10. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.

11. Mis-coordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the
calculation should utilize the fastest device to compute the incident energy for the corresponding location.

12. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. A maximum clearing time of 2 seconds will be used based on IEEE 1584-2002 section B.1.2. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

G. Submittal:

1. The results of studies shall be summarized in a preliminary and final report. The preliminary report shall be provided prior to submitted equipment approval. Three (3) bound copies of the complete final report shall be submitted. Electronic PDF copies of the report shall be provided. The report shall include:

   a. A One-line diagram shall be provided which clearly identifies individual equipment buses, bus numbers, device identification numbers and the maximum available short-circuit current at each bus when known.

   b. Log-log plots shall be provided to indicate the degree of system protection and coordination by displaying the time-current characteristics of series connected overcurrent devices and other pertinent system parameters.

   c. Adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.

   d. Results of the Arc-Flash Hazard Analysis shall be submitted in tabular form, and shall include device or bus name, bolted fault and arcing fault current levels, flash protection boundary distances, working distances, minimum personal-protective equipment AFIE rating and AFIE (Arc Flash Incident Energy) levels.

   e. Arc Flash Labels shall be furnished and installed in accordance with NFPA 70E and all applicable local codes and standards.

   f. Notify the engineer in writing, of any circuit protective devices improperly rated for the calculated available fault current, of any significant deficiencies in protection and/or coordination and of any significant deficiencies in protection and/or coordination.

   g. The study shall include a separate, tabular printout containing the recommended settings of all adjustable overcurrent protective devices, the equipment designation where the device is located, and the device number corresponding to the device on the system one-line diagram.
PART 1 - GENERAL

1.1. DESCRIPTION

A. The purpose of this section is to specify Division 26 responsibilities in the commissioning process which are being directed by the CxA.

B. The systems to be commissioned are listed in Section 01 09 00 Part 1.10.

C. Commissioning requires the participation of Division 26 to ensure that all systems are operating in a manner consistent with the Contract Documents. The general commissioning requirements and coordination are detailed in Section 01 09 00. Division 26 shall be familiar with all parts of Section 01 09 00 and the commissioning plan issued by the CxA and shall execute all commissioning responsibilities assigned to them in the Contract Documents.

1.2. RESPONSIBILITIES

A. Electrical Contractors. The commissioning responsibilities applicable to the electrical contractor are as follows (all references apply to commissioned equipment only):

Construction and Acceptance Phases

1. Attend a commissioning scoping meeting and other necessary meetings scheduled by the CxA to facilitate the Cx process.

2. Contractors shall provide normal cut sheets and shop drawing submittals to the CxA of commissioned equipment.

3. Provide additional requested documentation, prior to normal O&M manual submittals, to the CxA for development of start-up and functional testing procedures.

   a. Typically this will include detailed manufacturer installation and start-up, operating, troubleshooting and maintenance procedures, full details of any owner/using agency-contracted tests, full factory testing reports, if any, and full warranty information, including all responsibilities of the Owner/Using Agency to keep the warranty in force clearly identified. In addition, the installation and checkout materials that are actually shipped inside the equipment and the actual field checkout sheet forms to be used by the factory or field technicians shall be submitted to the Commissioning Authority.

   b. The Commissioning Authority may request further documentation necessary for the commissioning process.

   c. This data request may be made prior to normal submittals.

4. Provide a copy of the O&M manuals submittals of commissioned equipment, through normal channels, to the CxA for review and approval.

5. Contractors shall assist (along with the design engineers) in clarifying the operation and control of commissioned equipment in areas where the specifications, control drawings or equipment documentation is not sufficient for writing detailed testing procedures.

6. Provide assistance to the CxA in preparation of the specific functional performance test procedures specified. Subs shall review test procedures to ensure feasibility, safety and equipment protection and provide necessary written alarm limits to be used during the tests.

7. Develop a full start-up and initial checkout plan using manufacturer’s start-up procedures and the prefunctional checklists from the CxA for all commissioned equipment. Submit to CxA for review and approval prior to startup. Refer to Section 01 09 00 Part 3.4 for further details on start-up plan preparation.

8. During the startup and initial checkout process, execute and document the electrical-related portions of the prefunctional checklists provided by the CxA for all commissioned equipment.
9. Perform and clearly document all completed startup and system operational checkout procedures, providing a copy to the CxA.

10. Address current A/E punch list items before functional testing.

11. Provide skilled technicians to execute starting of equipment and to execute the functional performance tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.

12. Correct deficiencies (differences between specified and observed performance) as interpreted by the CxA, CPM and A/E and retest the equipment.

13. Prepare O&M manuals according to the Contract Documents.

14. During construction, maintain as-built red-line drawings for all drawings and final CAD as-buils for contractor-generated coordination drawings. Update after completion of commissioning (excluding deferred testing).

15. Provide training of the Owner/Using Agency’s operating staff using expert qualified personnel as specified.

16. Coordinate with equipment manufacturers to determine specific requirements to maintain the validity of the warranty.

Warranty Period

1. Execute seasonal or deferred functional performance testing, witnessed by the CxA, according to the specifications.

2. Correct deficiencies and make necessary adjustments to O&M manuals and as-built drawings for applicable issues identified in any seasonal testing.

B. Electrical Designer/Engineer

1. Refer to Section 01 09 00 or the responsibilities of the Electrical Designer/Engineer.

1.3. RELATED WORK

A. Refer to Section 01 09 00 Part 1.1 for a listing of all sections where commissioning requirements are found.

B. Refer to Section 01 09 00 Part 1.10 for systems to be commissioned and Section 01 09 00 Part 3.6 for functional testing requirements.

PART 2 - PRODUCTS

2.1. TEST EQUIPMENT

A. Division 26 shall provide all test equipment necessary to fulfill the testing requirements of this Division.

B. Refer to Section 01 09 00 Part 2.1 for additional Division 26 requirements.

PART 3 - EXECUTION

3.1. SUBMITTALS

A. Division 26 shall provide submittal documentation relative to commissioning equipment and systems as required Part 1 and Section 01 09 00 Part 3.3.

3.2. STARTUP

A. The electrical contractors shall follow the start-up and initial checkout procedures listed in the Responsibilities list in this section and in Section 01 09 00 Part 3.4. Division 26 and has start-up responsibility and is required to complete systems and sub-systems so they are fully functional, meeting the design objectives of the Contract Documents. The commissioning procedures and functional testing do not relieve or lessen this responsibility or shift that responsibility partially to the commissioning Authority or Owner/Using Agency.
B. Functional testing is intended to begin upon completion of a system. Functional testing may proceed prior to the completion of systems, or sub-systems at the discretion of the CxA and CPM. Beginning system testing before full completion does not relieve the Contractor from fully completing the system, including all prefunctional checklists as soon as possible.

3.3. FUNCTIONAL PERFORMANCE TESTS
A. Refer to Section 01 09 00 Part 1.10 for a list of systems to be commissioned and to Part 3.6 for a description of the process.

3.4. TESTING DOCUMENTATION, NON-CONFORMANCE AND APPROVALS
A. Refer to Section 01 09 00 Part 3.4 for specific details on non-conformance issues relating to prefunctional checklists and tests.
B. Refer to Section 01 09 00 Part 3.7 for issues relating to functional performance tests.

3.5. OPERATIONS AND MAINTENANCE (O&M) MANUALS
A. The following O&M Manual requirements do not replace O&M manual documentation requirements elsewhere in these specifications.
B. Division 26 shall compile and prepare documentation for all equipment and systems covered in Division 26 and deliver to the GC for inclusion in the O&M manuals, according to this Section, prior to the training of Owner/Using Agency personnel.
C. The CxA shall receive a copy of the O&M manuals for review.

3.6. TRAINING OF OWNER/USING AGENCY PERSONNEL
A. The GC shall be responsible for training coordination and scheduling and ultimately to ensure that training is completed. Refer to Section 01 09 00 Part 3.9 for additional details.
B. The CxA shall be responsible for overseeing and approving the content and adequacy of the training of Owner/Using Agency personnel for commissioned equipment. Refer to Section 01 09 00 Part 3.9 for additional details.
C. **Electrical Contractor.** The electrical contractor shall have the following training responsibilities:
   1. Provide the CxA with a training plan two weeks before the planned training according to the outline described in Section 01 09 00 Part 3.9.
   2. Provide designated Agency personnel with comprehensive training in the understanding of the systems and the operation and maintenance of each major piece of commissioned electrical equipment or system.
   3. Training shall start with classroom sessions, if necessary, followed by hands on training on each piece of equipment, which shall illustrate the various modes of operation, including startup, shutdown, fire/smoke alarm, power failure, etc.
   4. During any demonstration, should the system fail to perform in accordance with the requirements of the O&M manual or sequence of operations, the system will be repaired or adjusted as necessary and the demonstration repeated.
   5. The appropriate trade or manufacturer's representative shall provide the instructions on each major piece of equipment. This person may be the start-up technician for the piece of equipment, the installing contractor or manufacturer's representative. Practical building operating expertise as well as in-depth knowledge of all modes of operation of the specific piece of equipment is required. More than one party may be required to execute the training.
   6. The training sessions shall follow the outline in the Table of Contents of the operation and maintenance manual and illustrate whenever possible the use of the O&M manuals for reference.
   7. Training shall include:
SECTION 26 08 00 - COMMISSIONING OF ELECTRICAL SYSTEMS

a. Use the printed installation, operation and maintenance instruction material included in the O&M manuals.

b. Include a review of the written O&M instructions emphasizing safe and proper operating requirements, preventative maintenance, special tools needed and spare parts inventory suggestions. The training shall include start-up, operation in all modes possible, shut-down, seasonal changeover and any emergency procedures.

c. Discuss relevant health and safety issues and concerns.

d. Discuss warranties and guarantees.

e. Cover common troubleshooting problems and solutions.

f. Explain information included in the O&M manuals and the location of all plans and manuals in the facility.

g. Discuss any peculiarities of equipment installation or operation.

h. The format and training agenda in *The HVAC Commissioning Process, ASHRAE Guideline 1.1-2007* is recommended.

i. Classroom sessions shall include the use of overhead projections, slides, video and audio taped material as might be appropriate.

8. Hands-on training shall include start-up, operation in all modes possible, including manual, shut-down and any emergency procedures and maintenance of all pieces of equipment.

9. The Electrical Contractor shall fully explain and demonstrate the operation, function and overrides of any local packaged controls, not *controlled* by the central control system.

10. Training shall occur after functional testing is complete, unless approved otherwise by the Construction Project Manager.

11. Duration of Training. The electrical contractor shall provide training on each piece of equipment listed in the following schedule. This list is not meant to be all inclusive but is to provide a representative example of the level of training required by the electrical contractor. Electrical contractor shall assign hours to each type of equipment/system and submit completed comprehensive list and schedule to CxA and Owner/Using Agency for review prior to implementation.

<table>
<thead>
<tr>
<th>Hours</th>
<th>System</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lighting controls and systems (interior and exterior)</td>
</tr>
<tr>
<td></td>
<td>Security system (access control system)</td>
</tr>
<tr>
<td></td>
<td>Electrical power systems (medium &amp; low voltage, power quality &amp; control systems)</td>
</tr>
<tr>
<td></td>
<td>Fire alarm and smoke detection system</td>
</tr>
<tr>
<td></td>
<td>Telecommunications cabling systems (interior and exterior)</td>
</tr>
<tr>
<td></td>
<td>Overhead doors with automatic operators</td>
</tr>
</tbody>
</table>

3.2. DEFERRED TESTING

A. Refer to Section 01 09 00 Part 3.10 for requirements of deferred testing.

3.3. WRITTEN WORK PRODUCTS

A. Written work products of Contractors will consist of the start-up and initial checkout plan described in Section 01 09 00 Part 3.11 and the filled out start-up, initial checkout and prefunctional checklists.

END OF SECTION 26 08 00
A. OCCUPANCY SENSORS

1. Ceiling mounted occupancy sensors shall be dual-technology and white in color unless otherwise noted: Watt Stopper #DT-300, Hubbell #OMNI-DT-1000, Leviton #OSC10-MOW, Sensorswitch #CM-PDT-9, Lutron LOS-LDT-1000-WH or approved equivalent.

   a. Sensors shall be programmed to the following time delays:
      1. Open Offices/Classrooms – 30 minutes
      2. Bathrooms – 10 minutes
      3. Conference Rooms – 5 minutes
      4. Corridors – 5 minutes

2. Wall mounted occupancy sensors shall be dual-technology and white in color: Watt Stopper #DT-200, Hubbell #LOD-T, Leviton #OSW12-RMW, Sensorswitch #WV-PDT-16, Lutron LOS-WDT-WH or approved equivalent.

   a. Time delays – Refer to ceiling mount occupancy sensors.

3. Wallswitch occupancy sensors shall be white in color and be Watt-Stopper #DSW-100, Hubbell #LHMTS1, Leviton #OSSMD, Sensorswitch #WSD-PDT, Lutron MS-B102 or approved equivalent.

   a. Sensors shall be programmed to the following time delays:
      1. Offices – Adaptive if available, otherwise 30 seconds, walk-through enabled
      2. Conference Rooms – 5 minutes, walk-through enabled
      3. Storage Rooms – 30 seconds, walk-through enabled

4. Dual relay wall switch occupancy sensors shall be white in color and be: Wattstopper #DW-200, Hubbell #LHMTD2, Leviton #OSSMD, Sensorswitch #WSD-PDT-2P, Lutron MS-B202 or approved equipment.

   a. Time delays – Refer to wall switch occupancy sensors.

5. Provide occupancy sensors with relay packs as required or shown on the drawings.

6. Occupancy sensors shall be programmed to ‘manual-on’ unless otherwise specified.

7. Provide open plenum rated wiring in accordance with manufacturer’s wiring diagrams.

8. Rooms or areas with multiple sensors shall be wired so that any sensor activates all lights.
9. Sensors shall be installed a minimum of 6’ from all diffusers.

10. Refer to wiring diagrams on drawings for additional requirements.

B. DIGITAL COUNTDOWN TIMERS

1. WattStopper TS-400, Leviton 61244 Digital Countdown Timer or approved equivalent.

2. Countdown Timer to be programmed to the following:
   a. Storage Rooms – 5 minutes with audio and visual options disabled.
   b. Mechanical/Electrical Rooms – 20 minutes with audio and visual options enabled.

26 09 43 NETWORK LIGHTING CONTROLS

A. SYSTEM

1. Furnish and install a complete low voltage lighting control system consisting of relay control panels, switches and wiring to provide control as shown on the drawings.

2. Manufacturer shall submit specific connection diagrams and riser diagrams related to this project for approval.

3. System shall be a ‘Wattstopper DLM Lighting Control System as manufactured by Wattstopper or equivalent.
   a. System shall be furnished with a handheld display unit for system programming and time clock functions.

4. System shall be networked to allow complete system control from any switch location.

5. Contractor shall program system as shown in contract documents.
   a. Contractor shall furnish panel directories indicating circuit designation, and area designation for each relay.
   b. Contractor shall furnish the following as operating and maintenance manuals:
      1. Installation and programming instructions for all system components.
      2. Operating instructions for all system components.
      3. Relay schedule documentation.
      4. Switch schedule documentation.
      5. Time Clock schedule documentation.
B. Relays

1. Relays shall be mounted in control panels containing terminal strips, transformers, rectifiers, all interconnecting wiring and switch interface modules for multiple relays. Relays shall maintain position during power outages.

2. Low Voltage Relays shall be Wattstopper relay modules with manual by-pass or equal.

C. Switches

1. Switches shall be 4-wire bus controlled. The 4-wire bus shall be designed for open topology.

2. Switches shall have typed labels indicating fixtures controlled per the drawings.

3. Switches shall have LEDs indicating on/off status.

4. Switches shall be capable of being configured to control a single relay, a group of relays, or pattern control.

5. Lighting Switches shall be Wattstoper switches as indicated on the drawings, or equivalent.

D. Wiring

1. All wiring shall be as required by the equipment supplier.

2. Wiring may be run as concealed open-type plenum rated cable. Exposed or inaccessible wiring shall be installed in conduit. Where possible wiring/conduit shall be concealed.

E. Testing and Checkout

1. The Contractor shall provide a representative from the company to conduct a 4-hour training class at a time scheduled in advance with the Owner and shall occur during or immediately following system startup. These instructions are to be conducted during normal working hours. All pertinent costs shall be included in this contract.
26 20 00  LOW-VOLTAGE ELECTRICAL TRANSMISSION

A. SHORT CIRCUIT RATINGS

1. All short circuit ratings shall be Fully Rated device ratings, not Series Rated.

B. SERVICE ENTRANCE

1. One new pad mounted transformer shall be set by the Utility Company with secondary ratings of 3 phase, 4 wire, 480Y/277 volts. This Contractor shall furnish and install the secondary feeder from the transformer to the new main panel. The transformer pad and the primary feeder shall be furnished and installed by the Utility.
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26 22 00   LOW-VOLTAGE TRANSFORMERS

26 22 13   DRY-TYPE TRANSFORMERS

A. 600 Volts and Below

1. Furnish and install, as indicated on the electrical plans, dry-type transformer as manufactured by Square D Company, General Electric, Hevi-duty, Siemens or Eaton Cutler Hammer.

2. Three phase transformers shall be 480 delta primary and 208Y/120 secondary. Transformer shall have a minimum of 4 - 2-1/2% full current below normal and 2 - 2-1/2% full current above normal taps.

3. Transformers shall be ANSI Class AA (Self-Cooled), as defined by ANSI-C57.12.01. Transformers shall be 115°C-temperature rise above 40°C ambient. 115°C rise transformers shall be capable of carrying a 15% continuous overload without exceeding a 150°C rise in a 40°C ambient. All insulating materials to be in accordance with NEMA ST20-2014 standards for a 220°C UL component recognized insulation system.

4. Transformer efficiency shall be in accordance with DOE 10 CFR 431.192, April 2014.

5. Provide copper windings.

6. Transformers shall be US Department of Energy Candidate Standard Level (CSL) 3 with extremely low no load losses as well as being Harmonic Mitigating. Transformers shall be 115°C-temperature rise above 40°C ambient. All insulating materials to be in accordance with NEMA ST20-2014 standards for a 220°C UL component recognized insulation system.

7. K-Factor Rating: Transformers indicated to be K-factor rated shall comply with UL 1561 requirements for nonsinusoidal load current-handling capability to the degree defined by designated K-factor.
   a. Unit shall not overheat when carrying full-load current with harmonic distortion corresponding to designated K-factor.
   b. Indicate value of K-factor on transformer nameplate.

8. Provide a 4"wide x 1½" high phenolic nameplate reading the following for each switch:

   __kVA TRANSFORMER IDENTIFICATION (3/8” Lettering)
   FEEDS LOAD NAME (3/8” Lettering)
   FED FROM SOURCE NAME (1/4” Lettering)

9. Submittals
   a. Enclosure dimensions
b. KVA rating
c. Primary and secondary nominal voltages
d. Voltage taps
e. Weight
f. Insulation class
g. Temperature rise
h. Core and coil materials
i. Impedances
j. Audible noise level
k. Inrush data

10. Refer to Section 26 00 72 for support of equipment and “housekeeping pad” requirements.
26 24 00 SWITCHBOARDS AND PANELBOARDS

26 24 13 MAIN SWITCHBOARD

A. The main switchboards shall be furnished and installed as shown on the drawings and specified below.

1. The switchboards shall be dead front with front accessibility only in NEMA 1 enclosure.

2. The switchboards’ bussing shall be plated copper sized in accordance with UL 891 and have a short circuit rating of 50,000 RMS symmetrical amperes.

3. Provide 6” wide x 2” high phenolic switchboard nameplates reading the following:

<table>
<thead>
<tr>
<th>Nameplate Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWITCHBOARD MDPA</td>
</tr>
<tr>
<td>480/277V 3PH 4W 3000A</td>
</tr>
<tr>
<td>50kAIC FULLY RATED</td>
</tr>
<tr>
<td>FED FROM UTILITY TRANSFORMER</td>
</tr>
<tr>
<td>(5/8” Lettering)</td>
</tr>
<tr>
<td>(3/8” Lettering)</td>
</tr>
<tr>
<td>(3/8” Lettering)</td>
</tr>
<tr>
<td>(3/8” Lettering)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Nameplate Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>SWITCHBOARD MDPB</td>
</tr>
<tr>
<td>480/277V 3PH 4W 1200A</td>
</tr>
<tr>
<td>50kAIC FULLY RATED</td>
</tr>
<tr>
<td>FED FROM UTILITY TRANSFORMER</td>
</tr>
<tr>
<td>(5/8” Lettering)</td>
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<tr>
<td>(3/8” Lettering)</td>
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<tr>
<td>(3/8” Lettering)</td>
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<tr>
<td>(3/8” Lettering)</td>
</tr>
</tbody>
</table>

B. Fusible switches or circuit breakers shall be provided in the sizes and arrangements shown on the drawings. Provide a 3” wide x 1” high phenolic nameplate for each switch/breaker as follows:

<table>
<thead>
<tr>
<th>Equipment Identification</th>
</tr>
</thead>
<tbody>
<tr>
<td>__AS/__AF</td>
</tr>
<tr>
<td>(XX AMP SWITCH/XX AMP FUSE)</td>
</tr>
<tr>
<td>(1/4” Lettering)</td>
</tr>
</tbody>
</table>

C. The utility metering compartment shall be located in the top half of the service entrance section.

D. The customer metering compartment shall be located in the top half of the service entrance section. Digital metering shall be as specified in 26 27 13.

E. Manufacturer: The main switchboard will be a Type QED1 as manufactured by Square D or equivalent by General Electric, Siemens, or Eaton Cutler Hammer.

F. Refer to Section 26 00 72 for support of equipment and “housekeeping pad” requirements.

26 24 16 PANELBOARDS

A. DISTRIBUTION PANELBOARDS:
1. Panelboards shall be installed as shown on the drawings and specified below.

2. Panels shall be dead front type, with fusible switches or circuit breakers furnished in sizes as indicated on drawings.

3. The panels shall include an equipment grounding bus.

4. Main buses and connectors shall be copper of sufficient current carrying capacity to limit the temperature rise to 65KC per UL tests and have a minimum short circuit rating of 10,000A (120/208V) or 14,000A (277/480V) or as noted on the drawings.

5. All main bus joints, tap connections and contact points shall be silver or tin-plated.

6. Provide a 6” wide x 2” high phenolic switchboard nameplate reading the following:

   **PANELBOARD IDENTIFICATION**
   
   V _ Ph _ W _ A
   kAIC FULLY RATED
   FED FROM

   **EQUIPMENT IDENTIFICATION**
   
   AS/AF
   XX AMPS WITH/XX AMP FUSE

   a. The switches shall be provided with a door interlock to prevent access to fuses and switch when energized and manually operated interlock defeat mechanism. The door is to be furnished with “on-off” handle position markings and a means to lock the switch in the open position is to be provided.

7. Fusible Switches and Circuit Breakers: Fusible switches and circuit breakers shall be provided in the sizes and arrangements shown on the drawings. Fusible switches shall accept Class R fuses. Provide a 3” wide x 1” high phenolic nameplate for each switch as follows:

   **EQUIPMENT IDENTIFICATION**
   
   AS/AF
   (XX AMPS WITH/XX AMP FUSE)

   a. The switches shall be provided with a door interlock to prevent access to fuses and switch when energized and manually operated interlock defeat mechanism. The door is to be furnished with “on-off” handle position markings and a means to lock the switch in the open position is to be provided.

8. Manufacturer: The panelboard shall be as manufactured by Siemens, Square D Company, General Electric, or Eaton Cutler Hammer.

9. Refer to Section 20 00 72 for support of equipment and “housekeeping pad” requirements.

B. CIRCUIT BREAKER PANELBOARDS

1. Panels shall be dead front, safety type, furnished with branch circuit protecting devices, equipment grounding bus, phenolic nameplate, main bus and cable lugs factory assembled, with all components in place, ready for installation. Contractor to determine top or bottom feed for lug placement. Feed locations shall not be reviewed by the Engineer.
2. The circuit breakers shall be of the molded case, bolt-on type suitable for voltage and ampere ratings indicated on drawings and in schedules and shall have a minimum interrupting capacity of 10,000 amperes (120/208V) or 14,000 amperes (277/480V) or as noted on the drawings.

3. Buses and connectors shall be silver or tin plated hard drawn copper of 98% conductivity, with current carrying capacity to maintain established rise tests as defined in UL Standard UL 67.

4. A directory frame shall be attached to inside face of hinged door. The directory card shall be neatly typed to identify circuits. A transparent plastic facing shall protect the directory card. Room numbers shall be included in directory descriptions. Furnish a copy of each panel directory to the Architect/Engineer. Where existing panelboard loads are modified, the panel directories shall be updated.

5. All flush mounted panelboards shall have spare 1" conduits stubbed up out of the panelboard and extended to above an accessible ceiling. Panelboards in interior wall shall have two conduits stubbed out on both sides of the wall (four conduits total). Panelboards in exterior walls shall have three conduits stubbed out into the building interior.

6. Panelboards to be by Square D Corporation, Siemens, General Electric Company, or Eaton Cutler Hammer.
26 27 00  LOW-VOLTAGE DISTRIBUTION EQUIPMENT

26 27 13  METERING

A. The manufacturer of the main switchboard shall furnish and factory install a Square D Powerlogic PM820 power monitor connected to the incoming power source in the main switchboard.

1. The monitors shall have the ability to display real-time voltage, current, real power, reactive power, apparent power, power factor, and frequency. The meter shall also be capable of alarming, logging, and waveform capture based upon setup values and limits.

26 27 26  WIRING DEVICES

A. General: Furnish and install wiring devices as scheduled in Table 1 below, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA and FedSpec standards.

1. Provide white color devices and nylon wall plates except as otherwise indicated.

B. Listings and Standards:

Switches - UL20, FedSpec WS896-E
Receptacles - UL948, FedSpec WC-596F, NEMA WD-1 and WD-6
GFI – UL943
Hospital Grade Receptacles - UL498, FedSpec WC-596F, NEMA WD-1 and WD-6

TABLE NO. 1

Note: Ivory catalog # is listed, provide unless specified otherwise.

DEVICES

<table>
<thead>
<tr>
<th>Devices</th>
<th>Hubbell</th>
<th>Leviton</th>
<th>Cooper</th>
<th>P &amp; S</th>
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<tbody>
<tr>
<td>20A Duplex</td>
<td>HBL5362-I</td>
<td>5362A-I</td>
<td>5362V</td>
<td>5362A-I</td>
</tr>
<tr>
<td>20A GFI</td>
<td>GF20IL</td>
<td>7899-I</td>
<td>VGF20V</td>
<td>2095-I</td>
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<tr>
<td>20A Duplex w/ USB</td>
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<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hospital Grade</td>
<td>HBL8300I</td>
<td>8300-I</td>
<td>8300V</td>
<td>8300-I</td>
</tr>
<tr>
<td>Hospital Grade, Tamper Resistant</td>
<td>HBL8300TRI</td>
<td>5262-SG</td>
<td>TR8300V</td>
<td>SG62-HI</td>
</tr>
<tr>
<td>Recessed Clock Outlet</td>
<td>---</td>
<td>688-I</td>
<td>TR775W-BOX</td>
<td></td>
</tr>
<tr>
<td>Hospital Grade, GFI</td>
<td>GF8300HI</td>
<td>8898-HGI</td>
<td>VGFH20V</td>
<td>2094-HGI</td>
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### Low Voltage Distribution Equipment

#### Switches

<table>
<thead>
<tr>
<th>Type</th>
<th>Model</th>
<th>Voltage</th>
<th>Current</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>20A Single</td>
<td>1221I</td>
<td>1221-2I</td>
<td>AH2221V</td>
<td>PS20ACI-I</td>
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<tr>
<td>20A 3-way</td>
<td>1223I</td>
<td>1223-2I</td>
<td>AH2223V</td>
<td>PS20AC3-I</td>
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<td>20A 4-way</td>
<td>1224I</td>
<td>1224-2I</td>
<td>AH2224V</td>
<td>PS20AC4-I</td>
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<td>20A 2 pole</td>
<td>1222I</td>
<td>1222-2I</td>
<td>AH2222V</td>
<td>PS20AC2-I</td>
</tr>
<tr>
<td>20A Momentary</td>
<td>HBL1557-I</td>
<td>1257-I</td>
<td>1995V</td>
<td>PS1251-I</td>
</tr>
<tr>
<td>20A Pilot Light</td>
<td>HBL1221PL/PL7 1221-PLR/7PR 2221PL</td>
<td>PS20AC-RPL</td>
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#### Nylon Plates

<table>
<thead>
<tr>
<th>Type</th>
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<th>Voltage</th>
<th>Current</th>
</tr>
</thead>
<tbody>
<tr>
<td>Duplex</td>
<td>NP8I</td>
<td>80703-I</td>
<td>5132V</td>
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<tr>
<td>Quadplex</td>
<td>NP82I</td>
<td>80716-I</td>
<td>5150V</td>
</tr>
<tr>
<td>Single Toggle</td>
<td>NP1I</td>
<td>80701-I</td>
<td>5134V</td>
</tr>
<tr>
<td>2-Gang Toggle</td>
<td>NP2I</td>
<td>80709-I</td>
<td>5139V</td>
</tr>
<tr>
<td>GFI</td>
<td>NP26I</td>
<td>80401-N1</td>
<td>5151V</td>
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#### Weatherproof Plates

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<th>Voltage</th>
<th>Current</th>
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<td>WP GFI</td>
<td>NWP26</td>
<td>6196-V</td>
<td>1966-V</td>
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<tr>
<td>WP In Use GFI</td>
<td>Bell MX4280</td>
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#### Locking Plates

<table>
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<tr>
<th>Type</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single Gang</td>
<td>FSR WB-MS1G</td>
</tr>
<tr>
<td>Two-Gang</td>
<td>FSR WB-MS2G</td>
</tr>
<tr>
<td>Three-Gang</td>
<td>FSR WB-MS3G</td>
</tr>
<tr>
<td>Four-Gang</td>
<td>FSR WB-MS4G</td>
</tr>
</tbody>
</table>

#### Floor Boxes

Combination Power & Data: Wiremold RFB4E-OG
Cover: Coordinate color and style with Architect

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#### Incandescent Wallbox Dimmers

1. Modular preset dimmer switches for incandescent fixtures; switch poles and wattage as indicated, 120-volts, 60Hz, with continuously adjustable slide operator, and soft-tap or other quiet on-off switch. Equip with electromagnetic filter to eliminate noise, RF and TV interference, and 5-inch wire connecting leads. Dimmers shall be Lutron Nova Series, Leviton Decora Series, Prescolite Preset Series, or equivalent.

