USD TRACK AND SOCCER COMPLEX
UNIVERSITY OF SOUTH DAKOTA
Vermillion, SD
OSE# R0612--02X

Concessions & Ticket Booth – Scope of Work Outline

The Subcontractor shall provide all required and necessary labor, materials, equipment, hoisting, tools, transportation, handling, supervision and related services to successfully and satisfactorily execute and complete the Scope of Work identified for the project in accordance with the Drawings, Specifications and other Contract Documents.

All Work required by the Contract Documents within the following specification sections:

DIVISION 00 – PROCUREMENT AND CONTRACTING REQUIREMENTS
DIVISION 01 – GENERAL REQUIREMENTS
SECTION 033000 – CAST-IN-PLACE CONCRETE (as applies to Concessions/Ticket buildings only)
SECTION 054000 – COLD FORMED METAL FRAMING (need to find Load-bearing sections?)
SECTION 061000 – ROUGH CARPENTRY
SECTION 061600 – SHEATHING
SECTION 072500 – WEATHER BARRIERS
SECTION 074213 – FORMED METAL WALL PANELS
SECTION 075323 – ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) ROOFING
SECTION 076200 – SHEET METAL FLASHING AND TRIM
SECTION 079200 – JOINT SEALANTS
SECTION 081113 – HOLLOW METAL DOORS AND FRAMES
SECTION 083313 – COILING COUNTER DOORS
SECTION 087100 – DOOR HARDWARE
SECTION 092600 – GYPSUM BOARD ASSEMBLIES
SECTION 096513 – RESILIENT WALL BASE & ACCESSORIES
SECTION 099113 – EXTERIOR PAINTING
SECTION 099123 – INTERIOR PAINTING
SECTION 099600 – HIGH-PERFORMANCE COATINGS
SECTION 102113 – TOILET COMPARTMENTS
SECTION 102800 – TOILET, BATH, AND LAUNDRY ACCESSORIES
SECTION 123616 – METAL COUNTERTOPS
DIVISION 22 – PLUMBING
DIVISION 23 – MECHANICAL
DIVISION 26 – ELECTRICAL
SECTION 311000 – SITE CLEARING (as applies to Concessions/Pressbox/Ticket buildings only)
Includes Geotechnical Report
SECTION 312000 – EARTH MOVING (as applies to Concessions/Pressbox/Ticket buildings only)

Specific Scope Items and Clarifications:

1. Bidding contractor to provide all construction related to the Concessions and Ticket Booth building structures.

2. Subcontractor shall provide all General Conditions items, including but not limited to: scaffolding, hoisting, personnel lifts, unloading, inventorying, warehousing, material handling, handling equipment, temporary heat, temporary protection, enclosure protection and all safety devices necessary to perform the Work.
3. Contractor to coordinate all Electrical work associated with the Concessions/Pressbox & Ticketing buildings.
4. Contractor access will only be from the North/Northeast side of the Concessions building for the majority of the construction duration.
5. Contractor to specify number of calendar days needed for construction of the work on the stated location on the Bid Form.

SECTION 033000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

1.3 DEFINITIONS

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

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

1.4 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. Design Mixtures shall be certified by a licensed engineer in the state of South Dakota.

1. Indicate amounts of mixing water to be withheld for later addition at Project site.

C. Steel Reinforcement Shop Drawings: Placing Drawings that detail fabrication, bending, and placement. Include bar sizes, lengths, material, 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 and Control Joint Layout: Indicate proposed construction joints required to construct the structure. Submit plan of proposed control joint layout for review.

1. Location of construction and control joints is subject to review of the Architect.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.

B. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.

1. Manufacturer certified according to NRMCA's "Certification of Ready Mixed Concrete Production Facilities."

C. Testing Agency Qualifications: An independent agency, acceptable to authorities having jurisdiction, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

1. Personnel conducting field tests shall be qualified as ACI Concrete Field Testing Technician, Grade 1, according to ACI CP-1 or an equivalent certification program.

D. Welding Qualifications: Qualify procedures and personnel according to AWS D1.4/D 1.4M.

1.6 PRECONSTRUCTION TESTING

A. Preconstruction Testing Service: Engage a qualified testing agency to perform preconstruction testing on concrete mixtures.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Steel Reinforcement: Deliver, store, and handle steel reinforcement to prevent bending and damage.

1.8 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 (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301 (ACI 301M).
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 (ACI 301M) and as follows:

1. 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 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 (ACI 301M).
2. ACI 117 (ACI 117M).

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. Exterior-grade plywood panels, suitable for concrete forms, complying with DOC PS 1, and as follows:
   a. Structural 1, B-B or better; mill oiled and edge sealed.

B. Forms for Cylindrical Columns, Pedestals, and Supports: Metal, glass-fiber-reinforced plastic, paper, or fiber tubes that produce surfaces with gradual or abrupt irregularities not exceeding specified formwork surface class. Provide units with sufficient wall thickness to resist plastic concrete loads without detrimental deformation.

C. Void Forms: Biodegradable paper surface, treated for moisture resistance, structurally sufficient to support weight of plastic concrete and other superimposed loads.

D. Chamfer Strips: Wood, metal, PVC, or rubber strips, 3/4 by 3/4 inch (19 by 19 mm), minimum.

E. Form-Release Agent: Commercially formulated form-release agent that does not bond with, stain, or adversely affect concrete surfaces and does not impair subsequent treatments of concrete surfaces.

1. Formulate form-release agent with rust inhibitor for steel form-facing materials.

F. Form Ties: Factory-fabricated, removable or snap-off glass-fiber-reinforced plastic or metal form ties designed to resist lateral pressure of fresh concrete on forms and to prevent spalling of concrete on removal.

1. Furnish units that leave no corrodible metal closer than 1 inch (25 mm) to the plane of exposed concrete surface.
2. Furnish ties that, when removed, leave holes no larger than 1 inch (25 mm) in diameter in concrete surface.
3. Furnish ties with integral water-barrier plates to walls indicated to receive dampproofing or waterproofing.

2.3 STEEL REINFORCEMENT

A. Reinforcing Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), deformed.

B. Weldable Reinforcing Bars: ASTM A 706, Grade 60 (Grade 420), deformed.

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

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

2.4 REINFORCEMENT ACCESSORIES

A. Joint Dowel Bars: ASTM A 615/A 615M, Grade 60 (Grade 420), 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.

2.5 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:

1. Portland Cement: ASTM C 150/C 150M, Type I/II, gray.
2. Fly Ash: ASTM C 618, Class F or C.

C. Normal-Weight Aggregates: ASTM C 33/C 33M, Class 5S coarse aggregate or better, graded. Provide aggregates from a single source with documented service record data of at least 10 years' satisfactory service in similar applications and service conditions using similar aggregates and cementitious materials.

1. Maximum Coarse-Aggregate Size: 1-1/2 inches (38 mm) nominal.
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 and potable.

2.6 VAPOR RETARDERS

A. Sheet Vapor Retarder: ASTM E 1745, Class A. Include manufacturer's recommended adhesive or pressure-sensitive tape.

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. Flatiron Films; Iron Barr; 15mil, Class A.
b. Stego Industries, LLC; Stego Wrap; 15 mil, Class A.
c. Ardex Inc.: Greenblock; 15 mil, Class A.
d. Raven Industries Inc.; Vapor Block; 15 mil, Class A.

2.7 CURING MATERIALS

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

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. DaytonSuperior.
b. EuclidChemicalCompany(The);anRPMcompany.
c. SikaCorporation.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.

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

D. Water: Potable.

2.8 RELATED MATERIALS

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1752, cork or self-expanding cork.

B. Semirigid Joint Filler: Two-component, semirigid, 100 percent solids, aromatic polyurea with a Type A shore durometer hardness range of 90 to 95 according to ASTM D 2240.

C. Epoxy Bonding Adhesive: ASTM C 881, two-component epoxy resin, capable of humid curing

and bonding to damp surfaces, of class suitable for application temperature and of grade to suit requirements, and as follows:

1. Types IV and V, load bearing, for bonding hardened or freshly mixed concrete to hardened concrete.

2.9 CONCRETE MIXTURES, GENERAL

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301 (ACI 301M).

1. Use a qualified independent testing agency for preparing and reporting proposed mixture designs based on laboratory trial mixtures. Design mixtures shall be certified by a licensed engineer in the state of South Dakota

B. Cementitious Materials: Limit percentage, by weight, of cementitious materials other than portland cement in concrete as follows:

1. Fly Ash: 15 percent.

C. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 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 -retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a w/c ratio below 0.50.

2.10 CONCRETE MIXTURES FOR BUILDING ELEMENTS

A. Footings: Normal-weight concrete.

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 4 inches (100 mm) or 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or plasticizing admixture, plus or minus 1 inch (25 mm).
4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) 3/4-inch (19-mm) nominal maximum aggregate size.