#### Pulldown Cord Reels

1. Cord reels shall be 30 ft in length, spring loaded with a three NEMA 5-15R plug configuration. Cord reels shall be LUMAPRO #2YKT5 or equivalent.
E. All receptacles shall be identified with a black-on-clear printed adhesive label affixed to the coverplate. This label shall include the panel and branch circuit number supplying power to the receptacle.
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26 28 00  LOW-VOLTAGE CIRCUIT PROTECTIVE DEVICES

26 28 13  FUSES

A. Electrical Contractor shall furnish and install a complete set of fuses as manufactured by the Bussmann Company or Mersen Electrical Power (Ferraz Shawmut), sized for ordinary service of motors and other loads served and at each safety switch installed as shown on the drawings and as hereinafter specified.

B. Fuses for motor loads and all other loads up to 600 A and up to 600 V shall be Buss “Low-Peak” or Mersen Amptrap 2000 dual element fuses, having a minimum interrupting capacity of 200,000 A RMS symmetrical. The fuses shall be UL Class RK1.

C. Fuses for all loads above 600 A and up to 600 V shall be Buss “Low-Peak” or Ferraz Mersen Amptrap 2000 current limiting, time delay fuses, with a minimum interrupting capacity of 200,000 A RMS symmetrical. The fuses shall be UL Class L.

D. The installation of fuses of mixed manufacturers shall not be accepted. Fuse of only one manufacturer shall be installed.

E. Upon completion of the building construction, the Contractor shall provide a complete set of three spare fuses for each size and type used. Furnish and install a spare fuse cabinet equivalent to Bussmann Model SFC to store fuses over 400 amps.

26 28 16  DISCONNECT SWITCHES

A. Type of Switch: Furnish and install disconnect switches as specified where shown on the drawings.

1. All disconnect switches shall be classed Heavy Duty and enclosed as required by NEMA Standards. Switch sizes and fusing shall be as shown on the drawings.

2. Switch shall have a quick make, quick break mechanism operating through the box and not the cover. The switchblades shall be visible when the hinged door is open.

3. The cover shall be interlocked with the operating handle to prevent opening door when switch is “ON” and a means provided to lock switch in the “OFF” position. This mechanism shall be capable of being defeated.

4. Provide a 4” wide x 1½” high phenolic nameplate reading the following for each switch:

   EQUIPMENT IDENTIFICATION  (3/8” Lettering)
   SERVICE DISCONNECT  (3/8” Lettering)
   FED FROM SOURCE NAME  (1/4” Lettering)
B. Manufacturer: Switches shall be by Siemens, Square D, Eaton Cutler Hammer, or General Electric.
26 29 00  LOW-VOLTAGE CONTROLLERS

A. CONTROL AND INTERLOCK WIRING

1. The Electrical Contractor shall furnish and install control and interlock wiring as shown on the electrical drawings. Control and interlock wiring required by Division 22 or 25 but not shown on the electrical drawing shall be the responsibility of the Division 22 or 25 Contractor requiring the wiring.

2. Generally this will mean that Division 26 wires the series safety circuit to the magnetic starters, furnished with Hand-Off-Auto selector switches, using switches and devices furnished by the Mechanical Contractor.

3. Starter automation, as required by the temperature control sequence of operation, will be provided and wired by Division 22 or 25 with connections made to terminals on the automatic side of the selector switch and on starter coil auxiliary contacts.

4. The intention is that Division 26 furnish and install all wiring necessary to operate the magnetic starters with the selector switch in the Hand position and that Division 22 or 25 provide all additional automation required.

5. Relays, electropneumatic relays, and any other device required by Division 22 or 25 to operate in parallel with the starter coil shall be controlled through spare auxiliary contacts on the starter furnished by Division 26 and shall not be connected to the starter coil.

6. Single-phase motors generally are controlled by line voltage controllers furnished by the Temperature Control Contractor but installed by the Electrical Contractor. If the control sequence is more complicated than a single line voltage device such as a unit mounted thermostat, a relay or control device with a horsepower rated contact will be provided by the Temperature Control Contractor for installation by the Electrical Contractor adjacent to the motor disconnect device. The Electrical Contractor shall provide power-wiring connections to this control device. Temperature Control Contractor will provide control and interlock wiring to this control device.

26 29 13  MOTOR AND APPLIANCE CONTROL

A. Electrical Contractor shall furnish and install all electrical devices incident to the work except as otherwise stated herein. The Mechanical Contractor will furnish prewired control panels for equipment so indicated on the plans and will furnish EP switches, electrical thermostats, pressure switches and other temperature control devices as required by the specific sequence of operation for installation by the Electrical Contractor. Others will do testing and adjusting of mechanical system devices.

B. The motor and appliance control devices shall be as follows:

1. All starters shall be installed in NEMA 1 Enclosure unless noted otherwise on the drawings. Where noted other than NEMA 1, furnish the indicated NEMA rated enclosure.
2. Single Phase Magnetic Starters - Square D Class 8536 with one overload, 120 volt coil, N.O. auxiliary contacts, heavy-duty 30 mm and hand-off-automatic selector switch in cover all in an oversized NEMA enclosure.

3. Three Phase Manual Starters - Square D Class 2510 Type M, push button operated, lock-out guard, three thermal overloads in a NEMA enclosure. Furnish with or without pilot light and auxiliary contacts as indicated on drawings.

4. Three Phase Magnetic Starters - Square D Class 8536 with three overloads, 120 volt control transformer with 2 primary and 1 secondary fuses, heavy-duty 30 mm, hand-off-automatic selector switch, heavy-duty 30 mm pilot light, and extra N.O. auxiliary contacts all in a NEMA enclosure.

5. Three Phase Combination Starter and Fusible Disconnect Switch - Square D Class 8538 with a NEMA enclosure including a three pole fusible switch and a starter with three overloads, 120 volt control transformer with 2 primary and 1 secondary fuses, heavy-duty 30 mm, hand-off-automatic selector switch and heavy-duty 30 mm pilot light and N.O. auxiliary contacts.

6. Fractional HP Single Phase Manual Starters - Square D Class 2510 Type F, toggle switch operated with lock-out guard, single thermal overload. Furnish starters single speed with or without pilot lights as indicated on the drawings. All surface mounted starters shall be mounted in a 'FS' conduit box.

7. Integral HP Single Phase Manual Starters – Square D Class 2510 Type M, push button operated, lock-out guard, single thermal overload in NEMA enclosure. Furnish with or without pilot light and auxiliary contacts as indicated on drawings.

8. Selector Switches and Pushbutton Stations - Square D Class 9001 heavy duty 30 mm in NEMA enclosure.

9. Provide a 3" wide x 1½" high phenolic nameplate reading the following for each motor starter:

   **EQUIPMENT IDENTIFICATION**
   
   Size '_', __A Overload
   FED FROM _____
   
   (3/8” Lettering)
   (1/4” Lettering)

10. Relays - Square D Class 8501 with 120 volt coil in NEMA 1 enclosure. Furnish with number of poles indicated on the plans.

11. Provide a phenolic nameplate for each motor starter.

12. Devices of similar construction and design as manufactured by Eaton Cutler Hammer, Allen Bradley, Siemens, or General Electric are also acceptable.
A. The Electrical Contractor shall provide variable frequency drives as shown on the drawings. The Electrical Contractor shall furnish and install the controller, control devices, and interconnection wiring as specified below.

B. Drive General Description:

1. Furnish and install variable frequency drives as specified herein. The assembly shall include a circuit breaker or input fuses, motor overload relay(s) and operational options required by this specification.

2. A factory authorized trained technician shall make final adjustments and settings on the drive and shall submit a field report to the Engineer stating the setpoints and ramp time settings on each drive.

C. Drive Components:

1. The variable frequency drive system shall include a diode bridge rectifier, DC link reactor for reduction of harmonics, capacitor filter, and IGBT inverter section. The output shall be capable of a 12khz sine-coded pulse width modulated output for quiet operation. The drive ratings shall be based upon 8khz output.

2. The controller shall include the following devices:

   Drive manual on-off-auto selector switch to manually energize or de-energize the drive control system.

   Manual speed selector to allow a specified speed to be selected and maintained if the manual-off-automatic selector switch is in the manual position.

   Integral line side disconnect switch or circuit breaker, contactors, and thermal overload relays for each motor on drives controlling multiple motors.

   4-20 milliamp output that is directly proportional to drive speed.

3. Provide a 3" wide x 1" high phenolic nameplate for each starter or disconnect as follows:

   EQUIPMENT IDENTIFICATION  (3/8" Lettering)
   ___AS/___AF  (XX AMP SWITCH/XX AMP FUSE) (1/4" Lettering)

   or

   EQUIPMENT IDENTIFICATION  (3/8" Lettering)
   Size ‘_’, __A Overload  (1/4" Lettering)

4. The system protection as a minimum will provide the following:
a. Overcurrent protection of 100% continuous, 110% for 1 minute.
b. Instantaneous overcurrent trip at 150%.
c. Current limit stall prevention shall be adjustable 10 to 110%.
d. Ground fault protection.
e. Current limiting DC bus fuse.
f. Overvoltage protection.
g. Undervoltage protection.

5. When the drive faults, the drive shall activate a 1NO, 1NC-fault relay display for indication of type of trip.

OC: Overcurrent trip at 150%
OCA: Overcurrent on start-up
OCL: Overcurrent on output
OL: Overload
OP: Overvoltage due to power surge
OP2: Overvoltage while deceleration
POFF: Undervoltage
OH: Overheat
EF: Ground faults

6. Auto restart shall be a standard feature of the drive as follows:

Auto restart enabled or disabled by jumper or keypad selection.
If auto restart is selected the microprocessor shall determine, in the event of a fault, if a restart should be attempted. A restart will be attempted under the following condition:

Undervoltage (UP) - Every time as soon as voltage returns to a safe level. Fault relay is not activated.

Input Overvoltage (OPS) and DC Bus Overvoltage (OP) - Every time if voltage returns to normal within 30 seconds, fault relay is not activated.

Overcurrent (OC) - Drive delays 1 second and attempts a restart. If drive trips a second time it delays 2 seconds and attempts a second restart. Overall, five attempts are made after successive delays of 1, 2, 4, 8 and 16 seconds. If the restart fails the drive locks out and sets the fault relay on. (Number of restarts and time delays to be adjustable via keypad or jumpers).

A restart will not be attempted for any other type of fault and the drive will trip out immediately, activate the fault relay and make the appropriate indication on the display.

7. In the event of a fault trip the microprocessor shall save the status of the drive at the time of the fault and make that information available on the display until the drive is reset or the control power is removed.
8. An undervoltage condition of less than 100 ms duration shall not affect drive operation. If main power falls below 85% of rated voltage for longer than 100 ms while control power is retained the drive shall forcibly decelerate the load in an attempt to force a higher bus voltage through regeneration. This feature, depending on the inertia of the load, shall allow the drive to "ride through" a longer condition.

9. A minimum of 3% DC link or line reactor.

10. Operation functions shall include the following:

    Acceleration and deceleration time independently adjustable from .1 to 1200 seconds.

    Signal follower 0-5VDC, 0-10VDC, 4-20ma, 0-20ma, 1-5VDC, or 0-135 ohms selectable. An increasing input signal can command increasing or decreasing frequency as required by the application.

    Ramp to stop or coast to stop for normal operation (coast to stop on fault). Volts/Hertz patterns selectable by keypad.

    Upper and lower frequency limit adjustments shall be available. When the drive reaches one of the limits it shall activate an open collector signal available to the user. A dry contact signal shall be available as an option.

11. Drives shall have a Short Circuit Current Rating (SCCR) of 100,000 amps.

12. Manual bypass is not required on VFD unless indicated on bid documents

D. The following catalog data shall be submitted for the controller:

    Dimensioned drawings.
    Operation and installation manuals.
    Maintenance, adjustment, part breakdown and troubleshooting manual.
    Connection diagrams.
    Schematic diagrams including printed circuit boards, wiring harnesses, and enclosure mounted controls.

E. Drives shall be furnished with a BACNET Network Card factory installed.

F. Refer to Section 26 00 72 for support of equipment and "housekeeping pad requirements".

G. Variable frequency drives shall be Toshiba Q9, YASKAWA Z1000, or ABB ACH 550.
26 30 00 FACILITY ELECTRICAL POWER GENERATING AND STORING EQUIPMENT
26 40 00 ELECTRICAL AND CATHODIC PROTECTION

26 41 00 FACILITY LIGHTNING PROTECTION

26 41 13 LIGHTNING PROTECTION

A. Provide all labor, material, equipment, and services to perform all operations required for the complete installation and related work as specified herein.

B. An NFPA 780 system shall be designed and installed. The system shall conform to UL 96A (Lightning Protection Bulletin).

C. The installation shall receive a UL Master Label prior to project completion.

D. All materials shall be Class I Copper materials shall not be mounted on aluminum, galvanized steel, or zinc surfaces. Aluminum materials shall not come in contact with the earth or where rapid deterioration is possible. Aluminum and copper shall not come in contact with each other.

E. The main conductors shall be sized as per Class I standards. Conductors shall be free of excessive splices and no bend of a conductor shall form an angle of less than 90 degrees nor have a radius of bend less than 8 inches.

F. Down conductors shall be sized as per Class I standards. Down conductors shall be spaced at intervals averaging not more than 100 feet around the perimeter of the structure or as indicated on the drawings. Down conductors shall be concealed. A structure shall have no fewer than two down conductors.

G. Grounding electrodes shall be connected to each down conductor. The ground rod electrode shall be copper-clad steel, minimum 5/8” diameter and ten feet long. The top of the ground rod electrode shall be located a minimum of two feet below grade and below the frost line. The connection between the electrode and down conductor shall be exothermically welded.

H. In the case of a structure built with a structural steel frame, the roof conductors may be connected to the steel frame instead of using down conductors. The connections to the frame shall be at intervals not exceeding 100 feet along the perimeter of the structure. The ground rod electrodes shall then connect to the structural steel at intervals not averaging more than 60 feet apart. The steel columns shall be grounded using bonding plates or exothermically welded.

I. All grounding systems within the building shall be bonded together. This shall include the lightning protections system, electrical service, communication, and antenna system grounding electrodes.
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26 43 00 TRANSIENT VOLTAGE SURGE SUPPRESSION

26 43 13 SURGE PROTECTIVE DEVICES (SPD)

A. This section describes the materials and installation requirements for Surge Protective Devices (SPDs), formerly TVSS, for the protection of AC electrical circuits.

B. STANDARDS – Must be listed or comply with the most recent editions of:
   1. Underwriters Laboratories: UL1449 and UL 1283
   4. NEMA LS-1(rescinded Aug 19, 2009, replacement undetermined)

C. SUBMITTAL REQUIREMENTS
   1. Submittal shall include a copy of the SPD performance parameters listed at www.UL.com under Certifications, searching using Category Code: VZCA, to verify SCCR, VPR, MCOV, I-n, and Type 1 compliance with this specification. "Manufactured in accordance with" is not equivalent to UL listing and does not meet the intent of this specification.

D. PRODUCTS
   1. Subject to compliance, the following manufacturers are acceptable:
      Eaton, Current Technology, LEA, Dynatech, APT, Square D, Environmental Potentials
   2. SPD shall be UL labeled with a 200kA Short Circuit Current Rating (SCCR), as a Type 1 device, and a 20kA I-nominal (I-n) rating.
   3. Minimum surge current capability (single pulse rated) per phase shall be:
      Service Entrance or Transfer Switch: 300kA
      Distribution panelboards & MCC: 200kA
      Branch panelboards: 100kA
   4. UL 1449 Listed Voltage Protection Ratings (VPRs) shall not exceed the following:

      | System Voltage | L-N | L-G | L-L  | N-G  | MCOV |
      |----------------|-----|-----|------|------|------|
      | 208Y/120       | 700V| 700V| 1200V| 700V | 150V |
      | 480Y/277       | 1200V| 1200V| 1800V| 1200V| 320V |

   5. SPD shall include visual LED diagnostics including a minimum of one green LED indicator per phase, and one red service LED.
   6. All units shall also include a surge counter mounted in the enclosure.

E. INSTALLATION
   1. SPD shall be installed in accordance with the manufacturer’s installation manual using the recommended breaker and wire sizes.
2. The SPD unit shall be located as close as is practical to the switch or circuit breaker serving the unit. All efforts shall be made to locate the switch or circuit breaker in a place where the SPD leads are as short as possible. In no case shall the factory SPD leads be extended or spliced.

3. All of the SPD units shall be provided in a NEMA 1 or 12 enclosure, unless otherwise specified.
26 50 00 LIGHTING

26 51 00 LIGHT FIXTURES AND LAMPS

26 51 13 INTERIOR LIGHTING FIXTURES, LAMPS, AND BALLASTS

A. LIGHT FIXTURES

1. Furnish and install light fixtures as shown on the drawings and described herein. Fixtures shall be furnished complete with all auxiliaries, hardware, lenses, lamps, sockets, wiring, supports, etc.

2. LED drivers shall be 0-10V dimming, 1-100% unless otherwise indicated. LED drivers shall have Class ‘A’ sound rating, UL Class 2, RoHS compliance.

3. Electronic fluorescent ballasts shall be high frequency type with no detectable flicker, UL Class P, FCC and NEMA compliance with regard to EMI and RFI, meet all applicable ANSI and IEEE standards regarding harmonic distortion and surge suppression, high power factor, lamp current crest factor not more than 1.6, sound rating “A”, and designed for specified lamp types. Ballasts shall be by Advance, Universal/Magnetek, or Osram/Sylvania.

4. All fixtures installed in plaster or drywall ceilings shall be provided with metal plaster frames. All fixtures in acoustic tile ceilings shall be installed symmetrically in pattern, at center of tile or as noted on drawings. Fixture trim shall be installed to prevent cutting, denting, deforming, or otherwise damaging the ceiling tile.

5. Complete units and all electrical components for all lighting fixtures shall bear the Underwriters’ Laboratories and Electrical Testing Laboratory Labels.

6. All fixtures shall be rigidly supported. Fixtures installed in acoustic tile ceilings shall be rigidly mounted to ceiling frame or structure above in accordance with the NEC and ASTM E580. Fixtures mounted in plaster or gypsum board ceilings shall be secured to the ceiling structure. Fixture mountings to concrete slabs shall be with Phillips “Red Head” expansion anchors or equivalent.

7. All fixtures located in fire-rated ceilings shall be so installed as to protect the integrity of the fire-rated ceiling.

8. The actual locations of light fixtures in mechanical rooms shall be adjusted to avoid interference with mechanical equipment ductwork, and piping.

B. LAMPS

1. All LED fixtures shall have replaceable lamps/light engines for 10 years after installation date.

2. All fluorescent lamps shall be of the wattage and type shown on the Lighting Fixture Schedule.
3. All incandescent lamps shall be inside frosted unless noted and of the wattage shown on the light fixture schedule.

4. All metal halide lamps shall be clear unless noted and of the wattages and type shown on the light fixture schedule.

5. All lamps shall be as manufactured by Phillips, Osram Sylvania, or General Electric unless noted otherwise.

6. All burnt out lamps shall be replaced with new lamps to the satisfaction of the Engineer, prior to final acceptance.
26 52 00 EMERGENCY LIGHTING

26 52 13 EMERGENCY BATTERY BACKUP BALLAST

A. Fluorescent emergency ballasts for T8 lamps shall be Bodine B50 or equivalent capable of providing 1350 lumens. Fluorescent emergency ballast for T5 and T5HO lamps shall be Bodine LP600 or equivalent capable of providing a minimum of 1250 lumens.

B. Fluorescent emergency ballasts for compact fluorescent lamps shall be Bodine B84C or equivalent and compatible with the lamps provided. The light outputs shall be at least 1000 lumens for 42W, 700 lumens for 32W and 575 lumens for 26W.

C. Emergency ballasts in stairway fixtures supplied by an emergency generator shall be Bodine Gen1 or equivalent.

D. Emergency Lighting Transfer Switch (LTS)

1. Furnish and install where indicated on the drawings, a Functional Devices, Inc. Generator Transfer Device.

2. Where indicated as type ‘LTS’, furnish and install a Functional Devices, Inc. #ESRN. generator transfer device with an ‘ESRTB’ remote test button. The device shall be capable of bypassing the wall switch when the auxiliary generator powers lighting. The device shall consist of relay switching circuitry and be UL924 listed. Inputs fused at 20A maximum; shall draw 280mA and 1.6W during normal operation; and shall comply with the current NEC. The device shall be UL listed for installation remote from the fixture, warranted for a full five years from date of purchase.

END OF SECTION
26 00 00
27 00 00 COMMUNICATIONS

27 00 01 GENERAL

A. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Division 27 of the Specifications.

B. Provisions and conditions cited in this Section shall apply to Work for other sections of Division 27 of these Specifications.

27 00 02 REFERENCES, REGULATORY REQUIREMENTS

A. Work for this Section of the Specifications shall be performed in accordance with the Codes, Standards, etc., as identified in Division 27.

27 00 03 REFERENCES, RELATED SECTIONS of the SPECIFICATIONS

A. Requirements of the following Sections of the Specifications apply to Work for this Section:

Division 26 – Electrical
Division 28 – Electronic Safety and Security

27 00 04 DEFINITIONS

A. Refer to Section 26 00 05 – Definitions.

27 00 05 WORK INCLUDED

A. Furnish material, labor and services necessary for, and incidental to, installing the following systems where shown on the Plans and as hereinafter specified. Include all necessary work in the related sections of the Specifications to provide for complete systems.

27 00 06 SUBMITTALS:

A. The Contractor shall submit the following for approval in accordance with Subsection 26 00 43, Duties of the Contractor - Submittals.

B. Provide manufacturer's technical product data of each material and accessory item with engineering support information, installation manual, operation and maintenance manual. Data shall be specific to product specified and clearly identified on all data sheets, which contains multiple models or sizes.
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27 05 00 COMMON WORK RESULTS FOR COMMUNICATIONS

27 05 26 GROUNDING AND BONDING FOR COMMUNICATIONS SYSTEMS

27 05 28 PATHWAYS FOR COMMUNICATIONS SYSTEMS

A. All cabling shall be as shown on plans, and per specifications.

B. Cabling may be run as open-type plenum rated cable concealed above lay-in ceiling spaces. Non plenum rated cabling shall be installed in conduit. Cabling shall be installed in conduit in all exterior locations and in all exposed or inaccessible locations including all open to structure, cloud ceilings, inside wall partitions or above drywall, wood, and other inaccessible ceilings.

B. Cabling may be run as open-type plenum rated cable concealed above lay-in ceiling space and exposed open to structure above or cloud type ceilings unless noted below. Cabling shall be installed above bar joist flanges to conceal cabling from view when routed through exposed ceiling. Non plenum rated cabling shall be installed in conduit. Cabling shall be installed in conduit in all exterior locations, all areas exposed below 8’ A.F.F., and all inaccessible locations including inside wall partitions or above drywall, wood, and other inaccessible ceilings. Cabling shall be installed in conduit in the following spaces:
   1. Electrical, Mechanical Equipment Rooms
   2. Storage and Janitor Closets
   3. Stairwells
   4. Restrooms

C. Cables shall be continuous from outlet to termination equipment.

D. Cables shall be terminated using tools recommended by the termination manufacturer.

E. Provide 2” minimum sleeves in all walls which cable runs pass through.

F. Furnish and install a minimum of (1) one cable pathway device through fire rated partitions and floors, and where indicated on the drawings. Device shall be Specified Technologies, Inc. EZDP33FWS, 3M QuickPass, or equivalent.

G. Furnish and install a minimum of (1) one cable pathway device over all office and exam room doors, and where indicated on the drawings. Devices shall be Specified Technologies, Inc. Acoustical EZ Path, or equivalent.

H. Refer to 26 05 29 for fire sealing of penetrations through fire rated walls.

I. Provide access panels as necessary for cable routing.

27 05 28.29 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

A. Cables shall be supported with “J-Hooks” a minimum of every six feet. Bridal rings can be used when supporting (other than Cat 6) a maximum of six wires. Support devices are to be attached to existing permanent structure.
B. Cables shall be installed in cable tray where available.

C. Cables and supports shall be installed at a readily accessible location above ceilings.

27 05 28.33 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

A. Furnish and install conduit rough-ins at all outlets locations where shown on drawings. Rough-in shall consist of a two-gang outlet box, single gang trim ring, and a minimum 1” conduit stubbed above an accessible ceiling. Plastic bushings shall be installed on both ends of conduit. Install blank covers on all unused rough-ins.

C. All conduits serving telephone/data communication outlets shall be 1” minimum. Conduits for all other system cable runs shall be sized for 40% maximum fill, or as shown on the drawings. Redundant paths shall be installed where fill exceeds 40%.

D. Provide pull strings in all conduits.

E. Conduit bends shall accommodate radius requirements of fiber cable as necessary.
A. **Description of Work**

1. The Electrical Contractor shall furnish and install all materials, accessories, and labor required to install a new telephone and/or data cabling system. **Category cabling will be furnished, terminated, and tested by the University of Missouri Health System. Cable shall be pulled by the contractor.**

2. The Contractor shall be trained and certified by the equipment manufacturer.

3. The Contractor shall attend coordination meetings with the Owner and Engineer prior to installation.

B. **Acceptable Manufacturers**

1. Cabling to be furnished by the University of Missouri Health System

C. **Rough-Ins**

1. Furnish and install rough-ins where shown on drawings. Rough-in shall consist of a two-gang outlet box, single gang trim ring, and a minimum 1" conduit stubbed above an accessible ceiling. Install blank covers on all unused rough-ins.

2. Maximum fill of conduit is not to exceed forty percent.

3. Furnish and install minimum 2" sleeve through fire rated partitions.

4. Refer to 260529 for fire sealing of penetrations through fire rated walls.

D. **Cabling**

1. One Four-pair category 6 23 gauge MPP/CMP plenum rated 100 ohm UTP cables to be designated as station **voice** to be wired at wall outlet on (UNJ600-BK) modules using T568B wiring scheme termination at wall outlet per manufactures specification and at the closet end on patch panels (part #UNP610-24P) using the T568B wiring scheme. These cables shall be designated as V1 along with the outlet number assigned. Place the ivory voice icon (UNJ-ICON-IV) in the designated area on jack.

2. One Four-pair category 6, 23 gauge MPP/CMP plenum rated UTP cables to be designated as station **network** to be wired at wall outlet on (UNJ600-BK) modules using T568B wiring scheme termination at wall outlet per manufactures specification and at the closet end on patch panels (part #UNP610-24P) using the T568B wiring scheme. These cables shall be
designated as N1 along with the outlet number assigned. Place the ivory data icon (UNJ-ICON-IV) in designated area on jack.

3. Cable jacket color shall be in accordance with the building standards.

4. Cables shall not exceed 90 meters from termination location to wall outlet.

E. **Telephone/Data Cabling Systems Equipment**

1. Furnish and install faceplate and modular jacks at each **Voice/Data** outlet as described below:
   a. One Panduit single gang Sloped Modular Flush-Mount Faceplate (part #CFPSL4EIY).
   b. One Panduit Mini-Com modular jack to be designated as stations Voice (part #CJ688TGEI).
   c. Two Panduit Mini-Com modular jacks to be designated as stations Network (part #CJ688TGBU).
   d. Install one **Voice**, and two **Network** cable for each outlet.

2. Furnish and install faceplate and modular jacks at each **Voice** outlet as described below:
   a. One Panduit single gang Sloped Modular Flush-Mount Faceplate (part #CFPSL2EIY).
   b. One Panduit Mini-Com modular jack to be designated as stations Voice (part #CJ688TGEI).
   c. Install one **Voice** cable for each outlet.

3. Furnish and install faceplate and modular jacks at each **Data** outlet as described below:
   a. One Panduit single gang Sloped Modular Flush-Mount Faceplate (part #CFPSL2EIY).
   b. Two Panduit Mini-Com modular jacks to be designated as stations Network (part #CJ688TGEI).
   c. Install two **Network** cables for each outlet.

4. Furnish and install faceplate and modular jacks at each **Non-Standard Voice/Data** outlet as describe below:
   a. One Panduit Sloped Modular Flush-Mount Faceplate in size as required to accommodate number of terminations.
b. Panduit Mini-Com modular jacks to be designated as stations Network (part #CJ688TGEI) in quantity as indicated on the drawings.

c. Install **Network** cables for each outlet.

d. One Panduit Mini-Com modular jack to be designated as stations Voice (part #CJ688TGEI) in quantity as indicated on the drawings.

e. Install **Voice** cables for each outlet.

5. The University of Missouri Health System will provide and install terminal blocks for termination of voice cables. The University of Missouri Health System will furnish and install racks, patch panels, and horizontal management for termination of network cables and fiber.

6. **Labeling and Standards**

a. Cables at wall outlets and terminations at communication closet shall be identified and labeled as follows, depending on typical vs non typical.

   **Typical**
   V1 - first telephone (or voice) cable at a given outlet.
   N1 - first network cable at a given outlet

b. The first location shall start with the number (1) and continue, labels at wall outlet shall be TIA/EIA-606 Compliant

c. All of work described above shall be ANSI/TIA/EIA-568B.1, B.2, B.3-1 & 569B compliant and follow NEC codes local or otherwise.

d. All voice and network terminations at communication closet shall be terminated on patch panels and 19” racks permanently mounted on floor of Telecommunication Room. Cables shall be terminated in distinct and separate panels for each type; voice, building network, and research network.

7. Voice cable shall be Panduit (part #PUP6004WH-U White) Plenum. Network cable shall be Panduit (part #PUP6004BU-U Blue) Plenum. No equivalents accepted. All of the above mentioned equipment and scope of work shall be properly grounded and bonded per TIA/EIA-607.

8. Provide 10- Commscope (part #UNC6-XX-10F-B) and 20- Commscope (part #UNC6-XX-5F-B) Modular Interface patch Cords for use in Telecommunications Room and at work outlet for Network.

F. **Testing and Labeling**

1. The University of Missouri Health System will test telephone and data cabling.
2. Label jacks at outlet faceplates and patch panels and label cables at the outlets and other termination location in accordance with the building standards.

3. Provide colored cables and jacks in accordance with the building standards.

G. **As Built Drawings**

1. Provide as-built drawings indicating cable routing and cable/jack/patch panel identification.

END OF SECTION
27 00 00
PART 1 – GENERAL

1.1 RELATED DOCUMENTS
A. Drawings and general provisions of the contract, including General and Supplementary Conditions and Division 1 Specification sections, apply to this section.

1.2 SUMMARY
A. This section includes complete system of electronic noise generators, amplifiers, wiring, loudspeakers, Controls and components to generate, amplify, distribute and reproduce digitally synthesized and stabilized background sound masking to improve speech privacy in zones of coverage. Components contained herein this paragraph may be collectively integrated in a printed circuit board as part of a speaker unit.

1.3 DEFINITIONS AND REFERENCES
A. Test and Calibration Conditions: Spaces completely furnished but unoccupied, lights and HVAC systems on, HVAC system testing and balancing completed, ceiling components in place. Additional testing to be provided after space is occupied to adjust for variations in use.
B. Covered spaces: Spaces above which masking speakers are installed.
C. Pink Noise: Random noise signal with equal energy in each octave.
D. SoundMasking: Sound that reduces the intelligibility of intruding speech and the distraction from activity noise. Sound that when measured falls inside the “preferred curve”. The masking sound spectrum slopes downward with an increasing frequency. The rate of this slope of sound is 5 dB per octave, having a steeper roll-off above 2 KHz. The low frequency response is determined by the low frequency capabilities of the masking system loudspeakers.

1.4 QUALITY ASSURANCE
A. AMERICAN NATIONAL STANDARDS INSTITUTE (ANSI):
   2. ANSI S1.6 American National Standard Specification for Preferred Frequencies and Band Numbers for Acoustical Measurements.
B. AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM):
1.5 DESCRIPTION OF SYSTEM

A. All masking units must be UL Listed for use in a ceiling plenum.

B. The system must be manufactured in the USA.

C. All equipment and associated hardware shall be fabricated and installed in accordance with the manufacturer's specified recommendations.

D. All wiring shall be minimum 18 gauge.

E. Location of grounding points shall be determined carefully to insure minimizing of system hum and elimination of ground loops. In addition, all connections of shields and conductors to equipment shall be in accordance with manufacturer's instructions and best professional practices.

F. In open areas and larger enclosed spaces, the overall sound level produced should have spacial uniformity of no more than ±½ dB between any two sound generating units.

G. The sound generating units must have an adjustable sound spectrum shaping control in order to meet the varying spectral requirements of drywall ceilings; various types of ceiling tile, air return grills and openings around lighting fixtures, etc.

   1. The spectrum shaping ability shall be variable within the accepted background sound masking range (acoustical preferred curve).
   2. Units installed over drywall ceilings should be wired for spectrum control adjustment and remote sound level.
   3. Sound-Power Level produced by system: Sound masking system must not exceed NC 40 contour between 400 and 2000Hz, and have smooth roll-off above and below those frequencies when measured 1 meter from speaker.
      a. Final adjusted level: Determine final level for each space individually by measurement as specified.
      b. Measurements: Made under Calibration conditions.

H. Maximum Average range of sound power level: 1 dB in the 250, 500, 1000, 2000, 4000 and 6000Hz range for 75 percent of the locations covered.

I. Spatial Uniformity (Directional Effect): People in masked space under normal operating conditions cannot determine source of masking sound.

J. Temporal Uniformity: One minute time-averaged sound pressure level of any octave band of masking sound from 250 to 8000 Hz remains constant in any space to within a standard deviation of 2 dB when measured over a 30-minute period.

K. Sound Quality: No audible hum or noise, other than masking noise, from this system in masked spaces should be detected.

1.6 PERFORMANCE

A. The system shall be capable of producing masking frequencies in the preferred spectrum range.

   1. Each unit shall allow smooth and seamless adjustability of the sound spectrum within the preferred curve, to allow for a variety of ceiling conditions.
B. Speaker housings/enclosures must be damped to avoid undesirable resonance.

C. System shall be designed so that individual speaker or component failure will have no impact on the balance of the system.

D. Design of system must be powered by low voltage.
   1. Use adequately rated step down transformers.
      a. Primary: 120 Volt AC 60 Hz.
      b. Secondary: 16-18 Volt AC 60 Hz.
   2. Power usage:
      a. Power: Typical consumption, 100 Watts per 18,000 square feet for masking only.
      b. Power: Typical consumption, 200 Watts per 18,000 square feet for masking and paging.

1.7 CODES AND PERMITS

A. Install all work in full accordance with the requirements of all local and governmental departments having jurisdiction over these matters, as well as with any requirements of the NFPA, MEA, BSA, UL, and other applicable Codes.

1.8 QUALIFICATIONS

A. Source Limitations: Obtain sound masking equipment components from a single source that assumes responsibility for compatibility of items used.

B. Components, speakers and power transformers must be UL listed for their appropriate use or listed as an equal to UL through another competent agency.

C. Privacy: Perform a speech and privacy evaluation to provide an articulation index (AI) as per ASTM E1130-02. A report of the AI must be provided with each exclusive project.

D. Manufacture Qualifications: Manufacturer must manufacture sound masking equipment and have a minimum of 10 years sound masking experience. Sound masking product provided must be in existence for a minimum of six years with proven performance criteria for providing speech privacy.

E. Warranty: A 10 year full warranty from the manufacturer must be provided for all sound masking equipment.

E. In-Plenum Speakers only.

1.9 SUBMITTALS

A. Product Data: For each component including nationally recognized testing laboratory listing data.

B. Submit manufacturer’s product data and shop drawings of the following apparatus, giving full information as to dimensions, materials, and all information pertinent to adequacy of submitted equipment:
   1. Masking Sound Speakers.
   2. Additional necessary masking equipment needed.
   3. Wiring Diagram.
   4. Transformers.
   5. Programmable Timers (If needed).
C. Shop Drawings: Prepare and submit detailed dimensioned shop drawings for conduit runs (if required) and other distribution services including elevations showing minimum clearances and installed features and devices for system components. Show types and locations of masking speakers and their wiring connections. Channel assignments, and axis orientations. Show ducts, beams and other significant sound reflecting and absorbing elements in ceiling space and show locations of partitions below ceiling. Include a diagram showing interconnection of major system components for each zone and channel and indicating grounding connections.
   1. Each shop drawing shall contain job title and reference(s) to the applicable drawing(s) and/or specification article(s).

D. Product Certificates: Signed by manufacturers of sound masking equipment and components certifying that products furnished comply with requirements.

E. Qualification Data: For firms and persons specified in “Quality Assurance” Article.

F. Record of Final Field Tests and Measurements: Include final adjustment of system.

G. Maintenance Data: For sound masking equipment and components (if needed) to include in maintenance manuals specified in Division.
   1. Include data for each type of product, including all features and operating sequences. Both automatic and manual.

1.10 COORDINATION

A. Coordinate quantity and arrangement of speaker assemblies with ceiling space configuration and with components occupying ceiling space, including structural members, pipes air distribution components, raceways, cable trays, recessed lighting fixtures and other items.

1.11 OPERATING AND MAINTENANCE INSTRUCTIONS

A. Furnish a minimum of hard copy and one electronic copy (PDF) of operating instructions and service maintenance manuals for the equipment employed in the systems. This shall include wiring diagrams. The information in the manuals and on the drawings shall be sufficiently detailed to allow a technician of normal competence to understand, install, operate, maintain, calibrate and repair the equipment.

B. The Owner’s designated operating personnel shall be provided instruction. This shall include instruction in the operation, care and maintenance of the installation. Instruction shall be scheduled at the mutual convenience of the Owner/Contractor, after demonstrations and acceptance testing.

1.12 GUARANTEES AND CERTIFICATION

A. System shall be warranted to be free from defects in materials, workmanship, and performance for a 10-year from date of installation.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements. Provide products by the following:
   1. Lencore Acoustics Corp.
      1 Crossways Park Drive W
      Woodbury, NY 11797
2.2 EQUIPMENT

A. The enclosure for the sound masking speakers shall consist of aluminum or electroplated steel, cylindrical housing.

B. Speakers: 5 ¼ inch units mounted on metal baffles and arranged for optimum, multidirectional, angular sound distribution. Arrange units for suspension from the building structure above the ceiling.

C. Zoning: The system must be capable of being zoned on both a global and local level for sound. Global zoning: must accommodate a minimum of 50,000 square feet and local zoning will be designed in accordance with the space plan for those areas requiring special attention; i.e. patient rooms, exam rooms, reception areas, provider offices, clerical work areas, open areas, patient check in areas, special work areas, executive areas. All zoning must allow both volume and frequency adjustments within each zone measured at 48" A.F.F. within +/- ½ dBA.

D. Loudspeaker
   2. Power Rating: 10 Watts Root Mean Squared (RMS).
   3. Frequency Response: 50-12,000 Hz.
   5. Impedance: 16 Ohms.
   6. Magnet Weight: 10 oz. (283.5 grams.)

E. Noise generator: Octave bands from 50Hz to 8000Hz.
   1. Voltage: 16 to 24 Volts AC, 60 Hz.
   2. Contour Adjustments.
   3. Spectrum adjustment shall meet acoustical preferred curve.

F. Output Adjustments.
   1. 10 Position step-volume control @ 1.5 dB per step.

G. Wire: The speaker wiring shall be minimum 18 gauge, stranded, non-shielded, UL Listed, Plenum Rated.

H. Step Down Transformer:
   1. Power Requirement: 120v AC, 60 Hz.
   3. Power Rating: 95VA.
   4. Size: 4 ¼ “ X 4 ¼ “ X 4”.
   5. Transformer Specifications: 16V/95VA.

I. Remote Central Volume Control:
   1. The Remote Central Volume Control unit must operate as a central volume control from which universal volume adjustments can be made remotely for a minimum 50 main units (150 total speakers) and covering up to 33,000 square feet system-wide.
   2. The unit must consist of an individual self-contained noise generator, audio amplifier,
louderspeaker in a damped aluminum enclosure, powered by 16/18 volts AC and is capable of driving one secondary model in addition to the aforementioned.

3. The central volume remote control unit must allow adjustment to the volume of sound masking system remotely.

4. Volume adjustment: A rotating switch accompanied by a wall mountable plate and is adjusted by rotating the dial from 0 to 10.

5. Each remote central volume remote control unit is solid state and consists of a CMOS/MSI digital random sequence noise generator, electronic amplifier, and filter for active spectrum shaping and is equipped with a 10-step volume control, an additional continuous volume control, and the central volume remote adjustment control (as previously described above). Range of sound level: 41-86 dBA. Additionally contained is a continuous and completely separate volume control for paging/music.

J. Programmable Audio-Level Control Unit:

1. Automatic Sound Power Level Changes: Two system channel changes, capable of different time settings for each day of the week.

2. Zones: per attached System Design Floor Plans at the end of this Section.

3. Clock Accuracy: + / - 2 seconds per day (Leap year and DST updated automatically).

4. Battery: Rechargeable lead sealed, 12 volt, 2.2 Ah provides approximately 24 hours backup power.

5. Programming:
   1. Programmable attenuation range: 0 to + 9 dB.
   2. Slide control attenuation range: + 5 to – 5 dB.
   3. Minutes per dB change: 1 to 5 minutes.
   5. Acclimatize days per dB change: 1 to 5 days.
   6. Acclimatization length: 1 to 54 days not counting Sat. & Sun.
   7. Maximum overall attenuation range: + 5 to – 18 dB.
   8. Programmable events: 24 events per day for each zone.

6. Program Memory: Nonvolatile for one year, minimum, without power. When reenergized after a power outage, control starts at zero level and automatically advances system sound level at same rate used for programmed level changes.

K. System Design:

1. Basis of System Design: Lencore system per four floor plans at end of section prepared by SpectraSource, Inc. 921 North Fourth Street, Atchison, KS.

2. System Design includes:
   1. (7) 6 inch RCVC (Volume Control Units)
   2. (35) 6 inch Main Units
   3. (42) 6 inch Secondary Units
   4. (3) 95T-16 Transformers

PART 3 - EXECUTION

3.1 MOUNTING OF MASKING SOUND LOUDSPEAKERS

A. Mountings and Loudspeakers shall be concealed above the acoustical ceiling. The loudspeakers shall be suspended from the slab above by chain. The speaker face shall be located at a height equal to one-quarter of the ceiling plenum depth. Where possible, the bottom, of each speaker shall be located a minimum of 6” to 8” (150 to 200mm) above the acoustical ceiling tile. However, it is most important that all units hang at a uniform height throughout to insure a uniformity of sound when the system is turned on.
B. Wiring Method: Install wiring in accordance with all local electrical codes. Conceal cable in accessible ceilings, walls and floors where possible.

C. Pulling Cable: Do not exceed manufacturers' recommended pulling tensions. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between normal termination points. Remove and discard cable where damaged during installation and replace it with new cable.

D. Grounding: As recommended by manufacturers, unless more stringent requirements are indicated. Ground equipment and conductors to eliminate shock hazard and to minimize ground loops. Common mode returns, noise pickup, cross talk and other impairments. Install 5-Ohm ground at main equipment location. Measure, record and report ground resistance.

E. Impedance Matching: For systems components including connecting cable, provide end to-end level and impedance matched signal paths. Use matching networks and balancing devices at connections where necessary to avoid mismatches.

F. Splices, taps and terminations: Make splices, taps and terminations on numbered terminal strips in junction, pull and outlet boxes; and equipment closures.

G. The speaker locations shown on the drawings are schematic only and may require field modification to avoid major ductwork, structures and other plenum barriers. Additional speakers may be required to provide uniform sound distribution because of these plenum obstructions.

H. All local hanging codes must be reviewed and observed by the installer/contractor.

I. Identification:
   a. Identify system components, wiring, cabling, and terminals according to Division 26 Section "Identification for Electrical Systems" Use color coded conductors and apply wire and cable marking tape to designate wires and cables so media are identified in coordination with system wiring diagrams.

J. All equipment and associated hardware shall be fabricated and installed in accordance with the manufacturer's specified recommendations.

3.2 PRELIMINARY TESTS AND ADJUSTMENTS

A. At the completion of installation of speakers, the Contractor shall perform initial tests and adjustment. With the speakers installed in accordance with specified spacing and orientation, tests shall be conducted in an open area of 35 ft. x 35 ft. minimum size. Tests shall indicate that all acoustical performance requirements described herein are satisfied.

B. All testing and adjusting of the system shall be accomplished in the absence of the occupants.

C. Tests and adjustments shall be performed as described below.
   1. Hum and Noise Level.
   2. Loudspeaker Operation.
   3. Freedom from Buzzes, Rattles and Objectional Distortion.
   4. Gain Control Settings.
   5. A written report representing the results of the above tests, including numerical values, shall be submitted for review.

3.3 FINAL TESTS AND ADJUSTMENTS

A. The manufacturers' agent with the support and cooperation of Contractor/Installer shall perform the acceptance testing of the completed installation. These tests shall be performed to
demonstrate that the equipment is fully furnished and installed in compliance with the terms of the Specifications in all Contract Documents. Except as otherwise specified, the Manufacturer/Contractor shall provide all instruments, equipment, labor and materials necessary to complete these tests.

B. Manufacturers Field Service: Engage a factory authorized service representative to inspect field assembled components and equipment installation and connections. Report results in writing. Include the following.
1. Operational Test: Start system to confirm proper operation. Remove malfunctioning units, replace with new units and retest. Make initial sound spectrum and level adjustments for each zone.
2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
3. Inspection: Verify that units and controls are properly labeled and interconnecting wires and terminals are identified.
4. Sound Masking Power Level Adjustments: Adjust independently for each space to minimum level of 47dBA to ensure speech privacy between adjacent workstations while complying with other system requirements.

C. The Contractor shall project the completion date of tests and adjustments so that he can give a minimum of one week's notice to the Owner's Representative.

D. Measurements of system performance shall be made using a calibrated ANSI precision sound level meter set for "slow" meter damping and 'A' scale filtering. The measurements shall be made at not less than twenty test positions at 4’ height above the floor level, with gain adjusted to provide the system design level. All interior finishes and furnishings shall be in place. Tests shall be for each floor at times not occupied by personnel.

E. Final Acceptance Testing:
1. Instrumentation: Use a professional quality sound level meter in accordance with ANSI S1.4. Record test observations, readings and corrective actions.
2. System Tests: Include the following for each zone: Relative Sound Power Level.
   a. Band Open Plan Areas at Enclosed Offices
      200 +2.5 -2
      250 +3 -2
      315 +2 -2.5
      400 +1 -3
      500 0 -4
      630 -1 -5
      800 -2 -6
      1000 -3 -7
      1250 -4 -8.5
      1600 -5 -10
      2000 -6 -12
   3. Adjust level of masking sound for each space so one third octave band centered at 500 Hz has final selected sound power level for that space. Measure deviation from listed values in one-third octave bands from 400 to 2000Hz. Measured values must not deviate from those listed by more than 4 dB for open plan areas and 8dB for enclosed offices. The total of individual band deviations in eight bands must not exceed 16 dB for open plan areas and 30 dB for enclosed offices.
   5. Temporal Stability Test: Check for uniformity of time by measuring sound level in each of 11 octave bands at one-minute intervals over a 30-minute test period. Deviations must not exceed limits specified in “System Description”.

F. Retest: Correct deficiencies identified by tests and observations and retest until meeting specified requirements.
G. Recording Control Settings and System Adjustments: Record final control settings and programming and final tap setting of speaker matching transformers. Record final sound level measurements and observations.

3.4 ADJUSTMENT

A. Occupancy Adjustments: When requested within 12 months of date of substantial completion manufacturer is to provide onsite assistance in adjusting system to suit actual occupied conditions. Provide one visit to site outside normal occupancy hours for this purpose without additional cost to the owner.

3.5 DEMONSTRATION

A. Engage a factory authorized service representative to train Owner’s maintenance personnel to adjust, operate and maintain services as specified below:

1. Train owner’s maintenance personnel on procedures and schedules for starting up and shutting down, troubleshooting, servicing, and maintaining equipment and schedules.
2. Review data in maintenance manual. Refer to Division 1.
3. Schedule training with owner through Owner Representative with at least seven days advance notice.

SECTION INCLUDES FOUR PAGES OF SOUNDMASKING PLANS FOLLOWING THIS SHEET

END OF SECTION 27 5119
ELECTRONIC SAFETY AND SECURITY

28 00 01 GENERAL

A. The Plans, the general provisions of the Contract including the General, Supplementary and/or Special Conditions and specification sections of Division 1 shall apply to Work of Division 28 of the Specifications.

B. Provisions and conditions cited in this Section shall apply to Work for other sections of Division 28 of these Specifications.

28 00 02 REFERENCES, REGULATORY REQUIREMENTS

A. Work for this Section of the Specifications shall be performed in accordance with the Codes, Standards, etc., as identified in Division 28.

28 00 03 REFERENCES, RELATED SECTIONS of the SPECIFICATIONS

A. Requirements of the following Sections of the Specifications apply to Work for this Section:

Division 26 – Electrical
Division 27 – Communications

28 00 04 DEFINITIONS

A. Refer to Section 26 00 05 – Definitions.

28 00 05 WORK INCLUDED

A. Furnish material, labor and services necessary for, and incidental to, installing the following systems where shown on the Plans and as hereinafter specified. Include all necessary work in the related sections of the Specifications to provide for complete systems.

28 00 06 SUBMITTALS:

A. The Contractor shall submit the following for approval in accordance with Subsection 26 00 43, Duties of the Contractor - Submittals.

B. Provide manufacturer's technical product data of each material and accessory item with engineering support information, installation manual, operation and maintenance manual. Data shall be specific to product specified and clearly identified on all data sheets, which contains multiple models or sizes.
28 05 00 COMMON WORK RESULTS FOR ELECTRONIC SAFETY AND SECURITY

28 05 28 PATHWAYS FOR ELECTRONIC SAFETY AND SECURITY SYSTEMS

A. All requirements listed in 27 05 28 shall apply for Electronic Safety and Security low voltage cabling unless noted below.

B. Cabling for the following systems shall be installed in conduit:
   1. Fire Alarm
   2. Access Control
   3. Intrusion Detection
   4. Video Surveillance

C. Cables shall be continuous from outlet to termination equipment.

D. Cables shall be terminated using tools recommended by the termination manufacturer.

E. Provide 2” minimum sleeves in all walls which cable runs pass through.

F. Furnish and install a minimum of (1) one cable pathway device through fire rated partitions and floors, and where indicated on the drawings. Device shall be Specified Technologies, Inc. EZDP33FWS, 3M QuickPass, or equivalent.

G. Refer to 26 05 29 for fire sealing of penetrations through fire rated walls.

H. Provide access panels as necessary for cable routing.

28 05 28.29 HANGERS AND SUPPORTS FOR COMMUNICATIONS SYSTEMS

A. Cables shall be supported with “J-Hooks” a minimum of every six feet. Bridal rings can be used when supporting (other than Cat 6) a maximum of six wires. Support devices are to be attached to existing permanent structure.

B. Cables shall be installed in cable tray where available.

C. Cables and supports shall be installed at a readily accessible location above ceilings.

28 05 28.33 CONDUITS AND BACKBOXES FOR COMMUNICATIONS SYSTEMS

A. Furnish and install conduit rough-ins where shown on drawings. Rough-in shall consist of a 4-11/16” outlet box, single gang trim ring, and a minimum 1” conduit stubbed above an accessible ceiling. Plastic bushings shall be installed on both ends of conduit. Install blank covers on all unused rough-ins.

B. Provide conduit for non plenum rated cable. Exposed or inaccessible cables shall be installed in conduit. Where possible cables/conduit shall be concealed.

C. Conduits for all cable runs shall be sized for 40% maximum fill, or as shown on the drawings.

D. Provide pull strings in all conduits.
E. Conduit bends shall accommodate radius requirements of fiber cable as necessary.

F. Provide sleeves in all walls which cable runs pass through.

G. Furnish and install a minimum of (1) one cable pathway device through fire rated partitions and floors, where indicated on the drawings. Device shall be Specified Technologies, Inc. EZDP33FWS, 3M QuickPass, or equivalent.

H. Refer to 26 05 29 for fire sealing of penetrations through fire rated walls.

I. Provide access panels as necessary for cable routing.
28 23 00  VIDEO SURVEILLANCE

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

B. SUMMARY
   1. Section includes rough-ins for owner provide cameras and associated hardware. Cameras to terminate on owner provided Ethernet switches, located near CAT6 patch panels. Video Surveillance system head-end equipment is located in IT room 1054.

D. EXAMININATION
   1. Coordinate final camera location and desired viewing angles with Owner.
   2. Coordinate location of LAN POE rated switch to be used with Owner.
   3. Examine pathway elements intended for cables. Check supporting hooks, raceways and other elements for compliance with space allocations, installation tolerance, and other conditions affecting installation. Provide new surface raceway where needed.
   4. Coordinate interior wall location for power supply serving exterior camera housings. Locate existing 120Vac, 15 or 20 amp, non-switched power source that can be tapped to feed power supply.
   5. Proceed with installation only after unsatisfactory conditions have been corrected.

E. WIRING
   1. Comply with requirements in Division 26 Section “Raceway and Boxes for Electrical Systems.”
   2. Wiring Method: Install cables in raceways unless otherwise indicated.
      a. Raceways are not required in accessible indoor ceiling spaces and attics.
      b. Utilize surface raceway in office and classroom spaces. Existing raceways may be reused where possible. New must be provided where not.
   3. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer’s limitations on bending radii. Provide and use lacing bars and distribution spools.
   4. Splices, Taps, and Terminations: For power and control wiring, use numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures. Tighten electrical connectors and terminals according to
manufacturer’s published torque-tightening values. If manufacturer’s torque values are not indicated, use those specified in UL 486A-486B.

5. For LAN connection and copper communication wiring, comply with Division 27 Sections “Communications Backbone Cabling” and “Communications Horizontal Cabling.”

A. Description of Work

1. Install a complete and operational addressable fire alarm system as indicated by drawings, schedules, and riser diagrams.

2. The equipment supplier must be the local factory authorized representative and must also be factory authorized, trained and certified to perform warranty service for the equipment being supplied.

3. Firm shall be regularly engaged in manufacturer of fire alarm systems of types, sizes, and electrical characteristics required, and whose products have been in satisfactory use in similar service for not less than 5 years.

4. Firm with at least 5 years of successful experience on projects with fire alarm systems work similar to that required for this project providing local factory authorized service and spare parts inventory.

5. For a period of one year from date of Owner's first beneficial use, the system shall be under service contract, as authorized by the manufacturer. During that period, replacement components and labor shall be readily available during standard business hours. After the one-year guarantee period, the supplier warrants that he is capable of providing service on a 24 hour, 7-day a week basis for at least five (5) additional years.

6. The Contractor and (equipment supplier) shall perform conductor testing in accordance with NFPA 72, table 7-2.2, Items 11a-d, prior to installation of devices. Test results shall be submitted to the Engineer.

7. Provide shop drawings showing manufacturer’s technical product data, including specifications and installation instruction, for each type of fire alarm system equipment. Project specific point-to-point drawings, wiring diagrams, fire alarm matrix, device addresses and voltage drop and battery calculations shall be provided. Partial submittal packages may be returned without being reviewed.

8. Sealed fire alarm drawings required for permit application are the responsibility of the Contractor and fire alarm system supplier.

9. The Contractor shall provide as-built drawings with final project specific point-to-point wiring diagrams, device addresses and battery calculations. The contractor shall provide all as-builts showing manufacturer’s technical product data, including specifications and installation instruction, for each type of fire alarm system equipment. Refer to specification section 26 00 38 for all other as-built requirements.