B. Foundation Walls: Normal-weight concrete.

1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Slump Limit: 4 inches (100 mm) or 8 inches (200 mm) for concrete with verified slump of 2 to 4 inches (50 to 100 mm) before adding high-range water-reducing admixture or

plasticizing admixture, plus or minus 1 inch (25 mm).

4. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.

5. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

C. Slabs-on-Grade: Normal-weight concrete.

1. Minimum Compressive Strength: 3500 psi (24.1 MPa) at 28 days.
2. Maximum W/C Ratio: 0.45.
3. Minimum Cementitious Materials Content: 470 lb/cu. yd. (279 kg/cu. m).
4. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
5. Air Content: 5.5 percent, plus or minus 1.5 percent at point of delivery for 1-1/2-inch (38-mm) nominal maximum aggregate size.
6. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.
7. Air Content: Do not allow air content of trowel-finished floors to exceed 3 percent.

2.11 FABRICATING REINFORCEMENT

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

2.12 CONCRETE MIXING

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94/C 94M and ASTM C 1116/C 1116M, and furnish batch ticket information.

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 FORMWORK INSTALLATION

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301 (ACI 301M), 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 (ACI 117M).

C. Limit concrete surface irregularities, designated by ACI 347 as abrupt or gradual, as follows:

1. Class A, 1/8 inch (3.2 mm) for smooth-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.
2. Install reglets to receive waterproofing and to receive through-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, shelf angles, and other conditions.
3. Install dovetail anchor slots in concrete structures as indicated.

3.3 REMOVING AND REUSING FORMS

A. General: Formwork for sides of beams, walls, columns, and similar parts of the Work that does not support weight of concrete may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for 48 hours after placing concrete. Concrete has to be hard enough to not be damaged by form-removal operations, and curing and protection operations need to be maintained.

1. Leave formwork for beam soffits, joists, slabs, and other structural elements that support weight of concrete in place until concrete has achieved at least 80 percent of its 28-day design compressive strength.
2. Remove forms only if shores have been arranged to permit removal of forms without loosening or disturbing shores.

B. Clean and repair surfaces of forms to be reused in the Work. Split, frayed, delaminated, or otherwise damaged form-facing material are not acceptable for exposed surfaces. Apply new form-release agent.

C. When forms are reused, clean surfaces, remove fins and laitance, and tighten to close joints. Align and secure joints to avoid offsets. Do not use patched forms for exposed concrete surfaces unless approved by Architect.

3.4 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 (150 mm) and seal with manufacturer's recommended tape.

3.5 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.

1. Weld reinforcing bars according to AWS D1.4/D 1.4M, where indicated.

D. Set wire ties with ends directed into concrete, not toward exposed concrete surfaces.

E. Install welded-wire reinforcement in longest practicable lengths on bar supports spaced to minimize sagging. Lap edges and ends of adjoining sheets at least one mesh spacing. Offset laps of adjoining sheet widths to prevent continuous laps in either direction. Lace overlaps with wire.

3.6 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. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.

3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
6. Use epoxy-bonding adhesive 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-third 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- (3.2-mm-) 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. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 079200 "Joint Sealants," are indicated.
3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.

E. Doweled Joints: 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.

3.7 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.

C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301 (ACI 301M).

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

D. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete is placed on concrete that has hardened enough to cause seams or planes of weakness. 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 (ACI 301M).
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 (150 mm) 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.

E. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.

1. Consolidate concrete during placement operations, so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
2. Maintain reinforcement in position on chairs during concrete placement.
3. Screed slab surfaces with a straightedge and strike off to correct elevations.
4. Slope surfaces uniformly to drains where required.
5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleedwater appears on the surface. Do not further disturb slab surfaces before starting finishing operations.

3.8 FINISHING FORMED SURFACES

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view, or to be covered with a coating or covering material applied directly to concrete.

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

3.9 FINISHING FLOORS AND SLABS

A. General: Comply with ACI 302.1R recommendations for screeding, 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 (6 mm) in one direction.

1. Apply scratch finish to surfaces to receive concrete floor toppings or to receive mortar setting beds for bonded cementitious floor finishes.

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 indicated to receive trowel finish.

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 scheduled to remain exposed to view or to be covered with resilient flooring, carpet, ceramic or quarry tile set over a cleavage membrane, paint, or another thin-film-finish coating system.

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

a. Specified overall values of flatness, F(F) 35; and of levelness, F(L) 25, unless specified otherwise.

b. Concrete surface tolerance shall be no greater than 1/8-inch in any direction for a distance of 10 feet; non-cumulative.

E. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces where ceramic or quarry tile is to be installed by either thickset or thin-set 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, sidewalks, curbs & gutter, 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.