B. Acceptable Manufacturers
1. Subject to compliance with requirements, provide fire alarm components from one of the following system:

   Siemens MXL

C. Fire Alarm Control Panel

1. The Fire Alarm System will be microprocessor based, non-coded, and utilize analog/addressable devices. It will be electronically supervised, common signalling, individual device indicating, with remote central station monitoring. The system shall operate from manual fire alarm stations, smoke detectors, thermal detectors, duct detectors, water flow, and tamper switches.

2. The panel shall include an 80 character LCD display that can be viewed without opening the front cover of the control panel.

3. The panel shall be expandable to 318 addressable devices per loop (159 detectors/159 modules).

4. The system shall transmit alarm signals to a remote central station in full compliance with NFPA 72. The batteries will be able to operate the system under maximum normal load condition for not less than 24 consecutive hours followed by five (5) minutes of alarm.

5. Provide a low voltage, 24 volt DC fire alarm control panel including all circuitry, power supplies, batteries, programming and cabinet space necessary to perform required functions, and to service as test and trouble signal points.

6. All input/output cards shall be modular, plug-in type devices.

7. Equipment control panel for number of initiating addresses as required plus 20% spare capacity.

8. The control panel shall include the following additional features:

   Walk test feature for single person testing of the system. This feature includes special audible indication and zone trouble indication.

   Temporal code 3 selectable for each indicating circuit.

   Alarm verification, programmable per device.

   Totally field programmable with multiple password protection.

   All initiation and indication circuits shall be power limited for use with limited energy cables.

   Addressable monitor modules may be field programmed for normal water flow or supervisory operation.

   Any output control/relay module circuit may be mapped to any input device in non-volatile program memory.
Display program function allows system field program information to be easily displayed using front panel controls.

Disable capability for each device shall be provided from the control panel.

A 650-event history log stored in non-volatile memory with storage of alarm verification activities.

RS-485 serial port shall be provided for high-speed 4-wire annunciation of the system.

9. Contractor to provide dedicated 20A, 120VAC power connection to fire alarm control panel. The circuit breaker for this dedicated circuit to be labeled “Fire Alarm System Power”.

D. Fire Alarm Communicator:

1. Provide dual path commercial fire alarm communicator with cellular and IP communication capabilities (Honeywell #IPGSM-4G or equal). The Contractor shall provide cable, connectors and installation of two data cables from the data rack. The communicator will transmit each event as digital information over the data or cellular network. The contractor shall test the signal of the cellular antenna and provide additional antennae as required to produce a reliable cellular signal.

E. Remote Annunciator

1. Remote annunciator panel shall include an 80-character backlit LCD display to mirror the fire alarm control panel display and piezo sounder to notify of system trouble.

2. Remote annunciator to be provided with key lock switch and control keypad for system acknowledge, audible signal silence and system reset functions.

3. Flush or surface mounting of remote annunciator panel to be coordinated prior to installation.

F. Initiating Devices


2. Photoelectric Detectors: Intelligent analog photoelectric smoke detectors shall use the photoelectric (light-scattering) principal to measure smoke density and shall, on command from the control panel, send data to the panel representing the analog level of smoke density. Sensitivity of the detector shall have an adjustable nominal sensitivity range per UL. It shall be possible to perform a calibrated sensitivity and performance test on the detector without generating smoke. The test method shall test all detectors. The detector shall have a UL operating range of 0-4000 ft. per minute. Provide a detector at control panel and each annunciator and remote power supply. Provide standard bases model. Provide a detector at control panel and each annunciator and remote power supply.
3. **Duct Detector**: Ionization duct smoke detector with sampling tube and protective housing. Provide remote test switches where noted. Contractor to provide all load relays necessary for fan shut-down.

4. **Thermal Detector**: Fixed temperature low profile type device with maximum protrusion of 2.1 inches and twist lock installation. Temperature rating to be 135 degrees or 190 degrees (H version). In elevator equipment rooms and shafts, heat detectors shall be located within two feet of each sprinkler head.

5. **Relay Modules**: Addressable relay modules with LED indicator light.

6. **Control Modules**: Addressable control modules with LED indicator light.

7. **Monitor Modules**: Addressable monitor modules with LED indicator light.

8. **Door Holders**: Flush wall mount electromagnetic door holder controlled by fire alarm system. Provide extension rods or box extensions as necessary. Door Holders shall be 24V. Provide power supplies as necessary. Label power supplies “Door Holder Power Supply”. Door Holders provided by Door Hardware Supplier.

9. **Beam Detector**: Intelligent beam smoke detector with multi mounting kit, surface mount kit and remote test switches where noted.

10. **Carbon Monoxide Detector**: 4-wire carbon monoxide detector monitored by fire alarm system with local alarm sounder and trouble relay. Mount per manufacturer’s instructions.

11. All initiating devices shall be identified with a black-on-clear (1/4” text minimum) printed adhesive label affixed to the device. This label shall include the device address.

G. **Signal Devices**

1. **Audible/Visual and Visual Signal Devices**

   - **Wall Mounted Selectable Candela Audible/Visual Signals**: Horn shall have 84 dB output at 10 feet on the high setting. Strobes shall have 15, 15/75, 30, 75, 110, and 115 candela output.

   - **Wall Mounted Selectable Candela Visual Signals**: Strobe shall have 15, 15/75, 30, 75, 110 and 115 candela output.

   - **Ceiling Mounted Selectable Candela Audible/Visual Signals**: Horn shall have 84 dB output at 10 feet on the high setting. Strobes shall be multi-candela units with 15, 15/75, 30, 75, 110, and 115 candela outputs.

   - **Ceiling Mounted Selectable Candela Visual Signals**: Strobes shall be multi-candela units with 15, 15/75, 30, 75, 110, and 115 candela outputs.

2. Signals shall meet the requirements of the Americans With Disabilities Act.
3. The visual section shall be polarized Xenon strobe in various candela ratings. The visual candela rating shall be as indicated on the drawings.

4. Audible signals and/or audible sections of combination signals shall be electronic multi-tone units and shall not require vibrating solenoids or contacts. The audible section shall provide for a high/medium/low setting providing different dB levels meeting the requirements of the particular room or space. Tone selection shall be continuous tones or the temporal pattern based on the ANSI S3.41 Standard shall be field selectable. Set audible signals to temporal pattern for this project and volume at high. Adjust volume for small rooms as required.

5. Visual and audible devices shall be synchronized.

6. The signals shall operate on 24 VDC polarized and meet UL 1971, UL464 and ADA. The signal shall be able to test circuit supervision without disconnecting wires.

7. There shall be FIRE lettering clearly visible from both sides. Red or white device color to be coordinated with Architect.

8. Provide remote power supplies as necessary. Provide dedicated 20A, 120V circuit to each remote power supply.

H. System Wiring

1. All wiring will be as required by the Equipment Supplier. Wire color-coding and the color shall remain the same throughout the system. In general, all initiating devices such as manual stations, thermal detectors, ionization detectors and all modules will be installed across a common #18AWG twisted shielded pair. The signal circuits, door release circuits, fan shut down, etc., shall require #14AWG.

2. No conduit or raceway system will include Class I or non-power limited fire protection signaling circuits with Class II or power limited fire protection signaling circuits in accordance with N.E.C. Article 725 or 760.

3. All conduit and wiring to flow switches, tamper switches, etc., shall be furnished and installed as part of this work.

4. Test results shall be submitted to Engineer.

5. Wiring may be run as concealed open-type plenum rated cable. Exposed or inaccessible wiring shall be installed in conduit. Where possible wiring/conduit shall be concealed. Provide sleeves in all walls which cable runs pass through. Refer to 26 05 29 for fire sealing of penetrations through fire rated walls. Provide access panels as necessary for cable routing. Support devices are to be attached to existing permanent structure.

I. Sequence of Operations

1. Fire alarm system to evacuate entire building in the event of an alarm.

2. The following will occur upon activation of any alarm initiating device (smoke detector, heat detector, manual pull station and water flow monitor module):
a. Activate remote station connection modules. Three distinct outputs must be provided: 1) Alarm, 2) Supervisory, 3) Trouble.
b. Sound audible signals and flash visual signals.
c. Display status information on the fire alarm control panel and each remote annunciator LCD screen.
d. Activate addressable control modules to shut down air handling units, close fire/smoke dampers and release all smoke doors.
e. Upon elevator lobby, elevator equipment room or elevator shaft detection, primary or alternate recall module contacts will close to activate elevator recall. Upon equipment room or shaft detection, an additional control module contact will close for a signal to the elevator cab.
f. Upon activation of elevator hoist way or elevator equipment room heat detectors the elevator power shunt trip fusible switch shall be caused to trip open.

3. The following to occur upon activation of a trouble signal (open circuit, ground fault, low battery, loss of AC power, etc.):
   a. Annunciate zone at fire alarm control panel and remote annunciator.

4. Duct detector detection to shut-down all air handling units and send supervisory signal to the fire alarm control panel and remote annunciator.

5. Tamper switch state change to send supervisory signal to fire alarm control panel and remote annunciator.

6. Exterior horn/strobe at fire department connection to only activate on water flow.

7. Signal Silence control button to deactivate audible notification devices.

8. System Reset control button to deactivate visual notification devices and return status of fire alarm system to normal state.

END OF SECTION
28 00 00
SECTION 31 2000
EARTH MOVING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. A Geotechnical Report dated April 5, 2019, prepared for the project by Engineering Surveys and Services.

1.2 SUMMARY

A. Section Includes:

1. Excavating and filling for rough grading the Site.
2. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses, and plants.
3. Excavating and backfilling for buildings and structures.
4. Subbase course for concrete walks, and pavements.
5. Subbase course and base course for asphalt paving.
6. Subsurface drainage backfill for walls and trenches.
7. Excavating and backfilling trenches for utilities and pits for buried utility structures.

B. Related Requirements:

1. Section 31 1000 "Site Clearing" for site stripping, grubbing, stripping, and stockpiling topsoil, and removal of above- and below-grade improvements and utilities.
2. Section 32 9200 "Turf and Grasses" for finish grading in turf and grass areas, including preparing and placing planting soil for turf areas.

1.3 DEFINITIONS

A. Backfill: Soil material or controlled low-strength material used to fill an excavation.

1. Initial Backfill: Backfill placed beside and over pipe in a trench, including haunches to support sides of pipe.
2. Final Backfill: Backfill placed over initial backfill to fill a trench.

B. Base Course: Aggregate layer placed between the subbase course and hot-mix asphalt paving.

C. Bedding Course: Aggregate layer placed over the excavated subgrade in a trench before laying pipe.

D. Borrow Soil: Satisfactory soil imported from off-site for use as fill or backfill.

E. Excavation: Removal of material encountered above subgrade elevations and to lines and dimensions indicated.
1. Authorized Additional Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions as directed by Owner. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

2. Unauthorized Excavation: Excavation below subgrade elevations or beyond indicated lines and dimensions without direction by Owner. Unauthorized excavation, as well as remedial work directed by Owner, shall be without additional compensation.

F. Fill: Soil materials used to raise existing grades.

G. Rock: Rock material in beds, ledges, unstratified masses, conglomerate deposits, and boulders of rock material 3/4 cu. yd. (0.57 cu. m) or more in volume.

H. Structures: Buildings, footings, foundations, retaining walls, slabs, tanks, curbs, mechanical and electrical appurtenances, or other man-made stationary features constructed above or below the ground surface.

I. Subbase Course: Aggregate layer placed between the subgrade and base course for hot-mix asphalt pavement, or aggregate layer placed between the subgrade and a cement concrete pavement or a cement concrete or hot-mix asphalt walk.

J. Subgrade: Uppermost surface of an excavation or the top surface of a fill or backfill immediately below subbase, drainage fill, drainage course, or topsoil materials.

K. Utilities: On-site underground pipes, conduits, ducts, and cables as well as underground services within buildings.

1.4 SUBMITTALS

A. Product Data: For each type of the following manufactured products required:
   1. Utility warning tapes.

B. Samples for Verification: For the following products, in sizes indicated below:
   1. None.

1.5 INFORMATIONAL SUBMITTALS

A. Material Test Reports: For each granular material used as follows:
   1. Gradation according to ASTM C 136.

B. Preexcavation Photographs or Videotape: Show existing conditions of adjoining construction and site improvements, including finish surfaces that might be misconstrued as damage caused by earth-moving operations. Keep on file - submit only upon request.

1.6 FIELD CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during earth-moving operations.
1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

A. Improvements on Adjoining Right-of-Way: Obtain authority and or permitting as required by the City of Columbia for performing work indicated on right-of-way adjoining Owner's property prior to construction.

1. Do not proceed with work on adjoining right-of-way until all permitting is obtained.

B. Utility Locator Service: Notify “Missouri One Call” for area where Project is located before beginning earth-moving operations.

C. Do not commence earth-moving operations until temporary site fencing and erosion- and sedimentation-control measures indicated in civil plans are in place.

D. Do not commence earth-moving operations until tree-protection measures indicated in civil plans are in place.

1.7 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GW, GM, GC, SW, SP, SM, SC, and CL according to ASTM D 2487 or a combination of these groups; free of rock or gravel larger than 8 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter. Soils that classify as CH should be analyzed and approved by a qualified geotechnical engineer prior to use.

C. Unsatisfactory Soils: Soil Classification Groups OL, MH, OH, and PT according to ASTM D 2487 or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within -2 to +4 percent of optimum moisture content at time of compaction.

D. Subbase Material: Subbase material shall meet the crushed stone base MoDOT requirements of Section 1007 of the current Missouri Standards for Highway Construction, Type 1.

E. Engineered Fill: Per the geotechnical report prepared for the project.

F. Bedding Course: Per ASTM C33 #67 or approved equal.

1.8 ACCESSORIES

A. Detectable Warning Tape: Acid- and alkali-resistant, polyethylene film warning tape manufactured for marking and identifying underground utilities, a minimum of 6 inches (150 mm) wide and 4 mils (0.1 mm) thick, continuously inscribed with a description of the utility, with metallic core encased in a protective jacket for corrosion protection, detectable by metal detector when tape is buried up to 30 inches (750 mm) deep; colored as follows:

2. Yellow: Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water systems.
5. Green: Sewer systems.

PART 2 - EXECUTION

2.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth-moving operations.

B. Protect and maintain erosion and sedimentation controls during earth-moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

2.2 DEWATERING

A. Prevent surface water and ground water from entering excavations, from ponding on prepared subgrades, and from flooding Project site and surrounding area.

B. Protect subgrades from softening, undermining, washout, and damage by rain or water accumulation.

1. Reroute surface water runoff away from excavated areas. Do not allow water to accumulate in excavations. Do not use excavated trenches as temporary drainage ditches.

2.3 EXPLOSIVES

A. Explosives: Do not use explosives.

2.4 EXCAVATION, GENERAL

A. Classified Excavation: Excavate to subgrade elevations. Material to be excavated will be classified as earth and rock. Do not excavate rock until it has been classified and cross sectioned by Architect. The Contract Sum will be adjusted for rock excavation according to unit prices included in the Contract Documents. Changes in the Contract Time may be authorized for rock excavation.

1. Earth excavation includes excavating pavements and obstructions visible on surface; underground structures, utilities, and other items indicated to be removed; and soil, boulders, and other materials not classified as rock or unauthorized excavation.

   a. Intermittent drilling; blasting, if permitted; ram hammering; or ripping of material not classified as rock excavation is earth excavation.
2.5 EXCAVATION FOR STRUCTURES

A. Excavate to indicated elevations and dimensions within a tolerance of plus or minus 1 inch (25 mm). If applicable, extend excavations a sufficient distance from structures for placing and removing concrete formwork, for installing services and other construction, and for inspections.

1. Excavations for Footings and Foundations: Do not disturb bottom of excavation. Excavate by hand to final grade just before placing concrete reinforcement. Trim bottoms to required lines and grades to leave solid base to receive other work.

2. Excavation for Underground Tanks, Basins, and Mechanical or Electrical Utility Structures: Excavate to elevations and dimensions indicated within a tolerance of plus or minus 1 inch (25 mm). Do not disturb bottom of excavations intended as bearing surfaces.

2.6 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

2.7 EXCAVATION FOR UTILITY TRENCHES

A. Excavate trenches to indicated gradients, lines, depths, and elevations.

1. Beyond building perimeter, excavate trenches to allow installation of top of pipe below frost line.

B. Excavate trenches to uniform widths to provide the following clearance on each side of pipe or conduit. Excavate trench walls vertically from trench bottom to 12 inches (300 mm) higher than top of pipe or conduit unless otherwise indicated.

1. Clearance: 6 inches (300 mm) each side of pipe or conduit, or as indicated on the drawings.

C. Trench Bottoms: Excavate and shape trench bottoms to provide uniform bearing and support of pipes and conduit. Shape subgrade to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits. Remove projecting stones and sharp objects along trench subgrade.

1. Excavate trenches deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

D. Trench Bottoms: Excavate trenches 4 inches (100 mm) deeper than bottom of pipe and conduit elevations to allow for bedding course. Hand-excavate deeper for bells of pipe.

1. Excavate trenches 6 inches (150 mm) deeper than elevation required in rock or other unyielding bearing material to allow for bedding course.

2.8 SUBGRADE INSPECTION

A. Notify Owner when excavations have reached required subgrade.

B. If Owner determines that unsatisfactory soil is present, continue excavation and replace with compacted backfill or fill material as directed.
C. Proof-roll subgrade below the building slabs and pavements with a pneumatic-tired [and loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes)] to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph (5 km/h).
2. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner, and replace with compacted backfill or fill as directed.

D. Authorized additional excavation and replacement material will be paid for according to Contract provisions for changes in the Work.

E. Reconstruct subgrades damaged by freezing temperatures, frost, rain, accumulated water, or construction activities, as directed by the Owner, without additional compensation.

2.9 UNAUTHORIZED EXCAVATION

A. Fill unauthorized excavation under foundations or wall footings by extending bottom elevation of concrete foundation or footing to excavation bottom, without altering top elevation. Lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa), may be used when approved by the Owner.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Owner.

2.10 STORAGE OF SOIL MATERIALS

A. Stockpile borrow soil materials and excavated satisfactory soil materials without intermixing. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.

1. Stockpile soil materials away from edge of excavations. Do not store within drip line of remaining trees.
2. Adhere to all current City of Columbia stockpile requirements.

2.11 BACKFILL

A. Place and compact backfill in excavations promptly, but not before completing the following:

1. Construction below finish grade including, where applicable, subdrainage, dampproofing, waterproofing, and perimeter insulation.
2. Surveying locations of underground utilities for Record Documents.
3. Testing and inspecting underground utilities.
4. Removing concrete formwork.
5. Removing trash and debris.
6. Removing temporary shoring, bracing, and sheeting.
7. Installing permanent or temporary horizontal bracing on horizontally supported walls.

B. Place backfill on subgrades free of mud, frost, snow, or ice.

2.12 UTILITY TRENCH BACKFILL

A. Place backfill on subgrades free of mud, frost, snow, or ice.
B. Place and compact bedding course on trench bottoms and where indicated. Shape bedding course to provide continuous support for bells, joints, and barrels of pipes and for joints, fittings, and bodies of conduits.

C. Trenches under Footings: Backfill trenches excavated under footings with lean concrete fill, with 28-day compressive strength of 2500 psi (17.2 MPa).

D. Trenches under Roadways: Place and compact backfill of Engineered Fill material to the bottom of the roadway pavement and a minimum 1 foot beyond edge of pavement in all directions. Place and compact in 8 inch maximum lifts.

E. Backfill voids with satisfactory soil while removing shoring and bracing.

F. Place and compact initial backfill of Engineered Fill, free of particles larger than 1 inch (25 mm) in any dimension, to a height of 12 inches (300 mm) over the pipe or conduit.
   a. Carefully compact initial backfill under pipe haunches and compact evenly up on both sides and along the full length of piping or conduit to avoid damage or displacement of piping or conduit. Coordinate backfilling with utilities testing.

G. Final Backfill (if not specifically indicated in civil plans):
   1. Soil Backfill: Place and compact final backfill of satisfactory soil to final subgrade elevation.

H. Warning Tape: Install warning tape directly above utilities, 12 inches (300 mm) below finished grade, except 6 inches (150 mm) below subgrade under pavements and slabs.

2.13 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 5 horizontal so fill material will bond with existing material.

B. Place and compact fill material in layers to required elevations as follows:
   1. Under grass and planted areas, use satisfactory soil material.
   2. Under walks and pavements, use satisfactory soil material.
   3. Under steps and ramps, use satisfactory soil material.
   4. Under building slabs, use satisfactory soil material.
   5. Under footings and foundations, use satisfactory soil material.
   6. Under grass and planted areas, use satisfactory soil material to achieve grades to bottom of topsoil layer. Achieve finished grade by placing a topsoil layer to thickness indicated in the civil plans.
      a. Topsoil shall be obtained from the onsite topsoil stockpile created with initial grading operations.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

2.14 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within -2 to +4 percent of optimum moisture content.
1. Do not place backfill or fill soil material on surfaces that are muddy, frozen, or contain frost or ice.
2. Remove and replace, or scarify and air dry, otherwise satisfactory soil material that exceeds optimum moisture content by +4 percent and is too wet to compact to specified dry unit weight.

2.15 COMPACTION OF SOIL BACKFILLS AND FILLS

A. Place backfill and fill soil materials in layers not more than 8 inches (200 mm) in loose depth for material compacted by heavy compaction equipment and not more than 4 inches (100 mm) in loose depth for material compacted by hand-operated tampers.

B. Place backfill and fill soil materials evenly on all sides of structures to required elevations and uniformly along the full length of each structure.

C. Compact soil materials to not less than the following percentages of maximum dry unit weight according to ASTM D 698:

1. Under building slabs, compact each layer of backfill or fill soil material at least 95 percent.
2. Under walkways, structures, steps, and pavements, compact each layer of backfill or fill soil material at least 95 percent.
3. Under turf or unpaved areas, compact each layer of backfill or fill soil material at least 95 percent to achieve bottom of topsoil layer elevation. Topsoil surface material shall not exceed 80 - 85 percent compaction. Light compaction only. Do not allow vehicular access within topsoil areas after placement. Excessively hardened, compacted, or tight topsoil will be rejected and is to be replaced by the Contractor at no cost to the Owner.
4. For utility trenches, compact each layer of initial and final backfill soil material at least 95 percent.

2.16 GRADING

A. General: Uniformly grade areas to a smooth surface, free of irregular surface changes. Comply with compaction requirements and grade to cross sections, lines, and elevations indicated.

1. Provide a smooth transition between adjacent existing grades and new grades.
2. Cut out soft spots, fill low spots, and trim high spots to comply with required surface tolerances.

B. Site Rough Grading: Slope grades to direct water away from buildings and to prevent ponding. Finish subgrades to elevations required to achieve indicated finish elevations, within the following subgrade tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Football Field Area: Plus or minus 1/4 inch.
3. Walks: Plus or minus 1/2 inch (13 mm).
4. Pavements: Plus or minus 1/2 inch (13 mm).

C. Grading inside Building Lines: Finish subgrade to a tolerance of 1/2 inch (13 mm) when tested with a 10-foot (3-m) straightedge.

D. Within Football Field:
1. Final subgrade preparation for receiving topsoil shall be done with equipment that does not leave indentations deeper than a half (1/2) inch. Typical wheeled road grading equipment is prohibited. Equipment with flotation turf tires, or lightweight designs specific for turf preparation/maintenance are acceptable.

2.17 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified geotechnical engineering testing agency to perform tests and inspections.

B. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

C. Footing Subgrade: At footing subgrades, at least one test of each soil stratum will be performed to verify design bearing capacities. Subsequent verification and approval of other footing subgrades may be based on a visual comparison of subgrade with tested subgrade when approved by Architect.

D. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 2937, and ASTM D 6938, as applicable. Tests will be performed at the following locations and frequencies:

1. Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2,500 square feet or less of paved area or building pad, but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 150 feet or less of wall length but no fewer than two tests.
3. Trench Backfill: At each compacted initial and final backfill layer, at least one test for every 150 feet or less of trench length but no fewer than two tests.
4. Paved areas, sidewalks, and other potential structural areas: At each compacted backfill layer, at least one test for every 10,000 square feet, but in no case fewer than 3 tests per lift.

E. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

2.18 PROTECTION

A. Protecting Graded Areas: Protect newly graded areas from traffic, freezing, and erosion. Keep free of trash and debris.

B. Repair and reestablish grades to specified tolerances where completed or partially completed surfaces become eroded, rutted, settled, or where they lose compaction due to subsequent construction operations or weather conditions.

1. Scarify or remove and replace soil material to depth as directed by the Owner; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.
1. Restore appearance, quality, and condition of finished surfacing to match adjacent work, and eliminate evidence of restoration to greatest extent possible.

2.19 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove waste materials, trash, and debris, and legally dispose of them off Owner's property.

B. Place and compact surplus satisfactory soil in northwest corner of area within grading limits. Place to provide adequate surface drainage with no standing water.

END OF SECTION 31 2000
SECTION 31 3116 - TERMITE CONTROL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Soil treatment with termiticide.

1.3 SUBMITTALS

A. Product Data: For each type of termite control product.

1. Include the EPA-Registered Label for termiticide products.

B. Product Certificates: For termite control products, from manufacturer.

C. Soil Treatment Application Report: After application of termiticide is completed, submit report for Owner's records and include the following:

1. Date and time of application.
2. Moisture content of soil before application.
3. Termiticide brand name and manufacturer.
4. Quantity of undiluted termiticide used.
5. Dilutions, methods, volumes used, and rates of application.
6. Areas of application.
7. Water source for application.

D. Warranties: Sample of special warranties.

1.4 QUALITY ASSURANCE

A. Regulatory Requirements: Formulate and apply termiticides and termiticide devices according to the EPA-Registered Label.

B. Source Limitations: Obtain termite control products from single source from single manufacturer.

1.5 PROJECT CONDITIONS

A. Environmental Limitations: To ensure penetration, do not treat soil that is water saturated or frozen. Do not treat soil while precipitation is occurring. Comply with requirements of the EPA-Registered Label and requirements of authorities having jurisdiction.
B. Coordinate soil treatment application with excavating, filling, grading, and concreting operations. Treat soil under footings, grade beams, and ground-supported slabs before construction.

1.6 WARRANTY

A. Soil Treatment Special Warranty: Manufacturer's standard form, signed by Applicator and Contractor, certifying that termite control work, consisting of applied soil termiticide treatment, will prevent infestation of subterranean termites. If subterranean termite activity or damage is discovered during warranty period, re-treat soil and repair or replace damage caused by termite infestation.

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

PART 2 - PRODUCTS

2.1 SOIL TREATMENT

A. Termiticide: Provide an EPA-Registered termiticide, complying with requirements of authorities having jurisdiction, in an aqueous solution formulated to prevent termite infestation. Provide quantity required for application at the label volume and rate for the maximum termiticide concentration allowed for each specific use, according to product's EPA-Registered Label.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. BASF Corporation, Agricultural Products; Termidor.
   b. Bayer Environmental Science; Premise 75.
   c. FMC Corporation, Agricultural Products Group; Dragnet FT or Talstar, or Prevail.
   d. Syngenta; Demon TC or Prelude or Probuild TC.

2. Service Life of Treatment: Soil treatment termiticide that is effective for not less than five years against infestation of subterranean termites.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for moisture content of soil per termiticide label requirements, interfaces with earthwork, slab and foundation work, landscaping, utility installation, and other conditions affecting performance of termite control.

B. Proceed with application only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's written instructions for preparation before beginning application of termite control treatment. Remove all extraneous sources of wood cellulose and other edible materials such as wood debris, tree stumps and roots, stakes, formwork, and construction waste wood from soil within and around foundations.
B. Soil Treatment Preparation: Remove foreign matter and impermeable soil materials that could decrease treatment effectiveness on areas to be treated. Loosen, rake, and level soil to be treated except previously compacted areas under slabs and footings. Termiticides may be applied before placing compacted fill under slabs if recommended in writing by termiticide manufacturer.

1. Fit filling hose connected to water source at the site with a backflow preventer, complying with requirements of authorities having jurisdiction.

3.3 APPLICATION, GENERAL
A. General: Comply with the most stringent requirements of authorities having jurisdiction and with manufacturer's EPA-Registered Label for products.

3.4 APPLYING SOIL TREATMENT
A. Application: Mix soil treatment termiticide solution to a uniform consistency. Provide quantity required for application at the label volume and rate for the maximum specified concentration of termiticide, according to manufacturer's EPA-Registered Label, to the following so that a continuous horizontal and vertical termiticidal barrier or treated zone is established around and under building construction. Distribute treatment evenly.