3.10 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. Equipment Bases and Foundations:

1. Coordinate sizes and locations of concrete bases with actual equipment provided.
2. Construct concrete bases 4 inches ((100 mm)) high unless otherwise indicated, and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
3. Minimum Compressive Strength: 3500 psi (24.1 MPa) at 28 days.
4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. For supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete substrate.
6. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
7. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.11 CONCRETE PROTECTING AND CURING

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 (ACI 301M) 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 (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.

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 (300-mm) lap over adjacent absorptive covers.

2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), 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.

F. Concrete Protection: Fully protect all concrete floor slabs indicated to remain exposed to view. Cover exposed floors with drop cloths, plywood panels or other coverings to prevent damage from tools, equipment and construction activities. Where necessary, utilize polyethylene sheeting to prevent staining caused by spills, leaks and overspray.

3.12 FLOOR SEALER

A. Floor Sealers: Seal all concrete floors scheduled to remain exposed to view (SCONC).

1. The Contractor shall remove oil, dirt, laitance, and other contaminants and complete surface repairs prior to application of floor sealer; leave substrates ready to accept floor sealer products.

2. Do not apply sealers to concrete that is less than 28 days' old.

3. Notify Architect not less than 48 hours prior to the application of final coat of floor sealer. Concrete floors must clean and free of markings, spills, stains and other blemishes before application of final floor sealer. Floor sealer should not be applied without Architect’s review and approval of concrete conditions.

3.13 JOINT FILLING

A. Prepare, clean, and install joint filler according to manufacturer's written instructions.

1. Defer joint filling until concrete has aged at least six month(s). Do not fill joints until construction traffic has permanently ceased.

B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joints clean and dry.

C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.14 CONCRETE SURFACE REPAIRS

A. Defective Concrete: Repair and patch defective areas when approved by Architect. Remove and replace concrete that cannot be repaired and patched to Architect's approval.

B. Patching Mortar: Mix dry-pack patching mortar, consisting of 1 part portland cement to 2-1/2 parts fine aggregate passing a No. 16 (1.18-mm) sieve, using only enough water for handling and placing.

C. Repairing Formed Surfaces: Surface defects include color and texture irregularities, cracks, spalls, air bubbles, honeycombs, rock pockets, fins and other projections on the surface, and stains and other discolorations that cannot be removed by cleaning.

1. Immediately after form removal, cut out honeycombs, rock pockets, and voids more than 1/2 inch (13 mm) in any dimension to solid concrete. Limit cut depth to 3/4 inch (19 mm). Make edges of cuts perpendicular to concrete surface. Clean, dampen with water, and brush-coat holes and voids with bonding agent. Fill and compact with patching mortar before bonding agent has dried. Fill form-tie voids with patching mortar or cone plugs secured in place with bonding agent.
2. Repair defects on surfaces exposed to view by blending white portland cement and standard portland cement so that, when dry, patching mortar matches surrounding color. Patch a test area at inconspicuous locations to verify mixture and color match before proceeding with patching. Compact mortar in place and strike off slightly higher than surrounding surface.
3. Repair defects on concealed formed surfaces that affect concrete's durability and structural performance as determined by Architect.

D. Repairing Unformed Surfaces: Test unformed surfaces, such as floors and slabs, for finish and verify surface tolerances specified for each surface. Correct low and high areas. Test surfaces sloped to drain for trueness of slope and smoothness; use a sloped template.

1. Repair finished surfaces containing defects. Surface defects include spalls, popouts, honeycombs, rock pockets, crazing and cracks in excess of 0.01 inch (0.25 mm) wide or that penetrate to reinforcement or completely through unreinforced sections regardless of width, and other objectionable conditions.
2. After concrete has cured at least 14 days, correct high areas by grinding.
3. Correct localized low areas during or immediately after completing surface finishing operations by cutting out low areas and replacing with patching mortar. Finish repaired areas to blend into adjacent concrete.
4. Correct other low areas scheduled to receive floor coverings with a repair underlayment. Prepare, mix, and apply repair underlayment and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface. Feather edges to match adjacent floor elevations.
5. Correct other low areas scheduled to remain exposed with a repair topping. Cut out low areas to ensure a minimum repair topping depth of 1/4 inch (6 mm) to match adjacent floor elevations. Prepare, mix, and apply repair topping and primer according to manufacturer's written instructions to produce a smooth, uniform, plane, and level surface.
6. Repair defective areas, except random cracks and single holes 1 inch (25 mm) or less in diameter, by cutting out and replacing with fresh concrete. Remove defective areas with clean, square cuts and expose steel reinforcement with at least a 3/4-inch (19-mm) clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding agent. Mix patching concrete of same materials and mixture as original concrete, except without coarse aggregate. Place, compact, and finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.
7. Repair random cracks and single holes 1 inch (25 mm) or less in diameter with patching mortar. Groove top of cracks and cut out holes to sound concrete and clean off dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding agent. Place patching mortar before bonding agent has dried. Compact patching mortar and finish to match adjacent concrete. Keep patched area continuously moist for at least 72 hours.