1. Slabs-on-Grade and Basement Slabs: Underground-supported slab construction, including footings, building slabs, and attached slabs as an overall treatment. Treat soil materials before concrete footings and slabs are placed.
2. Foundations: Adjacent soil, including soil along the entire inside perimeter of foundation walls; along both sides of interior partition walls; around plumbing pipes and electric conduit penetrating the slab; around interior column footers, piers, and chimney bases; and along the entire outside perimeter, from grade to bottom of footing. Avoid soil washout around footings.

B. Avoid disturbance of treated soil after application. Keep off treated areas until completely dry.

C. Protect termiticide solution, dispersed in treated soils and fills, from being diluted until ground-supported slabs are installed. Use waterproof barrier according to EPA-Registered Label instructions.

D. Post warning signs in areas of application.

E. Reapply soil treatment solution to areas disturbed by subsequent excavation, grading, landscaping, or other construction activities following application.

END OF SECTION 31 3116
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SECTION 32 1216
ASPHALT PAVING

PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Hot-mix asphalt paving.
      2. Asphalt surface treatments.

1.3 DEFINITION
   A. Hot-Mix Asphalt Paving Terminology: Refer to ASTM D 8 for definitions of terms.

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated. Include technical data and tested physical and performance properties.
      1. Job-Mix Designs: For each job mix proposed for the Work.
   B. Qualification Data: For qualified manufacturer and Installer.
   C. Material Certificates: For each paving material, from manufacturer.
   D. Material Test Reports: For each paving material.

1.5 QUALITY ASSURANCE
   A. Regulatory Requirements: Comply with materials, workmanship, and other applicable requirements of the current MoDOT Standard Specifications for Highway Construction for asphalt paving work.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

1.7 PROJECT CONDITIONS

A. Environmental Limitations: Do not apply asphalt materials if subgrade is wet or excessively damp, if rain is imminent or expected before time required for adequate cure, or if the following conditions are not met:

1. Prime Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
2. Tack Coat: Minimum surface temperature of 60 deg F (15.6 deg C).
4. Asphalt Base Course: Minimum surface temperature of 40 deg F (4.4 deg C) and rising at time of placement.
5. Asphalt Surface Course: Minimum surface temperature of 60 deg F (15.6 deg C) at time of placement.

PART 2 - PRODUCTS

2.1 AGGREGATES

A. General: Use materials and gradations that have performed satisfactorily in previous installations.

B. Type 1 Aggregate: Per the current MoDOT Standard Specifications for Highway Construction.

2.2 ASPHALT MATERIALS

A. All asphalt material shall conform to the current MoDOT Standard Specifications for Highway Construction.

B. Water: Potable.

2.3 AUXILIARY MATERIALS

A. Herbicide: Commercial chemical for weed control, registered by the EPA. Provide in granular, liquid, or wettable powder form.

B. Sand: ASTM D 1073 or AASHTO M 29, Grade Nos. 2 or 3.
2.4 MIXES

A. Hot-Mix Asphalt: Per the current MoDOT Standard Specifications for Highway Construction.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that subgrade is dry and in suitable condition to begin paving.

B. Proof-roll subgrade below pavements with heavy pneumatic-tired equipment to identify soft pockets and areas of excess yielding. Do not proof-roll wet or saturated subgrades.

1. Completely proof-roll subgrade in one direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof roll with a pneumatic tired loaded 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Excavate soft spots, unsatisfactory soils, and areas of excessive pumping or rutting, as determined by Owner, and replace with compacted backfill or fill as directed.

C. Proceed with paving only after unsatisfactory conditions have been corrected.

D. Verify that utilities, traffic loop detectors, and other items requiring a cut and installation beneath the asphalt surface have been completed and that asphalt surface has been repaired flush with adjacent asphalt prior to beginning installation of imprinted asphalt.

3.2 SURFACE PREPARATION

A. General: Immediately before placing asphalt materials, remove loose and deleterious material from substrate surfaces. Ensure that prepared subgrade is ready to receive paving.

B. Prime Coat: Apply uniformly over surface of compacted unbound-aggregate base course at a rate of 0.20 gal./sq. yd. Apply enough material to penetrate and seal but not flood surface. Allow prime coat to cure.

1. If prime coat is not entirely absorbed within 24 hours after application, spread sand over surface to blot excess asphalt. Use enough sand to prevent pickup under traffic. Remove loose sand by sweeping before pavement is placed and after volatiles have evaporated.
2. Protect primed substrate from damage until ready to receive paving.

C. Tack Coat: Apply uniformly to surfaces of existing pavement at a rate of 0.05 to 0.15 gal./sq. yd. (0.2 to 0.7 L/sq. m).

1. Allow tack coat to cure undisturbed before applying hot-mix asphalt paving.
2. Avoid smearing or staining adjoining surfaces, appurtenances, and surroundings. Remove spillages and clean affected surfaces.
3.3 HOT-MIX ASPHALT PLACING

A. Machine place hot-mix asphalt on prepared surface, spread uniformly, and strike off. Place asphalt mix by hand to areas inaccessible to equipment in a manner that prevents segregation of mix. Place each course to required grade, cross section, and thickness when compacted.

1. Place hot-mix asphalt base course per current MoDOT Standard Specifications for Highway Construction.

B. Promptly correct surface irregularities in paving course behind paver. Use suitable hand tools to remove excess material forming high spots. Fill depressions with hot-mix asphalt to prevent segregation of mix; use suitable hand tools to smooth surface.

3.4 JOINTS

A. Construct joints to ensure a continuous bond between adjoining paving sections. Construct joints free of depressions, with same texture and smoothness as other sections of hot-mix asphalt course.

1. Clean contact surfaces and apply tack coat to joints.
2. Offset longitudinal joints, in successive courses, a minimum of 6 inches (150 mm).
3. Offset transverse joints, in successive courses, a minimum of 24 inches (600 mm).
4. Construct transverse joints at each point where paver ends a day's work and resumes work at a subsequent time. Construct these joints using either "bulkhead" or "papered" method according to AIM-22, for both "Ending a Lane" and "Resumption of Paving Operations."
5. Compact joints as soon as hot-mix asphalt will bear roller weight without excessive displacement.
6. Compact asphalt at joints to a density within 2 percent of specified course density.

3.5 COMPACTION

A. General: Begin compaction as soon as placed hot-mix paving will bear roller weight without excessive displacement. Compact hot-mix paving with hot, hand tampers or with vibratory-plate compactors in areas inaccessible to rollers.

1. Complete compaction before mix temperature cools to 185 deg F (85 deg C).

B. Breakdown Rolling: Complete breakdown or initial rolling immediately after rolling joints and outside edge. Examine surface immediately after breakdown rolling for indicated crown, grade, and smoothness. Correct laydown and rolling operations to comply with requirements.

C. Intermediate Rolling: Begin intermediate rolling immediately after breakdown rolling while hot-mix asphalt is still hot enough to achieve specified density. Continue rolling until hot-mix asphalt course has been uniformly compacted to the following density:

1. Minimum Asphaltic Course Density: At least 98 percent of reference laboratory density according to ASTM D 6927.
2. Minimum Bituminous Course Density: At least 95 percent of reference lab density according to ASTM D 6927.

D. Finish Rolling: Finish roll paved surfaces to remove roller marks while hot-mix asphalt is still warm.
E. **Edge Shaping:** While surface is being compacted and finished, trim edges of pavement to proper alignment. Bevel edges while asphalt is still hot; compact thoroughly.

F. **Repairs:** Remove paved areas that are defective or contaminated with foreign materials and replace with fresh, hot-mix asphalt. Compact by rolling to specified density and surface smoothness.

G. **Protection:** After final rolling, do not permit vehicular traffic on pavement until it has cooled and hardened.

H. Erect barricades to protect paving from traffic until mixture has cooled enough not to become marked.

### 3.6 INSTALLATION TOLERANCES

A. **Pavement Thickness:** Compact each course to produce the thickness indicated within the following tolerances:

1. Base Course: Plus or minus 1/2 inch (13 mm).
2. Surface Course: Plus 1/4 inch (6 mm), no minus.

B. **Pavement Surface Smoothness:** Compact each course to produce a surface smoothness within the following tolerances as determined by using a 10-foot (3-m) straightedge applied transversely or longitudinally to paved areas:

1. Base Course: 1/4 inch (6 mm).
2. Surface Course: 1/8 inch (3 mm).
3. Crowned Surfaces: Test with crowned template centered and at right angle to crown. Maximum allowable variance from template is 1/4 inch (6 mm).

C. The paving tolerances noted above do not control in regards to site accessibility, and providing accessible routes in accordance with the American with Disabilities Act of 1990 and the 2010 ADA Standards for Accessible Design. Accessible routes shall meet the following:

1. Sidewalks shall not exceed 5% (1'-0" in 20'-0") longitudinal slope and 2% (1'-0" in 50'-0") cross-slope and shall be a minimum 5' wide except as noted on civil plans.
2. Parking areas for accessible spaces and access isles shall not exceed 2% slope (1'-0" in 50'-0") in any direction.
3. Ramps shall not exceed 8.33% (1'-0" in 12'-0") longitudinal slope and 2% (1'-0" in 50'-0") cross-slope and shall be 5' wide minimum except as noted on site layout plan.
4. All sidewalk intersections shall have a 5' x 5' landing at 2% (1/4" per 1') maximum or less slope in all directions.

### 3.7 FIELD QUALITY CONTROL

A. **Testing Agency:** Owner will engage a qualified testing agency to perform tests and inspections.

B. **Field testing, frequency, and methods may vary as determined by and between the Owner and the Owner’s Testing Agency.**

C. **Surface Smoothness:** Finished surface of each hot-mix asphalt course will be tested for compliance with smoothness tolerances.
D. Asphaltic surface and base courses shall be randomly cored at a minimum rate of 1 core per 20,000 square feet of paving, but not less than 3 cores in light duty areas and 3 cores in heavy-duty areas shall be obtained. Asphaltic concrete pavement samples shall be tested for conformance with mix design.

E. Immediately replace and compact hot-mix asphalt where core tests were taken.

F. Thickness Test: Measure thickness of each core sample taken. The thickness of the course or the combined courses shall meet or exceed the indicated thickness. Where the deficiency exists, remove the affected pavement area and replace it with new pavement or, at discretion of Owner, correct deficient paving thickness with tack coat and minimum 1-in overlay.

G. Field density test for in-place materials:
   1. Density test shall be conducted on each core sample taken in accordance with ASTM D1188 or D2726 as applicable.
   2. In-place density tests by nuclear method in accordance with ASTM D2950 shall also be taken as necessary to assure the specified density is obtained. Nuclear density shall be correlated with ASTM D1188 or D2726. Tests shall be taken at a minimum rate of one test per 2,500 square feet per lift, minimum.

H. Check all pavement for ponding areas and replace pavement as necessary to eliminate.

I. Remove and replace unacceptable areas as directed by Owner.

J. Remove and replace or install additional hot-mix asphalt where test results or measurements indicate that it does not comply with specified requirements.

3.8 DISPOSAL

A. Except for material indicated to be recycled, remove excavated materials from Project site and legally dispose of them in an EPA-approved landfill.
   1. Do not allow milled materials to accumulate on-site.

END OF SECTION 32 1216
SECTION 32 1313
CONCRETE PAVING

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section Includes:
   1. Driveways.
   2. Roadways.
   3. Parking lots.
   4. Curbs and gutters.
   5. Walks.
B. Related Sections:
   1. Division 03 Section "Cast-in-Place Concrete" for general building applications of concrete.

1.3 DEFINITIONS
A. Cementitious Materials: Portland cement alone or in combination with one or more of blended hydraulic cement.

1.4 SUBMITTALS
A. Product Data: For each type of product indicated.
B. Other Action Submittals:
   1. Design Mixtures: For each concrete paving mixture. Include alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
C. Qualification Data: For qualified ready-mix concrete manufacturer.
D. Material Certificates: For the following, from manufacturer:
   1. Cementitious materials.
   2. Steel reinforcement and reinforcement accessories.
   4. Admixtures.
   5. Curing compounds.
7. Joint fillers.

E. Material Test Reports: For each of the following:
   1. Aggregates.

F. Concrete Joint Plan: Include the following:
   1. Location and type of all joints. Follow the concrete joint detail(s) and notes in the civil plans.
   2. Include all concrete pavement for the project.

G. Wheel Stops: Manufacturer information including concrete design strength and air entrainment, dimensions, reinforcement, and intended installation procedure.

1.5 QUALITY ASSURANCE

A. Ready-Mix-Concrete Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
   1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities" (Quality Control Manual - Section 3, "Plant Certification Checklist").

B. Testing Agency Qualifications: 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.

C. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

1.6 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 FORMS

A. Form Materials: Plywood, metal, metal-framed plywood, or other approved panel-type materials to provide full-depth, continuous, straight, and smooth exposed surfaces.
   1. Use flexible or uniformly curved forms for curves with a radius of 100 feet (30.5 m) or less. Do not use notched and bent forms.

B. Form-Release Agent: Commercially formulated form-release agent that will not bond with, stain, or adversely affect concrete surfaces and that will not impair subsequent treatments of concrete surfaces.
2.2 STEEL REINFORCEMENT

A. Plain-Steel Welded Wire Reinforcement: ASTM A 185/A 185M, fabricated from galvanized-steel wire into flat sheets.

B. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420) plain-steel bars. Cut bars true to length with ends square and free of burrs.

C. Tie Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

D. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars, welded wire reinforcement, and dowels in place. Manufacture bar supports according to CRSI's "Manual of Standard Practice" from steel wire, plastic, or precast concrete of greater compressive strength than concrete specified, and as follows:

E. Equip wire bar supports with sand plates or horizontal runners where base material will not support chair legs.

2.3 CONCRETE MATERIALS

A. Cementitious Material: Use the following cementitious materials, of same type, brand, and source throughout Project:

1. Portland Cement: ASTM C150, Type I or II Portland cement.
2. The use of calcium chloride in concrete mixes will not be permitted.
3. Portland cement replacement levels with fly ash shall not exceed 15%.

B. Normal-Weight Aggregates: ASTM C33, uniformly graded. Provide aggregates from a single source.

1. Maximum Coarse-Aggregate Size: 1 inch (19 mm) nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.
3. Flint and chert will be limited to 1% maximum, by weight of the coarse aggregate, in all exposed concrete.
4. Lignite will be limited to 0.07%, by weight of the fine aggregate in all exposed concrete.

C. Water: Potable and complying with ASTM C 94/C 94M.


E. Chemical Admixtures: Admixtures certified by manufacturer to be compatible with other admixtures and to contain not more than 0.1 percent water-soluble chloride ions by mass of cementitious material.

1. Water-Reducing Admixture: ASTM C 494/C 494M, Type A.
2. Retarding Admixture: ASTM C 494/C 494M, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494/C 494M, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494/C 494M, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017/C 1017M, Type II.
2.4 CURING MATERIALS

A. Absorptive Cover: AASHTO M 182, Class 3, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) dry.

B. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

C. Water: Potable.

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

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

   a. Axim Italcementi Group, Inc.; Caltexol CIMFILM.
   b. BASF Construction Chemicals, LLC; Confilm.
   c. ChemMasters; Spray-Film.
   d. Conspec by Dayton Superior; Aquafilm.
   e. Dayton Superior Corporation; Sure Film (J-74).
   f. Edoco by Dayton Superior; BurkeFilm.
   g. Euclid Chemical Company (The), an RPM company; Eucobar.
   h. Kaufman Products, Inc.; VaporAid.
   i. Lambert Corporation; LAMBCO Skin.
   j. L&M Construction Chemicals, Inc.; E-CON.
   k. Meadows, W. R., Inc.; EVAPRE.
   l. Metalcrete Industries; Waterhold.
   m. Nox-Crete Products Group; MONOFILM.
   n. Sika Corporation, Inc.; SikaFilm.
   o. SpecChem, LLC; Spec Film.
   p. Symons by Dayton Superior; Finishing Aid.
   q. TK Products, Division of Sierra Corporation; TK-2120 TRI-FILM.
   r. Unitex; PRO-FILM.
   s. Vexcon Chemicals Inc.; Certi-Vex EnvioAssist.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

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

   a. Anti-Hydro International, Inc.; A-H Curing Compound #2 DR WB.
   b. ChemMasters; Safe-Cure Clear.
   c. Dayton Superior Corporation; Day-Chem Rez Cure (J-11-W).
   d. Euclid Chemical Company (The), an RPM company; Kurez W VOX.
   f. Lambert Corporation; AQUA KURE - CLEAR.
   g. L&M Construction Chemicals, Inc.; L&M CURE R.
   h. Meadows, W. R., Inc.; 1100-CLEAR SERIES.
   i. Nox-Crete Products Group; Resin Cure E.
   j. SpecChem, LLC; PaveCure Rez.
   k. Symons by Dayton Superior; Resi-Chem Clear.
   l. Tamms Industries, Inc., Euclid Chemical Company (The); TAMMSCURE WB 30C.
   m. Vexcon Chemicals Inc.; Certi-Vex Enviocure 100.
2.5 RELATED MATERIALS

A. Joint Fillers: Resilient premolded bituminous impregnated fiberboard units complying with ASTM D994, D1751, D2628; FS HH-F-341, Type II Class A.


2.6 CONCRETE MIXTURES

A. Prepare design mixtures, proportioned according to ACI 301 (ACI 301M), for each type and strength of normal-weight concrete, and as determined by either laboratory trial mixtures or field experience.

1. Use a qualified independent testing agency for preparing and reporting proposed concrete design mixtures for the trial batch method.
2. When automatic machine placement is used, determine design mixtures and obtain laboratory test results that meet or exceed requirements.

B. Proportion mixtures to provide normal-weight concrete with the following properties:

1. Compressive Strength (28 Days): 4000 psi (27.6 MPa).
2. Maximum Water-Cementitious Materials Ratio at Point of Placement: 0.45.
3. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).

C. Add air-entraining admixture at manufacturer's prescribed rate to result in normal-weight concrete at point of placement having an air content as follows:

1. Air Content: 6 percent plus or minus 1.5 percent for 3/4-inch (19-mm) nominal maximum aggregate size.

D. Chemical Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use plasticizing and retarding 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.

E. Cementitious Materials: Limit percentage by weight of cementitious materials other than portland cement according to ACI 301 (ACI 301M) requirements for concrete exposed to deicing chemicals.

2.7 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, and mix concrete materials and concrete according to ASTM C 94/C 94M. Furnish batch certificates for each batch discharged and used in the work.

1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine exposed subgrades and subbase surfaces for compliance with requirements for dimensional, grading, and elevation tolerances.

B. Proof-roll prepared subbase surface below concrete paving to identify soft pockets and areas of excess yielding.

1. Completely proof-roll subbase in one direction. Limit vehicle speed to 3 mph (5 km/h).
2. Proof-roll with a pneumatic-tired and loaded, 10-wheel, tandem-axle dump truck weighing not less than 15 tons (13.6 tonnes).
3. Correct subbase with soft spots and areas of pumping or rutting exceeding depth of 1/2 inch (13 mm) according to requirements in Division 31 Section "Earth Moving."

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

3.2 PREPARATION

A. Remove loose material from compacted subbase surface immediately before placing concrete.

3.3 EDGE FORMS AND SCREED CONSTRUCTION

A. Set, brace, and secure edge forms, bulkheads, and intermediate screed guides to required lines, grades, and elevations. Install forms to allow continuous progress of work and so forms can remain in place at least 24 hours after concrete placement.

B. Clean forms after each use and coat with form-release agent to ensure separation from concrete without damage.

3.4 STEEL REINFORCEMENT

A. General: Comply with CRSI’s "Manual of Standard Practice" for fabricating, placing, and supporting reinforcement.

B. Clean reinforcement of loose rust and mill scale, earth, ice, or other bond-reducing materials.

C. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement. Maintain minimum cover to reinforcement.

D. Install welded wire reinforcement in lengths as long as practicable. Lap adjoining pieces at least one full mesh, and lace splices with wire. Offset laps of adjoining widths to prevent continuous laps in either direction.

3.5 JOINTS

A. General: Form expansion, sawed or premolded strip, and keyed construction joints and tool edges true to line, with faces perpendicular to surface plane of concrete. Construct transverse joints at right angles to centerline unless otherwise indicated.
1. When joining existing paving, place transverse joints to align with previously placed joints unless otherwise indicated.

B. Keyed Construction Joints: Set construction joints at side and end terminations of paving and at locations where paving operations are stopped for more than one-half hour unless paving terminates at isolation joints.
   1. Continue steel reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of paving strips unless otherwise indicated.
   2. Construct joints in accordance with details as shown in Plans.

C. Expansion Joints: Locate expansion joints as shown and detailed in the Plans and as follows:
   1. Locate expansion joints at intervals of 150 feet maximum each way unless otherwise indicated.
   2. During concrete placement, protect top edge of joint filler with metal, plastic, or other temporary preformed cap. Remove protective cap after concrete has been placed on both sides of joint.

D. Sawed or Premolded Strip Joints: Joint spacing shall not exceed 15 feet maximum, or as noted in the civil plans. Panels shall be cut such that panels are nearly square and do not exceed 1.4 length to width ratio.
   1. Construct joints for depth equal to at least 1/3 of the concrete thickness.
   2. Sawed Joints: Form joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before developing random contraction cracks.
   3. All saw joints shall be sawed within 12-hours of concrete placement or as soon as the joint edge does not ravel.

E. Edging: After initial floating, tool edges of paving, gutters, curbs, and joints in concrete with an edging tool to a 1/8-inch (3-mm) radius. Repeat tooling of edges after applying surface finishes. Eliminate edging-tool marks on concrete surfaces.

F. Joint Fillers: Extend joint filler full-width and depth of joint, and not less than ½-inch or more than 1-inch below finished surface where joint sealer is indicated. Furnish joint filler in 1-piece lengths for full width being placed, wherever possible. Where more than 1 length is required, lace or clip joint filler sections together.

G. Joint sealants: Joints shall be sealed with approved exterior pavement joint sealants and shall be installed in accordance with manufacturer’s recommendations.

3.6 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.
D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.

E. Deposit and spread concrete in a continuous operation between transverse joints. Do not push or drag concrete into place or use vibrators to move concrete into place.

F. Consolidate concrete according to ACI 301 (ACI 301M) by mechanical vibrating equipment supplemented by hand spading, rodding, or tamping.
   1. Consolidate concrete along face of forms and adjacent to transverse joints with an internal vibrator. Keep vibrator away from joint assemblies or side forms. Use only square-faced shovels for hand spreading and consolidation. Consolidate with care to prevent dislocating dowels and joint devices.

G. Screed paving surface with a straightedge and strike off.

H. Commence initial floating using bull floats or darbies to impart an open-textured and uniform surface plane before excess moisture or bleed water appears on the surface. Do not further disturb concrete surfaces before beginning finishing operations or spreading surface treatments.

I. Curbs and Gutters: Use design mixture for automatic machine placement. Produce curbs and gutters to required cross section, lines, grades, finish, and jointing.

J. Slip-Form Paving: Use design mixture for automatic machine placement. Produce paving to required thickness, lines, grades, finish, and jointing.
   1. Compact subbase and prepare subgrade of sufficient width to prevent displacement of slip-form paving machine during operations.

K. Cold-Weather Placement: Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing, or low temperatures. Comply with ACI 306.1 and the following:
   1. When air temperature has fallen to or is expected to fall below 40 deg F (4.4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C) and not more than 80 deg F (27 deg C) at point of placement.
   2. Do not use frozen materials or materials containing ice or snow.
   3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in design mixtures.

L. Hot-Weather Placement: Comply with ACI 301 (ACI 301M) and as follows when hot-weather conditions exist:
   1. Cool ingredients before mixing to maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated in total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
   2. Fog-spray forms and subgrade just before placing concrete. Keep subgrade moisture uniform without standing water, soft spots, or dry areas.

3.7 FLOAT FINISHING

A. General: Do not add water to concrete surfaces during finishing operations.
B. Float Finish: Begin the second floating operation when bleed-water sheen has disappeared and concrete surface has stiffened sufficiently to permit operations. Float surface with power-driven floats or by hand floating if area is small or inaccessible to power units. Finish surfaces to true planes. Cut down high spots and fill low spots. Refloat surface immediately to uniform granular texture.

1. Fine-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, fine-line texture for all not sidewalk areas.

2. Medium-Textured Broom Finish: Draw a soft-bristle broom across float-finished concrete surface perpendicular to line of traffic to provide a uniform, medium texture for all sidewalk areas.

3.8 CONCRETE PROTECTION AND CURING

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

B. Comply with ACI 306.1 for cold-weather protection.

C. Evaporation Retarder: Apply evaporation retarder to concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) 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.

D. Begin curing after finishing concrete but not before free water has disappeared from concrete surface.

E. Curing Methods: Cure concrete by curing compound as follows:

1. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas that have been subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating, and repair damage during curing period.

F. Apply water repellent and chloride screen Prosoco Saltguard WB as directed by manufacturer and indicted in 321313 Appendix A to the following locations:

1. Onsite sidewalks and loading areas.

3.9 PAVING TOLERANCES

A. Outside of accessible paths, comply with tolerances in ACI 117 and as follows:

1. Elevation: 3/4 inch (19 mm).
2. Thickness: Plus 3/8 inch (10 mm), minus 1/4 inch (6 mm).
3. Surface: Gap below 10-foot- (3-m-) long, un leveled straightedge not to exceed 1/2 inch (13 mm).
4. Alignment of Tie-Bar End Relative to Line Perpendicular to Paving Edge: 1/2 inch per 12 inches (13 mm per 300 mm) of tie bar.
5. Lateral Alignment and Spacing of Dowels: 1 inch (25 mm).
7. Alignment of Dowel-Bar End Relative to Line Perpendicular to Paving Edge: 1/4 inch per 12 inches (6 mm per 300 mm) of dowel.
8. Joint Spacing: 3 inches (75 mm).
9. Contraction Joint Depth: Plus 1/4 inch (6 mm), no minus.
10. Joint Width: Plus 1/8 inch (3 mm), no minus.

B. The paving tolerances noted above do not control in regards to site accessibility, and providing accessible routes in accordance with the American with Disabilities Act of 1990 and the 2010 ADA Standards for Accessible Design. Accessible routes shall meet the following:
1. Sidewalks shall not exceed 5% (1'-0" in 20'-0") slope with a 2% (1'-0" in 50'-0") cross-slope and shall be 5' wide except as noted on site plan.
2. Parking areas for accessible spaces and access isles shall not exceed a 2% (1'-0" in 50'-0") slope in any direction.
3. Curb ramps shall not exceed 8.33% (1'-0" in 12'-0") slope with a 2% (1'-0" in 50'-0") cross-slope and shall be 5' wide except as noted on site layout plan.
4. All sidewalk intersections and door landings shall have a minimum 5' x 5' landing at 1/4" per 1' max slope in all directions.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Owner will engage a qualified testing agency to perform tests and inspections. Contractor shall be responsible for coordination with Owner's testing agency.

B. Contractor shall be required to notify the Owner's representative and testing agency a minimum of 48 hours prior to all placement of concrete.

C. Testing Services: 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 the first 28 cubic yards placed each day and one test for each additional 50 cu. yd. 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 C 143/C 143M; 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; 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 C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below and when it is 80 deg F (27 deg C) and above, and one test for each composite sample.
5. Compression Test Specimens: ASTM C 31/C 31M; cast and laboratory cure one set of four standard cylinder specimens for each composite sample.
6. Compressive-Strength Tests: ASTM C 39/C 39M; test one specimen at seven days, two specimens at 28 days and hold one specimen in reserve for future testing, if needed.
   a. A compressive-strength test shall be the average compressive strength from two specimens obtained from same composite sample and tested at 28 days.

D. Strength of each concrete mixture will be satisfactory if average of any three consecutive compressive-strength tests equals or exceeds specified compressive strength and no
compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).

E. Test results shall be reported in writing to Owner, 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.

F. Nondestructive Testing: Sonoscope or other nondestructive device may be permitted by Owner but will not be used as sole basis for approval or rejection of concrete.

G. 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 Owner.

H. Concrete paving will be considered defective if it does not pass tests and inspections.

I. Additional testing and inspecting, at Contractor’s expense, will be performed to determine compliance of replaced or additional work with specified requirements.

J. Prepare test and inspection reports.

3.11 REPAIRS AND PROTECTION

A. Remove and replace concrete paving that is broken, damaged, or defective or that does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Owner.

B. Drill test cores, where directed by Owner, when necessary to determine magnitude of cracks or defective areas. Fill drilled core holes in satisfactory paving areas with portland cement concrete bonded to paving with epoxy adhesive.