E. Perform structural repairs of concrete, subject to Architect's approval, using epoxy adhesive and patching mortar.

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

3.15 FIELD QUALITY CONTROL

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

B. Testing Agency: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.

C. Inspections:

1. Steel reinforcement placement.
2. Steel reinforcement welding.
3. Headed bolts and studs.
4. Verification of use of required design mixture.
5. Concrete placement, including conveying and depositing.
6. Curing procedures and maintenance of curing temperature.
7. Verification of concrete strength before removal of shores and forms from beams and slabs.

D. 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 one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd. (4 cu. m), but less than 25 cu. yd. (19 cu. m), plus one set for each additional 50 cu. yd. (38 cu. m) or fraction thereof.
2. Testing Frequency: Obtain at least one composite sample for each 100 cu. yd. (76 cu. m) 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.

3. 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.
4. 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.
5. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F (4.4 deg C) and below or 80 deg F (27 deg C) and above, and one test for each composite sample.
6. Unit Weight: ASTM C 567/C 567M, fresh unit weight of structural lightweight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
7. Compression Test Specimens: ASTM C 31/C 31M.

    a. Cast and laboratory cure two sets of two standard cylinder specimens for each composite sample.

8. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of two laboratory-cured specimens at 7 days and one set of two specimens at 28 days.
    a. A compressive-strength test shall be the average compressive strength from a set of

two specimens obtained from same composite sample and tested at age indicated.

9. 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 (3.4 MPa).
10. 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.
11. 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.
12. 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.
13. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
14. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.16 PROTECTION OF LIQUID FLOOR TREATMENTS

A. Protect liquid floor treatment from damage and wear during the remainder of construction period. Use protective methods and materials, including temporary covering, recommended in writing by liquid floor treatments installer.

END OF SECTION 033000

SECTION 054000 - COLD-FORMED METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

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

1.3 REFERENCES

A. AISI – North American Specification for the Design of Cold-Formed Steel Structural Members.

B. AWS D1.1 – Structural Welding Code - Steel.

C. AWS D1.3 – Structural Welding Code – Sheet Steel

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional specialty structural engineer, as defined in Section 014000 “Quality Requirements,” to design cold-formed-steel framing, prepare calculations, and coordinate Shop Drawings with the calculations.

B. Cold-Formed Steel Framing Design Standards:

1. Wall Studs: AISI S211. Provide minimum 16Ga stud and track thickness for exterior walls and soffitsHeaders: AISI S212.
2. Lateral Design: AISI S213.

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

D. Fire-Resistance Ratings: Comply with ASTM E 119; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

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

1.5 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM E 329 for testing indicated.

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

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

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 Building Systems.
2. Marino\WARE.
3. Steel Network, Inc. (The).

2.2 COLD-FORMED STEEL FRAMING, GENERAL

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

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

1. Grade: ST50H (ST340H).
2. Coating: G60 (Z180), A60 (ZF180), AZ50 (AZ150), or GF30 (ZGF90).

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

1. Grade: 50 (340), Class 1.
2. Coating: G60 (Z180).

2.3 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: 0.0598 inch (1.52 mm).
2. Min. Flange Width: 1-5/8 inches (41 mm).

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. Min. Flange Width: 1-1/4 inches (32 mm).

C. Vertical Deflection Clips: Manufacturer's standard bypass and head 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: 0.0966 inch (2.45 mm).
2. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

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: 0.0966 inch (2.45 mm).
b. Flange Width: 1 inch (25 mm) plus the design gap for one-story structures and 1 inch (25 mm) plus twice the design gap for other applications.

2. Inner Track: Of web depth indicated, and as follows:

a. Minimum Base-Metal Thickness: 0.0966 inch (2.45 mm).

F. Drift Clips: Manufacturer's standard bypass or head clips, capable of isolating wall stud from upward and downward vertical displacement and lateral drift of primary structure through positive mechanical attachment to stud web and structure.

2.4 SOFFIT FRAMING

A. Exterior Soffit Frame: Manufacturer's standard C-shaped steel sections, of web depths indicated, with stiffened flanges, and as follows:

1. Minimum Base-Metal Thickness: 0.0598 inch (1.52 mm).
2. Flange Width: 1-5/8 inches (41 mm), minimum.

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.
6. Foundation clips.
7. Gusset plates.
8. Stud kickers and knee braces.
9. Joist hangers and end closures.
10. Hole reinforcing plates.
11. Backer plates.

2.6 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 or ASTM A 780.

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 (6.4 mm) 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 (1:960) and as follows:

1. Spacing: Space individual framing members no more than plus or minus 1/8 inch (3 mm) 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 (3 mm).

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine supporting substrates and abutting structural framing for compliance with

requirements for installation tolerances and other conditions affecting performance of the Work.

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

3.2 PREPARATION

A. Install load bearing shims or grout between the underside of load-bearing wall bottom track and the top of foundation wall or slab at locations with a gap larger than 1/4 inch (6 mm) to ensure a uniform bearing surface on supporting concrete or masonry construction.

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

3.3 INSTALLATION, GENERAL

A. Cold-formed steel framing may be shop or field fabricated for installation, or it may be field assembled.

B. Install cold-formed steel framing according to AISI S200, and to manufacturer's written instructions unless more stringent requirements are indicated.

C. Install shop- or field-fabricated, cold-formed framing and securely anchor to supporting structure.

1. Screw, bolt, or weld wall panels at horizontal and vertical junctures to produce flush, even, true-to-line joints with maximum variation in plane and true position between fabricated panels not exceeding 1/16 inch (1.6 mm).

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. Do not bridge building expansion joints with cold-formed steel framing. Independently frame

both sides of joints.

H. Install insulation, specified in Section 072100 "Thermal Insulation," in built-up exterior framing members, such as headers, sills, boxed joists, and multiple studs at openings, that are inaccessible on completion of framing work.

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

J. Erection Tolerances: Install cold-formed steel framing level, plumb, and true to line to a maximum allowable tolerance variation of 1/8 inch in 10 feet (1:960) and as follows:

1. Space individual framing members no more than plus or minus 1/8 inch (3 mm) from plan location. Cumulative error shall not exceed minimum fastening requirements of sheathing or other finishing materials.

3.4 EXTERIOR NON-LOAD-BEARING WALL INSTALLATION

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

B. Fasten both flanges of studs to top and bottom track unless otherwise indicated. Space studs as follows:

1. Stud Spacing: 16 inches (406 mm) max.

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 or infill studs and anchor to building structure.
4. Connect drift clips to cold-formed metal framing 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 (1220 mm) apart. Fasten at each stud intersection.

1. Top Bridging for Single Deflection Track: Install row of horizontal bridging within 12 inches (305 mm) of single deflection track. Install a combination of bridging and stud or stud-track solid blocking of width and thickness matching studs, secured to stud webs or flanges.

a. Install solid blocking at centers indicated on Shop Drawings.

2. Bridging: Cold-rolled steel channel, welded or mechanically fastened to webs of punched studs.

3. Bridging: Combination of flat, taut, steel sheet straps of width and thickness indicated and stud-track solid blocking of width and thickness to match studs. Fasten flat straps to stud flanges and secure solid blocking to stud webs or flanges.

F. Install miscellaneous framing and connections, including stud kickers, web stiffeners, clip angles, continuous angles, anchors, and fasteners, to provide a complete and stable wall-framing system.

3.5 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 054000

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Wood blocking, cants, and nailers.
2. Plywood backing panels.

1.3 DEFINITIONS

A. Rough Carpentry: Carpentry work not specified in other Sections and not exposed, unless otherwise indicated.

B. Lumber grading agencies, and the abbreviations used to reference them, include the following:

1. NLGA - National Lumber Grades Authority.
2. SPIB - Southern Pine Inspection Bureau.
3. WCLIB - West Coast Lumber Inspection Bureau.
4. WWPA - Western Wood Products Association.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

A. Lumber: DOC PS 20 and applicable rules of lumber grading agencies certified by the American Lumber Standards Committee Board of Review.

1. Factory mark each piece of lumber with grade stamp of grading agency.
2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
3. Provide dressed lumber, S4S, unless otherwise indicated.
4. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2-inch nominal (38-mm actual) thickness or less, unless otherwise indicated.

B. Wood Structural Panels:

1. Plywood: Either DOC PS 1 or DOC PS 2, unless otherwise indicated.
2. Thickness: As needed to comply with requirements specified but not less than thickness indicated.
3. Comply with "Code Plus" provisions in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial."
4. Factory mark panels according to indicated standard.