C. Protect concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

D. Maintain concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 1313
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SECTION 32 1316
DECORATIVE CONCRETE PAVING
(ADDITIVE ALTERNATE NO. 4)

PART 1 - GENERAL

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

1.2 SUMMARY
A. Section includes colored concrete paving.
B. Related Sections:
   1. Section 321313 "Concrete Paving" for cast-in-place concrete paving with other finishes, curbs and gutters, pavement markings, and wheel stops.
   2. Section 321373 "Concrete Paving Joint Sealants" for joint sealants in expansion and contraction joints within decorative concrete paving and in joints between decorative concrete paving and asphalt paving or adjacent construction.

1.3 DEFINITIONS

1.4 ACTION SUBMITTALS
A. Product Data: For each type of product indicated.
B. Color for Initial Selection: To be selected by Architect, from Manufacturers full range.

1.5 INFORMATIONAL SUBMITTALS
A. Qualification Data: For qualified Installer and ready-mix concrete manufacturer.

1.6 QUALITY ASSURANCE
A. Installer Qualifications: An employer of workers trained and approved by manufacturer of decorative concrete paving systems.
   1. The contractor shall provide a qualified foreman or supervisor who has a minimum of three (3) years experience with colored concrete, and who has successfully completed at least five (5) colored concrete installations of high quality and similar in scope to that specified herein, and located within a 200 mile radius of the proposed Project. Evidence that the contractor is qualified to complete the project in a competent manner as specified herein
shall be submitted to, and approved by, the architect/engineer prior to the start of construction.

B. ACI Publications: Comply with ACI 301 (ACI 301M) unless otherwise indicated.

C. Mockups: Build mockups to verify selections made under sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.

1. Build mockups of full-thickness sections of decorative concrete paving to demonstrate typical joints; surface color, pattern, and texture; curing; and standard of workmanship.
2. Build mockups of decorative concrete paving in the location and of the size indicated or, if not indicated, build mockups where directed by Owner and not less than 96 inches (2400 mm) by 60 inches.
3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Owner specifically approves such deviations in writing.
4. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

A. Powered Integral Color Pigment: ASTM C 979, synthetic mineral-oxide pigments or colored water-reducing admixtures; color stable, free of carbon black, nonfading, and resistant to lime and other alkalis.

1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
   a. Solomon Colors, Inc.
2. Product shall be an integral color that is mixed in the concrete before placing, creating integral color throughout the full depth of the concrete.

2.2 CONCRETE PLACEMENT

A. Before placing concrete, inspect and complete formwork installation, steel reinforcement, and items to be embedded or cast-in.

B. Remove snow, ice, or frost from subbase surface and steel reinforcement before placing concrete. Do not place concrete on frozen surfaces.

C. Moisten subbase to provide a uniform dampened condition at time concrete is placed. Do not place concrete around manholes or other structures until they are at required finish elevation and alignment.

D. Comply with ACI 301 (ACI 301M) requirements for measuring, mixing, transporting, and placing concrete.
E. Do not add water to concrete during delivery or at Project site. Do not add water to fresh concrete after testing.

F. Install pigment in concrete batch prior to placement per Manufacturer’s written instructions. Verify color matches that approved by Architect.

G. Place concrete according to Section 32 131 Concrete Paving.

H. Install joints according to Section 32 1373 Concrete Paving Joint Sealants.

2.3 CONCRETE PROTECTION AND CURING

A. According to Section 32 131 Concrete Paving.

2.4 FIELD QUALITY CONTROL

A. According to Section 32 131 Concrete Paving.

2.5 REPAIRS AND PROTECTION

A. Remove and replace decorative concrete paving that is broken or damaged or does not comply with requirements in this Section. Remove work in complete sections from joint to joint unless otherwise approved by Architect.

B. Protect decorative concrete paving from damage. Exclude traffic from paving for at least 14 days after placement. When construction traffic is permitted, maintain paving as clean as possible by removing surface stains and spillage of materials as they occur.

C. Maintain decorative concrete paving free of stains, discoloration, dirt, and other foreign material. Sweep paving not more than two days before date scheduled for Substantial Completion inspections.

END OF SECTION 32 1316
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Cold-applied joint sealants.

B. Related Sections:
   1. Division 07 Section "Joint Sealants" for sealing nontraffic and traffic joints in locations not specified in this Section.
   2. Division 32 Section "Asphalt Paving" for constructing joints between concrete and asphalt pavement.
   3. Division 32 Section "Concrete Paving" for constructing joints in concrete pavement.

1.3 SUBMITTALS

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

B. Product Certificates: For each type of joint sealant and accessory, from manufacturer.

C. Installation Instructions: From manufacturer.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 2 years’ experience installing matching or similar products.

B. Source Limitations: Obtain each type of joint sealant from single source from single manufacturer.

1.5 PROJECT CONDITIONS

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. Compatibility: Provide joint sealants, backing materials, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer based on testing and field experience.

B. Colors of Exposed Joint Sealants: Matching adjacent concrete. This applies to colored concrete areas also.

2.2 COLD-APPLIED JOINT SEALANTS

A. Single-Component, Nonsag, Silicone Joint Sealant for Concrete: ASTM D 5893, Type NS.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Crafco Inc., an ERGON company; RoadSaver Silicone.
   b. Dow Corning Corporation; 888.
   c. Pecora Corporation; 301 NS.

B. Single-Component, Self-Leveling, Silicone Joint Sealant for Concrete: ASTM D 5893, Type SL.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Crafco Inc., an ERGON company; RoadSaver Silicone SL.
   b. Dow Corning Corporation; 890-SL.
   c. Pecora Corporation; 300 SL.

C. Multicomponent, Pourable, Traffic-Grade, Urethane Joint Sealant for Concrete: ASTM C 920, Type M, Grade P, Class 25, for Use T.

1. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, the following:
   a. Pecora Corporation; Urexpand NR-200.

D. Color for all joint sealants shall be gray, matching adjacent concrete. Other colors will not be accepted. Exception: all joint sealants adjacent to colored concrete shall match the color of the colored concrete.

2.3 HOT-APPLIED JOINT SEALANTS

A. Hot applied joint sealants will not be accepted.
2.4 JOINT-SEALANT BACKER MATERIALS

A. General: Provide joint-sealant backer materials that are nonstaining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by joint-sealant manufacturer based on field experience and laboratory testing.

B. Round Backer Rods for Cold-Applied Joint Sealants: ASTM D 5249, Type 3, of diameter and density required to control joint-sealant depth and prevent bottom-side adhesion of sealant.

C. Backer Strips for Cold-Applied Joint Sealants: ASTM D 5249; Type 2; of thickness and width required to control joint-sealant depth, prevent bottom-side adhesion of sealant, and fill remainder of joint opening under sealant.

2.5 PRIMERS

A. Primers: Product recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

PART 3 - EXECUTION

3.1 EXAMINATION

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

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

3.2 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

B. Joint Priming: Prime joint substrates where indicated or where recommended in writing by joint-sealant manufacturer, based on preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated unless more stringent requirements apply.

B. Joint-Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
C. Install joint-sealant backings of kind indicated to support joint sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of joint-sealant backings.
2. Do not stretch, twist, puncture, or tear joint-sealant backings.
3. Remove absorbent joint-sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install joint sealants using proven techniques that comply with the following and at the same time backings are installed:

1. Place joint sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Joint Sealants: Immediately after joint-sealant application and before skinning or curing begins, tool sealants according to the following requirements to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint:

1. Remove excess joint sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by joint-sealant manufacturer and that do not discolor sealants or adjacent surfaces.

F. Provide joint configuration to comply with joint-sealant manufacturer's written instructions unless otherwise indicated.

3.4 CLEANING

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

3.5 PROTECTION

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

3.6 PAVEMENT-JOINT-SEALANT SCHEDULE

A. Joint-Sealant Application: Joints within cement concrete pavement.

1. Joint Location:

c. Other joints as indicated in the civil plans.

3. Urethane Joint Sealant for Concrete: Multicomponent, pourable, traffic-grade.

B. Joint-Sealant Application: Joints between cement concrete and asphalt pavement

1. Joint Location:
   a. Joints between concrete and asphalt pavement.
   b. Joints between concrete curbs and asphalt pavement.
   c. Other joints as indicated in the civil plans.

END OF SECTION 32 1373
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PART 1 - GENERAL

1.1 SUMMARY

A. This Section includes the following:
   1. Painting and marking of pavements and curbs.

1.2 REFERENCE STANDARDS

A. American Association of State Highway and Transportation Officials (AASHTO)

B. ASTM International (ASTM)
   1. ASTM D4414 - Standard Practice for Measurement of Wet Film Thickness by Notched Gauges.

C. Federal Specifications (FS)
   1. FS A-A-2886 - Paint, Traffic, Solvent Based (supersedes FS TT-P-85 and FS TT-P-115, Type I).
   2. FS TT-P-1952 - Paint, Traffic and Airfield Marking, Waterborne.

1.3 SUBMITTALS

A. Product Data: For each pavement marking product. Include technical data and tested physical and performance properties.

1.4 PROJECT CONDITIONS

A. Maintain access for vehicular and pedestrian traffic as required for other construction activities. Utilize flagmen, barricades, warning signs, and warning lights as required.

B. Pavement-Marking Paint: Proceed with pavement marking only on clean, dry surfaces and at a minimum ambient or surface temperature of 55 deg F (12.8 deg C), and not exceeding 95 deg F (35 deg C).

1.5 QUALITY ASSURANCE

A. Use trained and experienced personnel in applying the products and operating the equipment required for properly performed work.
1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver pavement-marking materials to Project site in original packages with seals unbroken and bearing manufacturer's labels containing brand name and type of material, date of manufacture, and directions for storage.

B. Store pavement-marking materials in a clean, dry, protected location within temperature range required by manufacturer. Protect stored materials from direct sunlight.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Paint shall be waterborne or solvent borne, colors as shown or specified herein. Pavement marking paints shall comply with applicable state and local laws enacted to ensure compliance with Federal Clean Air Standards. Paint materials shall conform to the restrictions of the local Air Pollution Control District.

B. Waterborne Paint: Paints shall conform to FS TT-P-1952,

C. Solvent Borne Paint: Paint shall conform to FS A-A-2886 or AASHTO M248. Paint shall be non-bleeding, quick-drying, and alkyd petroleum base paint suitable for traffic-bearing surface and be mixed in accordance with manufacturer's instructions before application for colors White, Yellow, Blue, and Red.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine the work area and correct conditions detrimental to timely and proper completion of the work. Do not proceed until unsatisfactory conditions are corrected.

3.2 PREPARATION

A. Sweep and clean surface to eliminate loose material and dust.

B. New pavement surfaces shall be allowed to cure for not less than 30 days before application of marking materials.

3.3 APPLICATION

A. Apply two coats of paint at manufacturer's recommended rate, without addition of thinner, with maximum of 100 square feet per gallon or as required to provide a minimum wet film thickness of 15 mils and dry film thickness of 7 ½ mils per coat. Paint shall be applied for a total dry film thickness of 15 mils. Apply with mechanical equipment to produce uniform straight edges. At sidewalk curbs and crosswalks, use straightedge to ensure uniform, clean, and straight stripe.

B. Install pavement markings according to manufacturer's recommended procedures for the specified material.

C. Following items shall be painted with colors noted below:

1. Pedestrian Crosswalks: White
2. Fire Lanes: Red if curbs are indicated to be marked in Civil Construction Plans.
3. Lane Striping where separating traffic moving in opposite directions: Yellow
4. Lane Striping where separating traffic moving in the same direction: White
5. ADA Symbols: Blue
6. ADA parking space markings: Blue as shown on the Civil Construction Plans.
7. Parking Stall Striping: Yellow

D. See the Civil Site Plans for additional striping colors.

3.4 FIELD QUALITY CONTROL

A. Inspection: After the paint has thoroughly dried, visually inspect the entire application and touch up as required to provide clean, straight lines and surfaces throughout.

3.5 CLEANING

A. Waste materials shall be removed at the end of each workday. Upon completion of the work, all containers and debris shall be removed from the site. Paint spots upon adjacent surfaces shall be carefully removed by approved procedures that will not damage the surfaces and the entire job left clean and acceptable.

END OF SECTION 32 1380
SECTION 32 8400
IRRIGATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Piping.
3. Pressure-reducing valves.
4. Automatic control valves.
5. Automatic drain valves.
6. Transition fittings.
7. Miscellaneous piping specialties.
8. Sprinklers.
9. Quick couplers.
10. Drip irrigation specialties.
11. Controllers.

1.3 DEFINITIONS

A. Circuit Piping: Downstream from control valves to sprinklers, specialties, and drain valves. Piping is under pressure during flow.

B. Drain Piping: Downstream from circuit-piping drain valves. Piping is not under pressure.

C. ET Controllers: Evapotranspiration Controllers. Irrigation controllers which use some method of weather-based adjustment of irrigation. These adjusting methods include use of historical monthly averages of ET; broadcasting of ET measurements; or use of on-site sensors to track ET.

D. Main Piping: Downstream from point of connection to water distribution piping to, and including, control valves. Piping is under water-distribution-system pressure.

E. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.
1.4 PERFORMANCE REQUIREMENTS

A. Irrigation zone control shall be automatic operation with controller and automatic control valves.

B. Delegated Design: Design 100 percent coverage irrigation system only within areas indicated in the project plans, using performance requirements and design criteria indicated.

C. Minimum Working Pressures: The following are minimum pressure requirements for piping, valves, and specialties unless otherwise indicated:

1. Irrigation Main Piping: 200 psig (1380 kPa).
2. Circuit Piping: 150 psig (1035 kPa).

D. Separate water meter for irrigation provided by Owner. Provide backflow protection as required by water utility, Public Water Supply District No. 9.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Wiring Diagrams: For power, signal, and control wiring.

C. Delegated-Design Submittal: For irrigation systems that comply with performance requirements and design criteria. Provide irrigation plans designed by an irrigation design specialist with the irrigation design consultant clearly indicated on each sheet. Drawings shall include:

1. Zoning Chart: Show each irrigation zone and its control valve.
2. Complete layout of entire system and all components.
4. Adjustments necessary to avoid plantings and obstructions such as signs and light standards.
5. Specific product schedule of all components.
6. Design calculations including anticipated pressures, etc.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Field quality-control reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For sprinklers, controllers, and automatic control valves to include in operation and maintenance manuals.

B. Submit as-built drawings of all installed irrigation systems. Legibly mark drawings to record actual construction
1.8 QUALITY ASSURANCE

A. Installer Qualifications: Minimum 3 years experience installing similar irrigation systems and components.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Deliver piping with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe-end damage and to prevent entrance of dirt, debris, and moisture.

B. Store plastic piping protected from direct sunlight. Support to prevent sagging and bending.

1.10 PROJECT CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of water service.
2. Do not proceed with interruption of water service without Owner's written permission.

PART 2 - PRODUCTS

2.1 PIPES, TUBES, AND FITTINGS


   1. PVC Socket Fittings: ASTM D 2467, Schedule 80.
   2. PVC Socket Unions: Construction similar to MSS SP-107, except both headpiece and tailpiece shall be PVC with socket or threaded ends.
   3. Backflow piping shall be schedule 40 PVC.

2.2 PIPING JOINING MATERIALS

A. Solvent Cements for Joining PVC Piping: ASTM D 2564. Include primer according to ASTM F 656.

B. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.

2.3 MINIMUM COMPONENTS

A. Backflow preventer of 1.5” or 2” minimum.
B. Controller: Rain Bird LXD or approved equal.

C. Two wire system, minimum.

D. Provide surge protection.

E. Include Rain Bird decoders, or approved equal.

F. Include flow sensor.

G. Provide Hunter valves and heads or approved equal.

H. Ball valves shall be provided before every manifold.

I. A minimum of four quick couplers shall be provided.

J. Provide minimum 10 inch and up valve boxes with “IRRIGATION” lettering.

K. Provide a ball valve and quick coupler for the blowout.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavating, trenching, and backfilling are specified in Section 312000 "Earth Moving."

B. Provide minimum cover over top of underground piping according to the following:

1. Irrigation Main Piping: Minimum depth of 12 inches below finished grade.
2. Circuit Piping: 12 inches (300 mm).
3. Drain Piping: 12 inches (300 mm).

3.2 PREPARATION

A. Set stakes to identify locations of proposed irrigation system. Obtain Owner’s approval before excavation.

3.3 PIPING INSTALLATION

A. Location and Arrangement: Per approved submittal drawings. Install piping as indicated unless deviations are approved on Coordination Drawings.

B. Install piping at minimum uniform slope of 0.5 percent down toward drain valves.

C. Install piping free of sags and bends.

D. Install groups of pipes parallel to each other, spaced to permit valve servicing.
E. Install fittings for changes in direction and branch connections.

F. Install unions adjacent to valves and to final connections to other components with pipe connection.

G. Install underground thermoplastic piping according to ASTM D 2774 and ASTM F 690.

H. Install expansion loops in control-valve boxes for plastic piping.

I. Lay piping on solid subbase, uniformly sloped without humps or depressions.

J. Install PVC piping in dry weather when temperature is above 40 deg F (5 deg C). Allow joints to cure at least 24 hours at temperatures above 40 deg F (5 deg C) before testing.

K. Install water regulators with shutoff valve and strainer on inlet and pressure gage on outlet. Install shutoff valve on outlet. Install aboveground or in control-valve boxes.

L. Water Hammer Arresters: Install between connection to building main and circuit valves aboveground or in control-valve boxes.

M. Install transition fittings for plastic-to-metal pipe connections according to the following:

   1. Underground Piping:

      a. NPS 1-1/2 (DN 40) and Smaller: Plastic-to-metal transition fittings.
      b. NPS 2 (DN 50) and Larger: AWWA transition couplings.

3.4 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

   1. Apply appropriate tape or thread compound to external pipe threads 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.

D. PVC Piping Solvent-Cemented 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. 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.
   3. PVC Nonpressure Piping: Join according to ASTM D 2855.
3.5 VALVE INSTALLATION

A. Underground Curb Valves: Install in curb-valve casings with tops flush with grade.

B. Underground Iron Gate Valves, Resilient Seat: Comply with AWWA C600 and AWWA M44. Install in valve casing with top flush with grade.
   1. Install valves and PVC pipe with restrained, gasketed joints.

C. Pressure-Reducing Valves: Install in boxes for automatic control valves or aboveground between shutoff valves. Install full-size valved bypass.

D. Throttling Valves: Install in underground piping in boxes for automatic control valves.

E. Drain Valves: Install in underground piping in boxes for automatic control valves.

3.6 SPRINKLER INSTALLATION

A. Install sprinklers after hydrostatic test is completed.

B. Install sprinklers at manufacturer's recommended heights.

C. Locate part-circle sprinklers to maintain a minimum distance of 4 inches (100 mm) from walls and 2 inches (50 mm) from other boundaries unless otherwise indicated.

3.7 AUTOMATIC IRRIGATION-CONTROL SYSTEM INSTALLATION

A. Equipment Mounting: Install controllers on wall.
   1. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
   2. Install anchor bolts to elevations required for proper attachment to supported equipment.

B. Install control cable in same trench as irrigation piping and at least 2 inches (51 mm) below or beside piping. Provide conductors of size not smaller than recommended by controller manufacturer.

3.8 CONNECTIONS

A. Comply with requirements for piping specified in Section 221113 "Facility Water Distribution Piping" for water supply from exterior water service piping, water meters, protective enclosures, and backflow preventers. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to equipment, valves, and devices to allow service and maintenance.

C. Connect wiring between controllers and automatic control valves.
3.9 IDENTIFICATION

A. Identify system components. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Equipment Nameplates and Signs: Install engraved plastic-laminate equipment nameplates and signs on each automatic controller.

   1. Text: In addition to identifying unit, distinguish between multiple units, inform operator of operational requirements, indicate safety and emergency precautions, and warn of hazards and improper operations.

3.10 FIELD QUALITY CONTROL

A. Perform tests and inspections.

   1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

   1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
   2. Operational Test: After electrical circuitry has been energized, operate controllers and automatic control valves to confirm proper system operation.
   3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Any irrigation product will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

3.11 STARTUP SERVICE

A. Perform startup service.

   1. Complete installation and startup checks according to manufacturer's written instructions.
   2. Verify that controllers are installed and connected according to the Contract Documents.
   3. Verify that electrical wiring installation complies with manufacturer's submittal.

3.12 ADJUSTING

A. Adjust settings of controllers.

B. Adjust automatic control valves to provide flow rate at rated operating pressure required for each sprinkler circuit.

C. Adjust sprinklers and devices, except those intended to be mounted aboveground, so they will be flush with, or not more than 1/2 inch (13 mm) above, finish grade.
3.13 CLEANING
A. Flush dirt and debris from piping before installing sprinklers and other devices.

3.14 DEMONSTRATION
A. Train Owner's maintenance personnel to adjust, operate, and maintain automatic control valves and controllers.

3.15 PIPING SCHEDULE
A. Install components having pressure rating equal to or greater than system operating pressure.
B. Piping in control-valve boxes and aboveground may be joined with flanges or unions instead of joints indicated.
C. Underground irrigation main piping shall be one of the following:
   1. SDR 21, PVC, pressure-rated pipe; Schedule 80, PVC socket fittings; and solvent-cemented joints.
D. Circuit piping, shall be one of the following:
   1. SDR 26, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.
E. Underground Branches and Offsets at Sprinklers and Devices: Schedule 80, PVC pipe; threaded PVC fittings; and threaded joints.
   1. Option: Plastic swing-joint assemblies, with offsets for flexible joints, manufactured for this application.
F. Risers to Aboveground Sprinklers and Specialties: Schedule 80, PVC pipe and socket fittings; and solvent-cemented joints.
G. Drain piping shall be the following:
   1. SDR 21, 26, or 32.5, PVC, pressure-rated pipe; Schedule 40, PVC socket fittings; and solvent-cemented joints.

END OF SECTION 32 8400
PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:
   1. Hydroseeding.
   2. Sodding.

1.3 DEFINITIONS

A. Finish Grade: Elevation of finished surface of planting soil.

B. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and mollusccides. This also includes substances or mixtures intended for use as a plant regulator, defoliant, or desiccant.

C. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

D. Planting Soil: Existing, on-site topsoil meeting the definition in Section 31 10 00 Site Clearing, stockpiled during grading operations and not heavy compacted.

E. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 REQUIRED SUBMITTALS

A. Qualification Data: For turf and grass Installers.

B. Certification of Grass Seed: From seed vendor for each grass-seed monostand or mixture, stating the botanical and common name, percentage by weight of each species and variety, and percentage of purity, germination, and weed seed. Include the year of production and date of packaging.
   1. Certification of each seed mixture for turfgrass sod. Include identification and location of source and name and telephone number of supplier.
C. Product Certificates: For fertilizers, from manufacturer.

D. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.

E. Product specifications and certifications for Hydroseed. Include identification and location of source and name and telephone number of supplier.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of turf during a calendar year.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful turf establishment.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.

2. Experience: Three years' experience in turf installation in addition to requirements in Section 014000 "Quality Requirements."

3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.


1.7 DELIVERY, STORAGE, AND HANDLING

A. Seed and Other Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws, as applicable.

B. Sod: Harvest, deliver, store, and handle sod according to requirements in "Specifications for Turfgrass Sod Materials" and "Specifications for Turfgrass Sod Transplanting and Installation" sections in TPI's "Guideline Specifications to Turfgrass Sodding." Deliver sod within 24 hours of harvesting and in time for planting promptly. Protect sod from breakage and drying.

C. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.

2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.

3. Accompany each delivery of bulk materials with appropriate certificates.

1.8 FIELD CONDITIONS

A. Planting Restrictions: Plant during one of the following periods.
2. Fall Planting: September 1 to October 20.

B. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions.

PART 2 - PRODUCTS

2.1 TURFGRASS SOD
   A. Turf grass Sod: Furnish viable sod of uniform density, color, and texture that is strongly rooted and capable of vigorous growth and development when planted.
   B. Turf grass Species: Sod of grass species as follows, with not less than 95 percent germination, not less than 95 percent pure seed, and not more than 0.5 percent weed seed:
      1. Sun and Partial Shade: Proportioned by weight as follows:
         a. 70 percent tall turf type fescue cultivars (Festuca arundinacea variety).
         b. 10 percent chewings red fescue (Festuca rubra variety).
         c. 10 percent perennial ryegrass (Lolium perenne).
         d. 10 percent redtop (Agrostis alba).

2.2 FERTILIZERS
   A. Slow-Release Fertilizer: Granular or pelleted fertilizer consisting of 50 percent water-insoluble nitrogen, phosphorus, and potassium in the following composition:
      1. Composition: 20 percent nitrogen, 10 percent phosphorous, and 10 percent potassium, by weight.

2.3 HYDROSEEDING
   A. Provide fresh, clean, new-crop seed complying with tolerance for purity and germination established by Official Seed Analysts of North America. Provide Seed of grass species, proportions and minimum percentages of purity, germination, and maximum percentage of weed seed, as specified.
   B. Hydraulic Mulch: HydraCM matrix by North American Green, or approved equal. See Appendix for product specification.
   C. Permanent Grass Seed Mix: Proportioned by weight as follows:
      1. 85 percent tall turf type fescue cultivars (Festuca arundinacea variety).
      2. 15 percent perennial ryegrass (Lolium perenne).
2.4 PESTICIDES

A. General: Pesticide, registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to be planted for compliance with requirements and other conditions affecting installation and performance of the Work.

   1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
   2. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
   3. Uniformly moisten excessively dry soil that is not workable or which is dusty.

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

C. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Architect and replace with new planting soil.

3.2 PREPARATION

A. Protect structures; utilities; sidewalks; pavements; and other facilities, trees, shrubs, and plantings from damage caused by planting operations.

   1. Protect adjacent and adjoining areas, structures, pavement pads, etc. from hydroseeding overspray.
   2. Protect grade stakes set by others until directed to remove them.

3.3 TURF AREA PREPARATION

A. Placing Planting Soil: To thickness and grades indicated in civil plans. Provide light compaction only per Section 31 2000 Earth Moving.

   1. Reduce elevation of planting soil to allow for soil thickness of sod.

B. Kill and remove all existing weeds.
C. Verify all areas match the grading plan in the civil plans and provide positive drainage as intended in the plans.

D. Rake all areas smooth with no bumps, depressions, rills, or eroded areas deeper than ½ inch.

E. Remove all objects on the surface (typically rocks, roots, trash, broken concrete, etc.) larger than 2” in any dimension. Fill depressions left with topsoil.

F. Moisten prepared area before planting if soil is dry. Water thoroughly and allow surface to dry before planting. Do not create muddy soil.

G. Before planting, obtain Owner’s acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

H. Place fertilizer at a rate of 7 lbs/1000 sq. ft. or as recommended by manufacturer.

3.4 HYDROSEEDING

A. Mix specified permanent grass seed mix, temporary grass seed mix, and HydraCM per manufacturer’s written requirements. Continue mixing until uniformly blended into homogeneous slurry suitable for hydraulic application.

1. Permanent grass seed mix shall be mixed so 215 lb/acre is applied.
2. Temporary seed mix shall be mixed so 10 lb/acre is applied.
3. Spray-apply slurry uniformly to all areas to be seeded in a one-step process. Apply slurry at a rate so that HydraCM component is deposited at not less than 3000-lb/acre dry weight.

3.5 SODDING

A. Lay sod within 24 hours of harvesting. Do not lay sod if dormant or if ground is frozen or muddy.

B. Lay sod to form a solid mass with tightly fitted joints. Butt ends and sides of sod; do not stretch or overlap. Stagger sod strips or pads to offset joints in adjacent courses. Avoid damage to soil or sod during installation. Tamp and roll lightly to ensure contact with soil, eliminate air pockets, and form a smooth surface. Work sifted soil or fine sand into minor cracks between pieces of sod; remove excess to avoid smothering sod and adjacent grass.

C. Saturate sod with fine water spray within two hours of planting. For the next two weeks after planting, water daily or more frequently as necessary to maintain moist soil to a minimum depth of 1-1/2 inches (38 mm) below sod.

3.6 TURF MAINTENANCE

A. Protection: Protect the area against traffic or other use by placing warning signs, fences, and erecting any barricades that may be required before or immediately after sowing is completed.

B. General: Maintain and establish turf by watering, fertilizing, weeding, mowing, trimming, replanting, and performing other operations as required to establish healthy, viable turf. Roll, regrade, and replant bare or eroded areas and remulch to produce a uniformly smooth turf. Provide materials and installation the same as those used in the original installation.
1. Fill in as necessary soil subsidence that may occur because of settling or other processes. Replace materials and turf damaged or lost in areas of subsidence.
2. In areas where mulch has been disturbed by wind or maintenance operations, add new mulch and anchor as required to prevent displacement.
3. Apply treatments as required to keep turf and soil free of pests and pathogens or disease. Use integrated pest management practices whenever possible to minimize the use of pesticides and reduce hazards.

C. Watering: Install and maintain water trucks, temporary piping, hoses, and turf-watering equipment to convey water from sources and to keep turf uniformly moist to a depth of 4 inches (100 mm).