2.2 WOOD-PRESERVATIVE-TREATED MATERIALS

A. Preservative Treatment by Pressure Process: AWPA C2 (lumber) and AWPA C9 (plywood), except that lumber that is not in contact with the ground and is continuously protected from liquid water may be treated according to AWPA C31 with inorganic boron (SBX).

1. Preservative Chemicals: Acceptable to authorities having jurisdiction:

a. Chromated copper arsenate (CCA).

B. Kiln-dry material after treatment to a maximum moisture content of 19 percent for lumber and 15 percent for plywood. Do not use material that is warped or does not comply with requirements for untreated material.

C. Mark each treated item with the treatment quality mark of an inspection agency approved by the American Lumber Standards Committee Board of Review.

D. Application: Treat items indicated on Drawings, and the following:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.

2.3 MISCELLANEOUS LUMBER

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

1. Blocking.
2. Cants.
3. Nailers.

B. For items of dimension lumber size, provide Construction, Stud, or No. 2 grade lumber with 19 percent maximum moisture content and the following species:

1. Hem-fir or Hem-fir (north); NLGA, WCLIB, or WWPA.

C. For concealed boards, provide lumber with 19 percent maximum moisture content and the following species and grades:

1. Mixed southern pine, No. 2 grade; SPIB.

2.4 PLYWOOD BACKING PANELS

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

2.5 FASTENERS

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

1. Where rough carpentry is exposed to weather, in ground contact, or in area of high relative humidity, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M of Type 304 stainless steel.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: CABO NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

F. Lag Bolts: ASME B18.2.1. (ASME B18.2.3.8M).

G. Bolts: Steel bolts complying with ASTM A 307, Grade A (ASTM F 568M, Property Class 4.6); with ASTM A 563 (ASTM A 563M) hex nuts and, where indicated, flat washers.

H. Expansion Anchors: Anchor bolt and sleeve assembly of material indicated below with capability to sustain, without failure, a load equal to 6 times the load imposed when installed in unit masonry assemblies and equal to 4 times the load imposed when installed in concrete as determined by testing per ASTM E 488 conducted by a qualified independent testing and inspecting agency.

1. Material: Carbon-steel components, zinc plated to comply with ASTM B 633, Class Fe/Zn 5.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

A. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry to other construction; scribe and cope as needed for accurate fit. Locate nailers, blocking, and similar supports to comply with requirements for attaching other construction.

B. Do not use materials with defects that impair quality of rough carpentry or pieces that are too small to use with minimum number of joints or optimum joint arrangement.

C. Apply field treatment complying with AWPA M4 to cut surfaces of preservative-treated lumber and plywood.

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

1. CABO NER-272 for power-driven fasteners.
2. Table 23-II-B-1, "Nailing Schedule," and Table 23-II-B-2, "Wood Structural Panel Roof Sheathing Nailing Schedule," in the Uniform Building Code.

E. Use common wire nails, unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood; predrill as required.

F. Use finishing nails for exposed work, unless otherwise indicated. Countersink nail heads and fill holes with wood filler.

3.2 WOOD SLEEPER, 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. Build anchor bolts into masonry during installation of masonry work. Where possible, secure anchor bolts to formwork before concrete placement.

3.3 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations contained in APA Form No. E30K, "APA Design/Construction Guide: Residential & Commercial," for types of structural-use panels and applications indicated.

1. Comply with "Code Plus" provisions in above-referenced guide.

B. Fastening Methods: Fasten panels as indicated below:

1. Sheathing:

a. Screw to cold-formed metal framing.
b. Space panels 1/8 inch (3 mm) apart at edges and ends.

2. Plywood Backing Panels: Screw to supports.

END OF SECTION 061000

SECTION 061600 - SHEATHING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Wall sheathing.
2. Roof sheathing.
3. Subflooring.
4. Underlayment.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 WOOD PANEL PRODUCTS

A. Plywood: Either DOC PS 1 or DOC PS 2 unless otherwise indicated.

B. Oriented Strand Board: DOC PS 2.

C. Thickness: As needed to comply with requirements specified, but not less than thickness indicated.

D. Factory mark panels to indicate compliance with applicable standard.

2.2 PRESERVATIVE-TREATED PLYWOOD

A. Preservative Treatment by Pressure Process: AWPA U1; Use Category UC2 for interior construction not in contact with the ground, Use Category UC3b for exterior construction not in contact with the ground, and Use Category UC4a for items in contact with the ground.