1. Schedule watering to prevent wilting, puddling, erosion, and displacement of seed or mulch. Lay out temporary watering system to avoid walking over muddy or newly planted areas.
2. Water turf with fine spray at a minimum rate of 1 inch (25 mm) per week unless rainfall precipitation is adequate.
3. Onsite water may be used once the water lines are constructed and functional. Coordinate usage with Owner.

D. Mow turf as soon as top growth is tall enough to cut. Repeat mowing to maintain specified height without cutting more than one-third of grass height. Remove no more than one-third of grass-leaf growth in initial or subsequent mowings. Do not delay mowing until grass blades bend over and become matted. Do not mow when grass is wet. Schedule initial and subsequent mowings to maintain the following grass height:

1. Mow areas outside to a height of 3 to 4 inches.

E. Turf Postfertilization: Apply slow-release fertilizer after initial mowing and when grass is dry.

1. Apply fertilizer at a rate of at least 7 lb/1000 sq. ft. of turf area.

3.7 SATISFACTORY TURF

A. Turf installations shall meet the following criteria as determined by Owner:

1. Satisfactory Seeded Turf: A healthy, uniform, recently mowed, close stand of grass has been established, free of weeds and surface irregularities, with coverage exceeding 90 percent over any 10 sq. ft. (0.92 sq. m) and bare spots not exceeding 3 by 3 inches.
2. Satisfactory Sodded Turf: A healthy, uniform, recently mowed, well-rooted, even-colored, viable turf has been established, free of weeds, open joints, bare areas, and surface irregularities.

B. Use specified materials to reestablish turf that does not comply with requirements, and continue maintenance until turf is satisfactory.

C. Obtain approval of satisfactory turf for all areas by Owner.

3.8 PESTICIDE APPLICATION

A. Apply pesticides and other chemical products and biological control agents according to manufacturer’s written recommendations. Coordinate applications with Owner’s operations and others in proximity to the Work. Notify Owner before each application is performed.
B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.9 CLEANUP AND PROTECTION

A. Promptly remove soil and debris created by turf work from paved areas. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove waste material, trash, and debris, and legally dispose of them off Owner's property.

C. Erect temporary fencing or barricades and warning signs as required to protect newly planted areas from traffic. Maintain fencing and barricades throughout maintenance period and remove as approved by Owner.

3.10 MAINTENANCE SERVICE

A. Turf Maintenance Service: Provide full maintenance by skilled employees of turf Installer. Begin maintenance immediately after each area is planted and continue until acceptable turf is established, but for not less than the following periods:

1. Seeded Turf: As long as required until satisfactory turf is established and approved by Owner.
2. Sodded Turf: As long as required until satisfactory turf is established and approved by Owner.

END OF SECTION 32 9200
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Specification Sheet – HydraCM™ Steep Slope Matrix

DESCRIPTION

The HydraCM™ Steep Slope Matrix shall be a hydraulically-applied mulch composed of a patent-pending blend of mechanically processed straw fibers, reclaimed cotton plant materials, performance-enhancing tackifiers, and other proprietary additives. The HydraCM matrix is designed for soil erosion protection, and establishes an intimate bond upon application with the soil’s surface to create a continuous, porous, absorbent, and flexible erosion control matrix that allows for rapid germination and accelerated plant growth.

The all natural fiber mulch shall satisfy the control performance criteria set forth in the Ceriodaphnia dubia, Daphnia magna and Pimephales promelas tests as described in EPA documentation (USEPA 2002) and the Region VIII Whole Effluent Toxics Control Program (EPA Region VIII 1997); therefore illustrating no significant toxicity for the mulch.

Composition: All components of the HydraCM matrix shall be pre-packaged by the Manufacturer to assure material performance and in compliance with the following values. Under no circumstances will field mixing of additives or components be accepted.

<table>
<thead>
<tr>
<th>Material Content</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanically Processed Straw</td>
<td>70% +/- 3%</td>
</tr>
<tr>
<td>Mechanically Processed Reclaimed Cotton Plant Material</td>
<td>20% +/- 3%</td>
</tr>
<tr>
<td>Proprietary Hydro-colloidal Tackifiers and Activators</td>
<td>10% +/- 1%</td>
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Specifications

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<thead>
<tr>
<th>Contents</th>
<th>Straw/Reclaimed Cotton Plant Material</th>
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<tr>
<td>Packaging</td>
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<tr>
<td>Total Organic Matter</td>
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<tr>
<td>Carbon to Nitrogen Ratio</td>
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<tr>
<td>Moisture Content</td>
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<td>Color</td>
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<th>Test Method</th>
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<td>Cover Factor</td>
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<td>Percent Effectiveness</td>
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<tr>
<td>Vegetation Establishment</td>
<td>ASTM D7322</td>
<td>&gt;450%</td>
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* Modified ASTM D6459 (Standard Test Method for Determination of Erosion Control Blankets (ECB) Performance in Protecting Hillslopes from Rainfall-Induced Erosion)

Packaging

Bags are filled with 50 lbs (23 kg) of material and packaged in a UV and weather-resistant bag. Each pallet contains 40 bags or one ton of material with a plastic cover for enhanced protection from rain and UV rays.

NOTE: Not for use in channels, swales, or other areas where concentrated flows are anticipated, unless installed in conjunction with a temporary erosion control blanket or permanent turf reinforcement mat. HydraCM may be applied on saturated surfaces. Do not allow foot traffic or grazing on treated areas until vegetated. Be cautious of slippery surfaces while applying. Warning: Do not store near an open flame or heat source. Use caution when stacking units. See Installation guide for more detailed information regarding application of the HydraCM product.

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Plants.
2. Tree stabilization.
3. Tree-watering devices.

B. Related Requirements:

1. Section 329200 "Turf and Grasses" for turf (lawn) and erosion-control materials.

1.3 DEFINITIONS

A. Backfill: The earth used to replace or the act of replacing earth in an excavation.

B. Balled and Burlapped Stock: Plants dug with firm, natural balls of earth in which they were grown, with a ball size not less than diameter and depth recommended by ANSI Z60.1 for type and size of plant required; wrapped with burlap, tied, rigidly supported, and drum laced with twine with the root flare visible at the surface of the ball as recommended by ANSI Z60.1.

C. Bare-Root Stock: Plants with a well-branched, fibrous-root system developed by transplanting or root pruning, with soil or growing medium removed, and with not less than the minimum root spread according to ANSI Z60.1 for type and size of plant required.

D. Container-Grown Stock: Healthy, vigorous, well-rooted plants grown in a container, with a well-established root system reaching sides of container and maintaining a firm ball when removed from container. Container shall be rigid enough to hold ball shape and protect root mass during shipping and be sized according to ANSI Z60.1 for type and size of plant required.

E. Finish Grade: Elevation of finished surface of planting soil.

F. Pesticide: A substance or mixture intended for preventing, destroying, repelling, or mitigating a pest. Pesticides include insecticides, miticides, herbicides, fungicides, rodenticides, and molluscicides. They also include substances or mixtures intended for use as a plant regulator, defoliant, or desiccant. Some sources classify herbicides separately from pesticides.
G. Pests: Living organisms that occur where they are not desired or that cause damage to plants, animals, or people. Pests include insects, mites, grubs, mollusks (snails and slugs), rodents (gophers, moles, and mice), unwanted plants (weeds), fungi, bacteria, and viruses.

H. Planting Area: Areas to be planted.

I. Planting Soil: Existing, on-site soil; imported soil; or manufactured soil that has been modified with soil amendments and perhaps fertilizers to produce a soil mixture best for plant growth.

J. Plant; Plants; Plant Material: These terms refer to vegetation in general, including trees, shrubs, vines, ground covers, ornamental grasses, bulbs, corms, tubers, or herbaceous vegetation.

K. Root Flare: Also called “trunk flare.” The area at the base of the plant's stem or trunk where the stem or trunk broadens to form roots; the area of transition between the root system and the stem or trunk.

L. Stem Girdling Roots: Roots that encircle the stems (trunks) of trees below the soil surface.

M. Subgrade: The surface or elevation of subsoil remaining after excavation is complete, or the top surface of a fill or backfill before planting soil is placed.

1.4 COORDINATION

A. Coordination with Turf Areas (Lawns): Plant trees, shrubs, and other plants after finish grades are established and before planting turf areas unless otherwise indicated.

1. When planting trees, shrubs, and other plants after planting turf areas, protect turf areas, and promptly repair damage caused by planting operations.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

2. Slow release watering devices.

B. Samples for Verification: For each of the following:

1. Mulch: 1-pint (0.5-L) volume of each mulch required; in sealed plastic bags labeled with composition of materials by percentage of weight and source of mulch. Each Sample shall be typical of the lot of material to be furnished; provide an accurate representation of color, texture, and organic makeup.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For landscape Installer. Include list of similar projects completed by Installer demonstrating Installer’s capabilities and experience. Include project names, addresses, and year completed, and include names and addresses of owners’ contact persons.

B. Pesticides and Herbicides: Product label and manufacturer's application instructions specific to Project.
1.7 CLOSEOUT SUBMITTALS

A. Maintenance Data: Recommended procedures to be established by Owner for maintenance of plants during a calendar year. Submit before expiration of required maintenance periods.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: A qualified landscape installer whose work has resulted in successful establishment of plants.

1. Professional Membership: Installer shall be a member in good standing of either the Professional Landcare Network or the American Nursery and Landscape Association.
2. Experience: Three years' experience in landscape installation.
3. Installer's Field Supervision: Require Installer to maintain an experienced full-time supervisor on Project site when work is in progress.

B. Provide quality, size, genus, species, and variety of plants indicated, complying with applicable requirements in ANSI Z60.1.

C. Measurements: Measure according to ANSI Z60.1. Do not prune to obtain required sizes.

1. Trees and Shrubs: Measure with branches and trunks or canes in their normal position. Take height measurements from or near the top of the root flare for field-grown stock and container-grown stock. Measure main body of tree or shrub for height and spread; do not measure branches or roots tip to tip. Take caliper measurements 6 inches (150 mm) above the root flare for trees up to 4-inch (100-mm) caliper size, and 12 inches (300 mm) above the root flare for larger sizes.
2. Other Plants: Measure with stems, petioles, and foliage in their normal position.

D. Plant Material Observation: Owner may observe plant material either at place of growth or at site before planting for compliance with requirements for genus, species, variety, cultivar, size, and quality. Owner may also observe trees and shrubs further for size and condition of balls and root systems, pests, disease symptoms, injuries, and latent defects and may reject unsatisfactory or defective material at any time during progress of work. Remove rejected trees or shrubs immediately from Project site.

1. Notify Owner of sources of planting materials seven days in advance of delivery to site.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Packaged Materials: Deliver packaged materials in original, unopened containers showing weight, certified analysis, name and address of manufacturer, and indication of compliance with state and Federal laws if applicable.

B. Bulk Materials:

1. Do not dump or store bulk materials near structures, utilities, walkways and pavements, or on existing turf areas or plants.
2. Provide erosion-control measures to prevent erosion or displacement of bulk materials; discharge of soil-bearing water runoff; and airborne dust reaching adjacent properties, water conveyance systems, or walkways.
3. Accompany each delivery of bulk materials with appropriate certificates.

C. Deliver bare-root stock plants within 24 hours of digging. Immediately after digging up bare-root stock, pack root system in wet straw, hay, or other suitable material to keep root system moist until planting. Transport in covered, temperature-controlled vehicles, and keep plants cool and protected from sun and wind at all times.

D. Do not prune trees and shrubs before delivery. Protect bark, branches, and root systems from sun scald, drying, wind burn, sweating, whipping, and other handling and tying damage. Do not bend or bind-tie trees or shrubs in such a manner as to destroy their natural shape. Provide protective covering of plants during shipping and delivery. Do not drop plants during delivery and handling.

E. Handle planting stock by root ball.

F. Store bulbs, corms, and tubers in a dry place at 60 to 65 deg F (16 to 18 deg C) until planting.

G. Apply antidesiccant to trees and shrubs using power spray to provide an adequate film over trunks (before wrapping), branches, stems, twigs, and foliage to protect during digging, handling, and transportation.

1. If deciduous trees or shrubs are moved in full leaf, spray with antidesiccant at nursery before moving and again two weeks after planting.

H. Wrap trees and shrubs with burlap fabric over trunks, branches, stems, twigs, and foliage to protect from wind and other damage during digging, handling, and transportation.

I. Deliver plants after preparations for planting have been completed and install immediately. If planting is delayed more than six hours after delivery, set plants and trees in their appropriate aspect (sun, filtered sun, or shade), protect from weather and mechanical damage, and keep roots moist.

1. Heel-in bare-root stock. Soak roots that are in less than moist condition in water for two hours. Reject plants with dry roots.
2. Set balled stock on ground and cover ball with soil, peat moss, sawdust, or other acceptable material.
3. Do not remove container-grown stock from containers before time of planting.
4. Water root systems of plants stored on-site deeply and thoroughly with a fine-mist spray. Water as often as necessary to maintain root systems in a moist, but not overly wet condition.

1.10 FIELD CONDITIONS

A. Field Measurements: Verify actual grade elevations, service and utility locations, irrigation system components, and dimensions of plantings and construction contiguous with new plantings by field measurements before proceeding with planting work.

B. Planting Restrictions: Plant during one of the following periods. Coordinate planting periods with maintenance periods to provide required maintenance from date of Substantial Completion.

1. Spring Planting: March 1 to May 15.
2. Fall Planting: August 15 to November 1.
C. Weather Limitations: Proceed with planting only when existing and forecasted weather conditions permit planting to be performed when beneficial and optimum results may be obtained. Apply products during favorable weather conditions according to manufacturer's written instructions and warranty requirements.

1.11 WARRANTY

A. Special Warranty: Installer agrees to repair or replace plantings and accessories that fail in materials, workmanship, or growth within specified warranty period.

1. Failures include, but are not limited to, the following:
   a. Death and unsatisfactory growth, or health.
   b. Structural failures including plantings falling or blowing over.
   c. Faulty performance of tree stabilization.
   d. Deterioration of metals, metal finishes, and other materials beyond normal weathering.

2. Warranty Periods: Beginning from date of Substantial Completion and acceptance by Owner.
   a. Trees, Shrubs, Vines, and plantings: 12 months.

3. Include the following remedial actions as a minimum:
   a. Immediately remove dead plants and replace unless required to plant in the succeeding planting season.
   b. Replace plants that are more than 25 percent dead or in an unhealthy condition at end of warranty period.
   c. A limit of one replacement of each plant is required except for losses or replacements due to failure to comply with requirements.
   d. Provide extended warranty for period equal to original warranty period, for replaced plant material.

B. End of Warranty Final Acceptance - Acceptance of plants at the end of the warranty period.

1. At the end of the warranty period, the Owner's Representative shall observe all warranted work, upon written request of the Contractor. The request shall be received at least ten calendar days before the anticipated date for final observation.

2. End of Warranty Final Acceptance will be given only when all the requirements of the work under this specification and in specification sections Planting Soil and Irrigation have been met.

PART 2 - PRODUCTS

2.1 PLANT MATERIAL

A. General: Furnish nursery-grown plants true to genus, species, variety, cultivar, stem form, shearing, and other features indicated in Plant List, Plant Schedule, or Plant Legend indicated on Drawings and complying with ANSI Z60.1; and with healthy root systems developed by transplanting or root pruning. Provide well-shaped, fully branched, healthy, vigorous stock,
densely foliated when in leaf and free of disease, pests, eggs, larvae, and defects such as knots, sun scald, injuries, abrasions, and disfigurement.

1. Trees with damaged, crooked, or multiple leaders; tight vertical branches where bark is squeezed between two branches or between branch and trunk ("included bark"); crossing trunks; cut-off limbs more than 3/4 inch (19 mm) in diameter; or with stem girdling roots are unacceptable.
2. Collected Stock: Do not use plants harvested from the wild, from native stands, from an established landscape planting, or not grown in a nursery unless otherwise indicated.

B. Provide plants of sizes, grades, and ball or container sizes complying with ANSI Z60.1 for types and form of plants required. Plants of a larger size may be used if acceptable to Owner, with a proportionate increase in size of roots or balls.

C. Root-Ball Depth: Furnish trees and shrubs with root balls measured from top of root ball, which begins at root flare according to ANSI Z60.1. Root flare shall be visible before planting.

D. Labeling: Label each plant of each variety, size, and caliper with a securely attached, waterproof tag bearing legible designation of common name and full scientific name, including genus and species. Include nomenclature for hybrid, variety, or cultivar, if applicable for the plant.

E. If formal arrangements or consecutive order of plants is indicated on Drawings, select stock for uniform height and spread, and number the labels to assure symmetry in planting.

F. Annuals: Provide healthy, disease-free plants of species and variety shown or listed, with well-established root systems reaching to sides of the container to maintain a firm ball, but not with excessive root growth encircling the container. Provide only plants that are acclimated to outdoor conditions before delivery and that are in bud but not yet in bloom.

2.2 FERTILIZERS

A. Planting Tablets: Tightly compressed chip-type, long-lasting, slow-release, commercial-grade planting fertilizer in tablet form. Tablets shall break down with soil bacteria, converting nutrients into a form that can be absorbed by plant roots.

1. Size: 5-gram tablets.
2. Nutrient Composition: 20 percent nitrogen, 10 percent phosphorous, and 5 percent potassium, by weight plus micronutrients.

2.3 MULCHES

A. Organic Mulch: Free from deleterious materials and suitable as a top dressing of trees and shrubs, consisting of one of the following:

1. Type: Double dyed and double ground shredded hardwood, or approved equal.
2. Size Range: 3 inches (76 mm) maximum, 1/2 inch (13 mm) minimum.
3. Color: "Mocha".
2.4 PESTICIDES

A. General: Pesticide registered and approved by the EPA, acceptable to authorities having jurisdiction, and of type recommended by manufacturer for each specific problem and as required for Project conditions and application. Do not use restricted pesticides unless authorized in writing by authorities having jurisdiction.

B. Pre-Emergent Herbicide (Selective and Nonselective): Effective for controlling the germination or growth of weeds within planted areas at the soil level directly below the mulch layer.

C. Post-Emergent Herbicide (Selective and Nonselective): Effective for controlling weed growth that has already germinated.

2.5 TREE-STABILIZATION MATERIALS

A. Trunk-Stabilization Materials:

1. Upright and Guy Stakes: Rough-sawn, sound, new softwood with specified wood pressure-preservative treatment, free of knots, holes, cross grain, and other defects, 2-by-2-inch nominal (38-by-38-mm actual) by length indicated, pointed at one end.

2. Flexible Ties: Wide rubber or elastic bands or straps of length required to reach stakes or turnbuckles and compression springs.

3. Guys and Tie Wires: ASTM A 641/A 641M, Class 1, galvanized-steel wire, two-strand, twisted, 0.106 inch (2.7 mm) in diameter.

4. Guy Cables: Five-strand, 3/16-inch- (4.8-mm-) diameter, galvanized-steel cable, with zinc-coated [turnbuckles] [compression springs], a minimum of 3 inches (75 mm) long, with two 3/8-inch (10-mm) galvanized eyebolts.

5. Flags: Standard surveyor's plastic flagging tape, white, 6 inches (150 mm) long.

2.6 TREE-WATERING DEVICES

A. Slow-Release Watering Device: Standard product manufactured for drip irrigation of plants and emptying its water contents over two to nine hours; manufactured from UV-light-stabilized nylon-reinforced polyethylene sheet, PVC, or HDPE plastic.

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

   a. Tree Gator.
   b. BIO-PLEX.
   c. Engineered Watering Solutions; PQ Partners, LLC.
   d. Spectrum Products, Inc.

2. Color: green or tan.

2.7 MISCELLANEOUS PRODUCTS

A. Wood Pressure-Preservative Treatment: AWPA U1, Use Category UC4a; acceptable to authorities having jurisdiction, and containing no arsenic or chromium.
B. Antidesiccant: Water-insoluble emulsion, permeable moisture retarder, film forming, for trees and shrubs. Deliver in original, sealed, and fully labeled containers and mix according to manufacturer’s written instructions.

C. Burlap: Non-synthetic, biodegradable.

D. Mycorrhizal Fungi: Dry, granular inoculant containing at least 5300 spores per lb (0.45 kg) of vesicular-arbuscular mycorrhizal fungi and 95 million spores per lb (0.45 kg) of ectomycorrhizal fungi, 33 percent hydrogel, and a maximum of 5.5 percent inert material.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive plants, with Installer present, for compliance with requirements and conditions affecting installation and performance of the Work.

1. Verify that no foreign or deleterious material or liquid such as paint, paint washout, concrete slurry, concrete layers or chunks, cement, plaster, oils, gasoline, diesel fuel, paint thinner, turpentine, tar, roofing compound, or acid has been deposited in soil within a planting area.
2. Verify that plants and vehicles loaded with plants can travel to planting locations with adequate overhead clearance.
3. Verify all areas are to correct finish grade elevations.
4. Level and smooth all eroded areas.
5. Suspend planting operations during periods of excessive soil moisture until the moisture content reaches acceptable levels to attain the required results.
6. Uniformly moisten excessively dry soil that is not workable or which is dusty.

B. If contamination by foreign or deleterious material or liquid is present in soil within a planting area, remove the soil and contamination as directed by Owner and replace with new planting soil.

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

3.2 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities and turf areas and existing plants from damage caused by planting operations.

B. Install erosion-control measures to prevent erosion or displacement of soils and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways.

C. Lay out individual tree and shrub locations and areas for multiple plantings. Stake locations, outline areas, adjust locations when requested, and obtain Owner’s acceptance of layout before excavating or planting. Make minor adjustments as required.

D. Lay out plants at locations directed by Owner. Stake locations of individual trees and shrubs and outline areas for multiple plantings.
3.3 PLANTING AREA ESTABLISHMENT

A. Before planting, obtain Owner's acceptance of finish grading; restore planting areas if eroded or otherwise disturbed after finish grading.

B. Application of Mycorrhizal Fungi: Not required, but can be applied if believed it will increase survivability. Broadcast dry product uniformly over prepared soil at application rate according to manufacturer's written recommendations.

3.4 EXCAVATION FOR TREES AND SHRUBS

A. Planting Pits and Trenches: Excavate circular planting pits.
   1. Excavate planting pits with sides sloping inward at a 45-degree angle. Excavations with vertical sides are unacceptable. Trim perimeter of bottom leaving center area of bottom raised slightly to support root ball and assist in drainage away from center. Do not further disturb base. Ensure that root ball will sit on undisturbed base soil to prevent settling. Scarify sides of planting pit smeared or smoothed during excavation.
   2. Excavate approximately three times as wide as ball diameter for balled and burlapped stock.
   3. Excavate at least 12 inches (300 mm) wider than root spread and deep enough to accommodate vertical roots for bare-root stock.
   4. Do not excavate deeper than depth of the root ball, measured from the root flare to the bottom of the root ball.
   5. If area under the plant was initially dug too deep, add soil to raise it to the correct level and thoroughly tamp the added soil to prevent settling.
   6. Maintain angles of repose of adjacent materials to ensure stability. Do not excavate subgrades of adjacent paving, structures, hardscapes, or other new or existing improvements.
   7. Maintain supervision of excavations during working hours.
   8. Keep excavations covered or otherwise protected when unattended by Installer's personnel.
   9. If drain tile is indicated on Drawings or required under planting areas, excavate to top of porous backfill over tile.

B. Backfill Soil: Subsoil and topsoil removed from excavations may be used as backfill soil unless otherwise indicated.

C. Obstructions: Notify Owner if unexpected rock or obstructions detrimental to trees or shrubs are encountered in excavations.
   1. Hardpan Layer: Drill 6-inch- (150-mm-) diameter holes, 24 inches (600 mm) apart, into free-draining strata or to a depth of 10 feet (3 m), whichever is less, and backfill with free-draining material.

D. Drainage: Notify Owner if subsoil conditions evidence unexpected water seepage or retention in tree or shrub planting pits.

E. Fill excavations with water and allow to percolate away before positioning trees and shrubs.
3.5 TREE, SHRUB, AND VINE PLANTING

A. Inspection: At time of planting, verify that root flare is visible at top of root ball according to ANSI Z60.1. If root flare is not visible, remove soil in a level manner from the root ball to where the top-most root emerges from the trunk. After soil removal to expose the root flare, verify that root ball still meets size requirements.

B. Roots: Remove stem girdling roots and kinked roots. Remove injured roots by cutting cleanly; do not break.

C. Balled and Burlapped Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.

1. Backfill: excavated soil.
2. After placing some backfill around root ball to stabilize plant, carefully cut and remove burlap, rope, and wire baskets from tops of root balls and from sides, but do not remove from under root balls. Remove pallets, if any, before setting. Do not use planting stock if root ball is cracked or broken before or during planting operation.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
   a. Quantity: As recommended by manufacturer.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

D. Balled and Potted and Container-Grown Stock: Set each plant plumb and in center of planting pit or trench with root flare 1 inch (25 mm) above adjacent finish grades.

1. Backfill: excavated soil.
2. Carefully remove root ball from container without damaging root ball or plant.
3. Backfill around root ball in layers, tamping to settle soil and eliminate voids and air pockets. When planting pit is approximately one-half filled, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed.
4. Place planting tablets equally distributed around each planting pit when pit is approximately one-half filled. Place tablets beside the root ball about 1 inch (25 mm) from root tips; do not place tablets in bottom of the hole.
   a. Quantity: As recommended by manufacturer.
5. Continue backfilling process. Water again after placing and tamping final layer of soil.

E. Slopes: When planting on slopes, set the plant so the root flare on the uphill side is flush with the surrounding soil on the slope; the edge of the root ball on the downhill side will be above the surrounding soil. Apply enough soil to cover the downhill side of the root ball.

3.6 TREE, SHRUB, AND VINE PRUNING

A. Remove only dead, dying, or broken branches. Do not prune for shape.
B. Prune, thin, and shape trees, shrubs, and vines as directed by Owner.

C. Prune, thin, and shape trees, shrubs, and vines according to standard professional horticultural and arboricultural practices. Unless otherwise indicated by Owner, do not cut tree leaders; remove only injured, dying, or dead branches from trees and shrubs; and prune to retain natural character.

D. Do not apply pruning paint to wounds.

3.7 TREE STABILIZATION

A. Trunk Stabilization by Upright Staking and Tying: Install trunk stabilization as follows unless otherwise indicated:

1. Upright Staking and Tying: Stake trees of 2- through 5-inch (50- through 125-mm) caliper. Stake trees of less than 2-inch (50-mm) caliper only as required to prevent wind tip out. Use a minimum of two stakes of length required to penetrate at least 18 inches (450 mm) below bottom of backfilled excavation and to extend at least 60 inches above grade. Set vertical stakes and space to avoid penetrating root balls or root masses.

2. Space stakes equally around trees.

3. Support trees with bands of flexible ties at contact points with tree trunk. Allow enough slack to avoid rigid restraint of tree.

3.8 GROUND COVER AND PLANT PLANTING

A. Set out and space ground cover and plants other than trees, shrubs, and vines as indicated on Drawings in even rows with triangular spacing.

B. Use planting soil for backfill.

C. Dig holes large enough to allow spreading of roots.

D. For rooted cutting plants supplied in flats, plant each in a manner that minimally disturbs the root system but to a depth not less than two nodes.

E. Work soil around roots to eliminate air pockets and leave a slight saucer indentation around plants to hold water.

F. Water thoroughly after planting, taking care not to cover plant crowns with wet soil.

G. Protect plants from hot sun and wind; remove protection if plants show evidence of recovery from transplanting shock.

3.9 PLANTING AREA MULCHING

A. Mulch backfilled surfaces of planting areas and other areas indicated.

1. Trees and Shrubs in Turf Areas: Apply mulch ring of 3-inch (75-mm) average thickness, over a 48-inch radius or covering total area disturbed from planting, whichever is greater, around trunks or stems. Do not place mulch within 2 inches of trunks or stems.
2. Mulch in Planting Areas: Apply 3-inch (75-mm) average thickness of mulch over whole surface of planting area, and finish level with adjacent finish grades. Do not place mulch within 1 inch of trunks or stems.

3. For all Conifers or Evergreen Trees Installed within 20 Feet of Each Other: Apply a continuous mulch strip of 3-inch average thickness, 48 inch minimum width between and around the line of trees.

3.10 INSTALLING SLOW-RELEASE WATERING DEVICE

A. Provide one device for each tree and shrub similar to Treegator, or approved equal.

B. Place device on top of the mulch at base of tree or shrub stem and fill with water according to manufacturer's written instructions.

3.11 PLANT MAINTENANCE

A. Maintain plantings by pruning, cultivating, watering, weeding, fertilizing, mulching, restoring planting saucers, adjusting and repairing tree-stabilization devices, resetting to proper grades or vertical position, and performing other operations as required to establish healthy, viable plantings.

B. Fill in, as necessary, soil subsidence that may occur because of settling or other processes. Replace mulch materials damaged or lost in areas of subsidence.

C. Apply treatments as required to keep plant materials, planted areas, and soils free of pests and pathogens or disease. Use integrated pest management practices when possible to minimize use of pesticides and reduce hazards. Treatments include physical controls such as hosing off foliage, mechanical controls such as traps, and biological control agents.

D. All trees and shrubs shall be watered once a week with a minimum of 15 gallons by a slow release watering device. If 1 inch or more of rain falls on the site within 7 days of the previous watering, watering can be suspended for 7 days after the rainfall event if approved by Owner. All other plants shall be watered at a minimum rate of 1 inch per week. Provide water via offsite means.

3.12 PESTICIDE APPLICATION

A. As needed, apply pesticides and other chemical products and biological control agents according to authorities having jurisdiction and manufacturer's written recommendations. Coordinate applications with Owner's operations and others in proximity to the Work. Notify Owner before each application is performed.

B. Post-Emergent Herbicides (Selective and Nonselective): Apply only as necessary to treat already-germinated weeds and according to manufacturer's written recommendations.

3.13 REPAIR AND REPLACEMENT

A. General: Repair or replace existing or new trees and other plants that are damaged, in a manner approved by Owner.
1. Submit details of proposed pruning and repairs.
2. Perform repairs of damaged trunks, branches, and roots within 24 hours, if approved.
3. Replace trees and other plants that cannot be repaired and restored to full-growth status, as determined by Owner.

B. Remove and replace trees, shrubs, and landscape plants that are more than 25 percent dead or damaged or in an unhealthy condition or are damaged during construction operations that Owner determines are incapable of restoring to normal growth pattern. Plants shall also be free of insects, pests, eggs, bores, and larvae.

1. Provide new plants of same size as those being replaced.

3.14 CLEANING AND PROTECTION

A. During planting, keep adjacent paving and construction clean and work area in an orderly condition. Clean wheels of vehicles before leaving site to avoid tracking soil onto roads, walks, or other paved areas.

B. Remove surplus soil and waste material including excess subsoil, unsuitable soil, trash, and debris and legally dispose of them off Owner's property.

C. Protect plants from damage due to landscape operations and operations of other contractors and trades. Maintain protection during installation and maintenance periods. Treat, repair, or replace damaged plantings.

D. After installation and before Substantial Completion, remove nursery tags, nursery stakes, tie tape, labels, wire, burlap, and other debris from plant material, planting areas, and Project site.

E. At time of Substantial Completion, verify that tree-watering devices are in good working order and leave them in place. Replace improperly functioning devices.

3.15 MAINTENANCE SERVICE

A. Maintenance Service for Trees and Shrubs: Provide maintenance by skilled employees of landscape Installer. Begin maintenance immediately after plants are installed and continue until plantings are acceptably healthy and well established, but for not less than maintenance period below:

1. Maintenance Period: Throughout construction and until Substantial Completion of the project and acceptance of all landscaping by the Owner.
2. Approximately one month prior to the end of the maintenance service period, coordinate and arrange a site walk thru with Owner to determine the condition of all landscaping. Immediately make all corrections as determined from this walk thru and arrange another walk thru with Owner. Continue this process until all landscaping is deemed acceptable by Owner.

B. At planting Substantial Completion and written acceptance by the Owner of all landscaping, the Warranty Period shall begin. The date of substantial completion may be different than the date of substantial completion for the other sections of the project

C. Maintenance during the warranty period shall be by the Owner. Periodic inspections by the Contractor are allowed to verify plants are being adequately maintained.
3.16 MAINTENANCE DURING THE WARRANTY PERIOD BY OTHERS

A. After Substantial Completion Acceptance, the Contractor shall make sufficient site visits to observe the Owner's maintenance and become aware of problems with the maintenance in time to request changes, until the date of End of Warranty Final Acceptance.

   1. Notify the Owner's Representative in writing if maintenance, including watering, is not sufficient to maintain plants in a healthy condition. Such notification must be made in a timely period so that the Owner's Representative may take corrective action.
      a. Notification must define the maintenance needs and describe any corrective action required.
   2. In the event that the Contractor fails to visit the site and or notify, in writing, the Owner's Representative of maintenance needs, lack of maintenance shall not be used as grounds for voiding or modifying the provisions of the warranty.

3.17 END OF WARRANTY FINAL ACCEPTANCE / MAINTENANCE OBSERVATION

A. At the end of the Warranty and Maintenance period the Owner's Representative shall observe the work and establish that all provisions of the contract are complete and the work is satisfactory.

   1. If the work is satisfactory, the maintenance period will end on the date of the final observation.
   2. If the work is deemed unsatisfactory, the maintenance period will continue at no additional expense to the Owner until the work has been completed, observed, and approved by the Owner's Representative.

B. FAILURE TO PASS OBSERVATION: If the work fails to pass final observation, any subsequent observations must be rescheduled as per above.

END OF SECTION 32 9300
SECTION 33 0543
UNDERGROUND UTILITIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes the following:
   1. Conduit, and accessories for direct-buried utility lines.
   2. Pullboxes

1.3 DEFINITION

A. RNC: Rigid nonmetallic conduit.

1.4 SUBMITTALS

A. Product Data: For the following:
   1. Conduits and their accessories, including elbows, end bells, bends, fittings, and solvent cement.
   2. Warning tape.
   3. Hand holes.

B. Field quality-control test reports.

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

B. Comply with ANSI C2.

C. Comply with NFPA 70.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver conduit to Project site with ends capped. Store nonmetallic conduits with supports to prevent bending, warping, and deforming.
1.7 PROJECT CONDITIONS

A. Interruption of Existing Electrical Service: Do not interrupt electrical service to facilities occupied by Owner or others unless permitted under the following conditions:

1. Notify Owner no fewer than seven days in advance of proposed interruption of electrical service.
2. Do not proceed with interruption of electrical service without Owner's written permission.

1.8 COORDINATION

A. Coordinate all utility installation and relocation with the corresponding utility company prior to the start of construction.

B. Coordinate layout and installation of conduit with final arrangement of other utilities, sewers, site grading, and surface features as determined in the field. Maintain a minimum 18” vertical separation at all crossings.

C. Coordinate elevations of conduit into hand holes with final locations as determined by coordination with other utilities, underground obstructions, and surface features.

1.9 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.

PART 2 - PRODUCTS

2.1 CONDUIT


B. RNC: NEMA TC 2, Type EPC-40-PVC, UL 651, with matching fittings by same manufacturer as the conduit, complying with NEMA TC 3 and UL 514B.

C. RNC cap: Schedule 40 PVC cap of matching size as conduit to be applied to.

2.2 HAND HOLE

A. Description: Comply with SCTE 77.

1. Material and Load Rating: Units shall be rated for heavy duty traffic, H25 loading. Material can be pre cast concrete or polymer concrete.
2. Configuration: Units shall be designed for flush burial and have open bottom, unless otherwise indicated.
3. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure.
4. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.
5. Cover Legend: Molded lettering, "ELECTRIC" or "TELEPHONE" or "TELEVISION" (corresponding with each service.)
6. Minimum pull box size shall be 17” x 30” for the lid and 17” wide x 30” long x 17” deep for the body. Body extensions will not be allowed to achieve required dimensions.

PART 3 - EXECUTION

3.1 UNDERGROUND CONDUIT APPLICATION

A. Underground Conduit for Electric, Telephone, Communications, or Data Utility Service Cables: RNC, NEMA Type EPC-40-PVC, unless otherwise indicated.

3.2 EARTHWORK

A. Excavation and Backfill: Comply with Division 31 Section "Earth Moving," but do not use heavy-duty, hydraulic-operated, compaction equipment.

B. Restore surface features at areas disturbed by excavation and reestablish original grades, unless otherwise indicated. Replace removed sod immediately after backfilling is completed.

C. Restore areas disturbed by trenching, storing of dirt, cable laying, and other work. Restore vegetation and include necessary topsoiling, fertilizing, liming, seeding, sodding, sprigging, and mulching.

3.3 CONDUIT INSTALLATION

A. Curves and Bends: Use 5-degree angle couplings for small changes in direction. Use manufactured long sweep bends with a minimum radius of 36 inches, both horizontally and vertically, at other locations, unless otherwise indicated.

B. Joints: Use solvent-cemented joints in conduit and fittings and make watertight according to manufacturer's written instructions. Stagger couplings so those of adjacent conduit do not lie in same plane.

C. Building Wall Penetrations: Make a transition from underground duct to rigid steel conduit at least 10 feet (3 m) outside the building wall without reducing conduit line slope away from the building, and without forming a trap in the line. Use fittings manufactured for duct-to-conduit transition.

D. Sealing: Provide temporary closure at terminations of conduit that have cables pulled. Cap spare conduit at terminations.

E. Pulling Cord: Install 100-lbf- (445-N-) test nylon cord in conduit, including spares.

3.4 INSTALLATION OF HAND HOLES

A. Install hand holes level and plumb and with orientation and depth coordinated with connecting conduit to minimize bends and deflections required for proper entrances.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel from conduit depth to bottom of unit, graded from 1/2-inch (12.7-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.
a. Elevation: In paved areas and trafficways, set so cover surface will be flush with finished grade. Set covers of other hand holes 1 inch (25 mm) above finished grade.

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

1. Demonstrate capability and compliance with requirements on completion of installation of underground conduit and utility structures.
2. Pull aluminum or wood test mandrel through duct to prove joint integrity and test for out-of-round duct. Provide mandrel equal to 80 percent fill of duct. If obstructions are indicated, remove obstructions and retest.

B. Correct deficiencies and retest as specified above to demonstrate compliance.

3.6 CLEANING

A. Pull leather-washer-type duct cleaner, with graduated washer sizes, through full length of conduit. Follow with rubber duct swab for final cleaning and to assist in spreading lubricant throughout conduit.

END OF SECTION 33 0543
PART 1 - GENERAL

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

1.2 SUMMARY
   A. Section Includes:
      1. Pipe and fittings.
      2. Cleanouts.
      3. Curb Inlets.
      4. Stormwater inlets.
      5. Pipe outlets.

1.3 DEFINITIONS
   A. None.

1.4 SUBMITTALS
   A. Product Data: For each type of product indicated.
   B. Shop Drawings:
      1. Curb Inlets, stormwater inlets, and junction boxes. Include elevations, sections, details, frames, covers, and grates.
      2. Stormwater Detention Structures: Include elevations, sections, details, frames, grates, covers, and concrete design-mix reports.
      3. Pipe Outlets: Include elevations, sections, materials, and details.
   C. Field quality-control reports.

1.5 DELIVERY, STORAGE, AND HANDLING
   A. Do not store plastic structures, pipe, and fittings in direct sunlight.
   B. Protect pipe, pipe fittings, and seals from dirt and damage.
   C. Handle structures according to manufacturer’s written rigging instructions.
D. Handle catch basins, trench drains, and stormwater inlets according to manufacturer’s written rigging instructions.

PART 2 - PRODUCTS

2.1 PE PIPE AND FITTINGS

A. High Density Corrugated PE Pipe with integrally formed dual wall smooth waterway AASHTO M 252 and M294, Type S.
1. Manufacturer: Advanced Drainage Systems (ADS) N-12ST HDPE pipe, or approved equal.
2. Soil tight gasketed joints.

2.2 PVC PIPE AND FITTINGS

A. PVC Sewer Piping:
2. Fittings: ASTM D 3034, PVC with bell ends.

2.3 CONCRETE PIPE AND FITTINGS

A. Reinforced-Concrete Sewer Pipe and Fittings: ASTM C 76 (ASTM C 76M).
2. Class III, minimum, based on depth as detailed in civil plans.
3. Class IV, based on depth as detailed in civil plans.
4. Class V, based on depth as detailed in civil plans.

2.4 CLEANOUTS

A. Plastic Cleanouts:
1. Description: PVC body with either PVC top or cast-iron frame and lid depending on location. See civil plans for details.

2.5 CURB INLETS

A. Designed Precast Concrete Catch Basins: ASTM C 913, precast, reinforced concrete; designed according to ASTM C 890 for A-16 (ASSHTO HS20-44), heavy-traffic, structural loading; of depth, shape, and dimensions indicated, with provision for joint sealants.

B. General: Concrete according to ACI 318, ACI 350/350R (ACI 350M/350RM), and the following:
1. Cement: ASTM C 150, Type II.

C. Portland Cement Design Mix: 4000 psi (27.6 MPa) minimum, with 0.45 maximum water/cementitious materials ratio.

2. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (420 MPa) deformed steel.

D. Joint Sealants: ASTM C 990 (ASTM C 990M), bitumen or butyl rubber.

E. Grates and steps as detailed in the civil construction plans.

2.6 STORMWATER INLETS

A. PVC Inlets: As manufactured by Nyloplast and as shown in the civil plans, or approved equal. Include heavy duty frames and grates.

B. Concrete Inlets: Precast concrete manufactured per current City of Columbia Specifications and details. Include heavy-duty frames and grates

2.7 PIPE OUTLETS

A. Concrete Flared End Sections for reinforced concrete pipe (RCP): Per current MoDOT precast concrete flared end section detail 732.00N, with concrete toewall.

B. Galvanized Metal Flared End Sections for plastic pipe: As detailed in the civil plans. Include toe plate extensions per detail.

C. Riprap: Broken, irregularly sized and shaped, graded stone as shown in civil plans.

PART 3 - EXECUTION

3.1 EARTHWORK

A. Excavation, trenching, and backfilling are specified in Division 31 Section "Earth Moving."

3.2 PIPING INSTALLATION

A. Locations and Arrangements: Drawing plans and details indicate location and arrangement of underground storm drainage piping. Location and arrangement of piping layout take into account design considerations. Install piping as indicated.

B. Install piping beginning at low point, true to grades and alignment indicated with unbroken continuity of invert. Place bell ends of piping facing upstream. Install gaskets, seals, sleeves, and couplings according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements.
3. Install gravity-flow, nonpressure drainage piping according to the following:
   1. Install piping pitched down in direction of flow.
   2. Install piping with to depths indicated in civil plans. Minimum cover for HDPE pipe shall be maintained per manufacturer’s Specifications.
   3. Install PVC profile gravity sewer piping as detailed in civil plans.
   4. Install reinforced-concrete sewer piping as detailed in civil plans.

3.3 PIPE JOINT CONSTRUCTION

A. Join gravity-flow, nonpressure drainage piping according to the following:
   1. Join PVC profile gravity sewer piping according to ASTM D 2321 for elastomeric-seal joints or ASTM F 794 for gasketed joints.
   2. Join reinforced-concrete sewer piping according to ACPA’s “Concrete Pipe Installation Manual” for rubber-gasketed joints.

3.4 CLEANOUT INSTALLATION

A. Install cleanouts and riser extensions from sewer pipes to cleanouts at grade as detailed in civil plans.

3.5 CURB INLET INSTALLATION

A. Construct catch basins and junction boxes to sizes and shapes indicated.
   B. Set frames and grates to elevations indicated.

3.6 STORMWATER INLET AND OUTLET INSTALLATION

A. Construct riprap of broken stone, as indicated.
   B. Install flared end sections at all outlets that spill onto grade.

3.7 FIELD QUALITY CONTROL

A. Inspect interior of piping to determine whether line displacement or other damage has occurred. Inspect after approximately 24 inches (610 mm) of backfill is in place, and again at completion of Project.
   1. Submit separate reports for each system inspection.
   2. Defects requiring correction include the following:
      a. Alignment: Less than full diameter of inside of pipe is visible between structures.
      b. Deflection: Flexible piping with deflection that prevents passage of ball or cylinder of size not less than 92.5 percent of piping diameter.
      c. Damage: Crushed, broken, cracked, or otherwise damaged piping.
      d. Infiltration: Water leakage into piping.
      e. Exfiltration: Water leakage from or around piping.
3. Replace defective piping using new materials, and repeat inspections until defects are within allowances specified.
4. Reinspect and repeat procedure until results are satisfactory.

B. Test new piping systems, and parts of existing systems that have been altered, extended, or repaired, for leaks and defects.
   1. Do not enclose, cover, or put into service before inspection and approval.
   2. Test completed piping systems according to requirements of authorities having jurisdiction.
   3. Schedule tests and inspections by authorities having jurisdiction with at least 24 hours' advance notice.
   4. Submit separate report for each test.

C. Replace leaking piping using new materials, and repeat testing until leakage is within allowances specified.

3.8 CLEANING
A. Clean interior of piping of dirt and superfluous materials. Flush with water.

END OF SECTION 33 4100
APPENDIX A – INTERIOR FINISH KEY

FLOORS:

Carpet:

WCT-1  Walk off Carpet Tile, Mannington Commercial, Recoarse II, Traverse Tan 8413, Installation Quarter-Turn

CT-1  Carpet Tile, Mannington, Philadelphia, 42326 The Gulch, 18”x36”, Installation Horizontal Brick Ashlar (Offices, Waiting, Nurse Stations)

Sheet Vinyl:

SV-1  Sheet vinyl, Teknoflor, Forestscapes HPD, 88057 Buck, Weld rod color to match #88057 (Exam Rooms)

SV-2  Sheet vinyl, Mannington, Burlap, ETW203 Stone, heat weld all seams, Weld rod color to match #84238 (Corridors)

SV-3  Sheet vinyl, Mannington, Assurance II, 16325 Sable, heat weld all seams, weld rod color to match #842407 (Restrooms, Utility, Storage)

SC-1  Sealed Concrete (Mechanical Room)

TR-1  Floor Transition, Johnsonite, #283 Toast, Slim-line SLT- 66-A (CT-1 to SV-1)

TR-2  Floor Transition, Johnsonite, #63 Burnt Umber, Edge Guard, EG-66-H (SV-1 to Sealed Concrete)

Wall Base:

RB-1  Rubber base, Johnsonite, 4 ¼”h Reveal Base MW-66-F, 66 Either Ore, 8’ lengths (Public Areas)

RB-2  Rubber base, Johnsonite, 4 ¼”h TightLock, 66 Either Ore, 8’ lengths (All other Areas)

SVB-1  Sheet Vinyl wall base, SV-3

(Note: Use Schluter top cap (TS-2-A), heat weld all seams, cove up wall 6” as shown)
**WALLS:**

*Paint:

- **IPS -1A**: Eggshell Latex on Gyp. Bd., Sherwin Williams, SW7532 Urban Putty (Main color)
- **IPS -1B**: Eggshell Latex on Gyp. Bd., Sherwin Williams, SW 7695 Mesa Tan (Accent color)
- **IPS -1C**: Eggshell Latex on Gyp. Bd., Sherwin Williams, SW 7728 Green Sprout (Accent color)
- **IPS -1D**: Eggshell Latex on Gyp. Bd, Sherwin Williams, SW 6474 Raging Sea (Accent color)
- **IPS -1E**: Eggshell Latex on Gyp. Bd., Sherwin Williams, SW 0018 Teal Stencil (Accent color)
- **IPS -1F**: Eggshell Latex on Gyp. Bd., Sherwin Williams, SW 6213 Halcyon Green (Accent color)
- **IPS -1G**: Eggshell Latex on Gyp. Bd., Sherwin Williams, SW 0024 Curio Gray (Accent color)

*Wall Tile:

- **WT-1**: Wall Tile, American Olean, St. Germain, Crème, 12”x24” (Restroom Walls)
- **WT-2**: Wall Tile, Daltile, Cascading Waters, CW45 Cerulean Swel (Accent glass tile)

*Wallcovering:

- **WC -1**: Vinyl Wallcovering, National Wallcovering, Canopy, Y46844CP Linden
- **WC - 2**: Vinyl Wallcovering, DL Couch, Baccarat, R2-BC-04 Vesper (NOT USED)
- **WC - 3**: Vinyl Wallcovering, DL Couch, Baccarat, R2-BC-26 Cypress

**CEILINGS:**

*Acoustical Ceiling Tile:

- **ACT-1**: Acoustical Ceiling, Armstrong, Ultima1911, 15/16” Angled Tegular, white, 2’ x 2’
- **ACT-2**: Acoustical Ceiling, 2’x2’x1”, 15/16” grid, white, 0.95 NRC, Armstrong, 3250 Optima, Square Tegular (Psych Consult Rooms)

*Ceiling Paint:

- **IPS-2A**: Flat Latex on Gyp, SW 7007 Bright Ceiling White (Gyp Ceilings and Soffits)
MISCELLANEOUS:

Lobby Accent Panels:

AP-1  Accent Panel - Wood Ceiling Panel, Armstrong ACGI, Suspension System 7, Torsion Spring System, Walnut Veneer with Micro perforated, Species and Stain to match PL-1, Matte finish, 2’x4’ and 2’x8’ Panel sizes, Return trim edges to be PL-1, Metal reveal finish to match Color 101 Champagne of AP-2 (Lobby Accent Ceiling Panels)

AP-2  Accent Panel - Wood Wall Panel, Formica Hardstop panels in PL-1 with Formica trim pieces designed for Hardstop system, 4’x10’ Panels cut to size shown on Interior Elevations (Lobby Accent Wall Panels)

WTR-1  Wall trim, Hardstop Aluminum Trim, AT30 Division Bar, Color 101 Champagne

WTR-2  Wall trim, Hardstop Aluminum Trim, AT40 End Cap, Color 101 Champagne

Door and Trim Paint:

IPS-5A  Semi Gloss Enamel on Hollow Metal and Wood, Sherwin Williams, SW7532 Urban Putty (Door frames & metal doors)

DOORS:

WD-1  Wood Doors, VT Industries or Equal, Plain Sliced White Birch, Ravine Finish RA07

CASEWORK:

PL-1  Plastic Laminate, Formica, 6401 Natural Walnut, Matte Finish, 3mm PVC Edge banding to match, To be approved by Architect (Vertical surface of cabinets)

PL-2  Plastic Laminate, Pionite, AG381 Mineral Talc, 3mm PVC Edge banding to match, To be approved by Architect (Countertop @ sitting work surface height and Countertops with no Sink)

PL-3  Plastic Laminate, Formica, 6401 Natural Walnut (Restroom Apron)

SS-1  Solid Surface, Formica, 603 Natural Concrete (Countertops at all locations with a Sink, Transaction tops)

SS-2 (L-B)  Solid Surface, Formica, Corian, Bone, Model # Accessible 810P (Integral sink)

SS-3  Solid Surface, Formica, Formica, 603 Natural Concrete (windowsills)

SS-4  Solid Surface Shower walls, CS Acrovyn, Macadamia P9046, ¼” thick, 9’h x 3’w panel size for North and South walls, 9’x 4’w size panels for West wall
METAL SUPPORT BRACKETS:

MB-1  Rakks Under Counter Support Brackets, EH1818 or Similar, maximum spacing of 32"center to center Clear Anodized Finish

MB-2  Rakks Inside Wall Flush Mount Support Brackets, EH-1818 (2"x2"x1/4"L-shped vertical leg screwed to inside of the stud), Clear Anodized Finish

FIBER REINFORCED PANEL:

FRP-1  Fiber Reinforced Plastic, Panolam, 090" thick, 4'x8' sheets, White, Pebble Texture, All Seam Treatments and Moldings to be White (Janitor Closet)

SHADES:

RS-1  Roller Shade, Mecho Shade, 5% open, MechoShade Systems Inc, Light Filtering Woven Fabric, Stain and Fade Resistant, PVC- Coated Polyester Shadecloth, Designer Collection, 5407 Caramel Crème

RS-2  Roller Shade, Mecho Shade, Classic Blackout with logo/hours, 0731 Black/White 0% (Pharmacy drive thru only)

RESIN PANEL:

RP-1  Acrylic panel, 3 Form, Varia Ecoresin Whisper, 1/2", front and back sandstone finish, Hardware listed below as H-1 (Partition panels at Pharmacy counter)

RP-2  Acrylic panel, 3 Form, Varia Ecoresin Whisper, 1/2", front and back sandstone finish Hardware listed below as H-2 (Sliding doors)

RP-3  Acrylic panel, 3 Form, Varia Ecoresin, Queue Castaway, gauge, emboss both sides, 1/2" (Children's waiting area)

H-1  Pony Wall hardware: 3-Form Versa Slim System Pony Wall, Vertical end supports: equal Slim One, Top cap: Slim One Cap, Brackets: (2) Side brackets and MB T-Nut per Slim One post, Sized for panel thickness of ½", Bottom Plate: three inch plate for Slim One supports, Plate Covers: Slim One covers, Slot Covers: at all open slots. 2'-6" Height, Hardware finish Stainless

H-2  Frameless wall-mount sliding door with floor guide: 3-Form Slide, Hardware finish Stainless, Simple Spec 01 100.01 Customized (Sliding Doors)

H-3  Single point connector: 3-Form 1” Cap threaded Rod – Not used

H-4  Pony Wall hardware: 3-Form Versa Slim System Pony Wall, Vertical end supports: equal Slim One, Top cap: Slim One Cap, Brackets: (2) Side brackets and MB T-Nut per Slim One post, Sized for panel thickness of ½", Bottom Plate: three inch plate for Slim One supports, Plate Covers: Slim One covers, Slot Covers: at all open slots. Heights vary depending on location 1'-0" Height, Hardware finish Stainless

H-5  Suspension hardware: 3-Form Frameless Suspended Partition, Hardware finish Stainless, SimpleSpec 200.08
PHENOLIC LOCKERS:
LOCKERS  Black core, Face pattern and color shall be selected from manufacturers full color range

HDPE RESTROOM PARTITIONS:
HDPE-1  Solid Plastic Toilet Partitions, Scranton, Bronze Hammered

WALL PROTECTION:
CR-1  Crash Rail, Acrovyn, SCR-64 Surface Mount, color #305 Mushroom (Back Corridors)
CG-2  Corner Guard 2”x2”x6’-6”, - CS Acrovyn, color #305 Mushroom
CG-3  Corner Guard 3”x3” x6’-6”, - CS Acrovyn, color #305 Mushroom
WP -1  Abusive Resistant Wallcovering, Acrovyn, color #305 Mushroom
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APPENDIX B – EXTERIOR MATERIALS KEY

MASONRY:

Brick Masonry: Kansas Brick & Tile (KB&T) 500 Chestnut (Utility size)

*Smooth Face Decorative Concrete Masonry Unit (CMU)* - Northfield Block Company, Cordova Stone, Limestone color, Ground Face Finish

*Smooth Face Decorative CMU sills/watertable* - Northfield Block Company, Cordova Stone, Limestone color, Ground Face Finish, 6” High Window Sill (8648WS) with drip edge, chamfer dimensions X=2” and Y=1”

*Mortar*: Natural Grey

METAL ROOFING SPECIALTIES:

Metal Coping Cap at Decorative CMU: Color equal Valspar Coating 1760 Limestone
Metal Coping Cap at brick: Color to be selectect from manufacturer’s full range

FORMED METAL WALL PANELS:

*MWP-A*: Profile equal to Berridge HS-12, Color equal to Charcoal Grey

STOREFRONT & GLAZING at WINDOW OPENINGS:

Aluminum System: Color equal Kawneer clear anodized aluminum
Glazing: Refer to Glazing Specification

ALUMINUM CANOPY: (Prefabricated Rod Supported Canopy)

Fascia and Underside (ceiling) - Color equal Mapes Clear Anodized Aluminum

ROOFING:

PVC: Color equal Sika Sarnafil Lead Gray
TPO: Field Color: Tan, Demarcation Edge Color: Light Grey

EXTERIOR PAINT:

**EPS-5A** Metal Door Frames & Doors:
Alkyd, Exterior, Semi-Gloss (Gloss Level 5) color to be selected

**EPS-5B** Bollards:
Alkyd, Exterior, Semi-Gloss (Gloss Level 5) color to be selected

**EPS-5C** Columns at the Canopy:
Alkyd, Exterior, Semi-Gloss (Gloss Level 5) color to be selected
EXTERIOR PAINT CONTINUED:

**EPS-5D**
Steel Lintels at masonry openings:
Alkyd, Exterior, Semi-Gloss (Gloss Level 5) color to be selected

**EPS-5E**
Steel Lintels at Limestone openings:
Alkyd, Exterior, Semi-Gloss (Gloss Level 5) color to be selected

**EPS-5F**
Metal components at Dumpster enclosure:
Alkyd, Exterior, Semi-Gloss (Gloss Level 5) color to be selected

**EPS-5G**
Metal components at Roof top unit enclosure
Alkyd, Exterior, Semi-Gloss (Gloss Level 5) color to be selected

**EPS-5H**
Metal components at roof top gas piping
Alkyd, Exterior, Semi-Gloss (Gloss Level 5) color to be selected

SEALANT:

At Brick A: Color equal to Tremco Dymeric Bronze
At Limestone: Color equal to Dow Limestone
At Storefront: Color equal to Percora Anodized Aluminum