1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium.

B. Mark plywood with appropriate classification marking of an inspection agency acceptable to authorities having jurisdiction.

C. Application: Treat all plywood unless otherwise indicated Treat items indicated on Drawings and plywood in contact with masonry or concrete or used with roofing, flashing, vapor barriers, and waterproofing.

2.3 WALL SHEATHING

A. Plywood Wall Sheathing: Exterior, Structural I sheathing.

1. Nominal Thickness: Not less than 1/2 inch (13 mm).

2.4 ROOF SHEATHING

A. Plywood Roof Sheathing: Exterior, Structural I sheathing.

1. Nominal Thickness: Not less than 5/8 inch at pitched roofs; 3/4 inch (19.5 mm) at flat roofs.

2.5 SUBFLOORING AND UNDERLAYMENT

A. Plywood Subflooring: Exterior, Structural I single-floor panels or sheathing.

1. Nominal Thickness: Not less than 3/4 inch (19.5 mm). Tongue and groove.

2.6 FASTENERS

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

1. For roof and wall sheathing, provide fasteners with hot-dip zinc coating complying with ASTM A 153/A 153M of Type 304 stainless steel.

2. Fasteners at preservative treated lumber shall be appropriately resistant to the treated lumber and must comply with the recommendations of the fastener manufacturer and the wood preservative treatment supplier. Fasteners may need to be triple hot dip galvanized or stainless steel confirm with fastener manufacturer and pressure treated wood supplier and manufacturer.

B. Nails, Brads, and Staples: ASTM F 1667.

C. Power-Driven Fasteners: NES NER-272.

D. Wood Screws: ASME B18.6.1.

E. Screws for Fastening Wood Structural Panels to Cold-Formed Metal Framing: ASTM C 954, except with wafer heads and reamer wings, length as recommended by screw manufacturer for material being fastened.

1. For wall and roof sheathing panels, provide screws with organic-polymer or other corrosion-protective coating having a salt-spray resistance of more than 800 hours according to ASTM B 117.

2.7 MISCELLANEOUS MATERIALS

A. Adhesives for Field Gluing Panels to Framing: Formulation complying with APA AFG-01 ASTM D 3498 that is approved for use with type of construction panel indicated by manufacturers of both adhesives and panels.

1. Adhesives shall have a VOC content of 70 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

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

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

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

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

D. Use common wire nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections. Install fasteners without splitting wood.

E. Coordinate wall and roof 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.

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

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

3.2 WOOD STRUCTURAL PANEL INSTALLATION

A. General: Comply with applicable recommendations in APA Form No. E30, "Engineered Wood Construction Guide," for types of structural-use panels and applications indicated.

B. Fastening Methods: Fasten panels as indicated below:

1. Combination Subfloor-Underlayment:

a. Glue and screw to wood framing.
b. Space panels 1/8 inch (3 mm) apart at edges and ends.

2. Subflooring:

a. Glue and screw to wood framing.
b. Space panels 1/8 inch (3 mm) apart at edges and ends.

3. Wall and Roof Sheathing:

a. Screw to wood framing. Apply a continuous bead of glue to framing members at edges of wall sheathing panels.
b. Space panels 1/8 inch (3 mm) apart at edges and ends.

4. Underlayment:

a. Screw to subflooring.
b. Space panels 1/32 inch (0.8 mm) apart at edges and ends.
c. Fill and sand edge joints of underlayment receiving resilient flooring immediately before installing flooring.

END OF SECTION 061600

SECTION 072500 - WEATHER BARRIERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Building wrap.
2. Flexible flashing.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For building wrap, include data on air and water-vapor permeance based on testing according to referenced standards.

1.4 WARRANTY

A. Warranty: Provide manufacturer's standard weather barrier warranty covering both products and labor weather barrier.

1. Special weather-barrier manufacturer's warranty for weather barrier for a period of ten 10 years from date of Substantial Completion.

a. Additional requirements, including pre-installation meetings and jobsite observations by weather barrier manufacturer, shall be required to achieve specified warranty coverage.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Installer shall have experience with installation of commercial weather barrier assemblies under similar conditions.

1. Installation shall be in accordance with weather barrier manufacturer's installation guidelines and recommendations.

B. Source Limitations: Provide commercial weather barrier and accessory materials produced by single manufacturer.

1.6 DELIVERY, STORAGE AND HANDLING

A. Deliver weather barrier materials and components in manufacturer's original, unopened, undamaged containers with identification labels intact. Store weather barrier materials as recommended by weather barrier manufacturer.

1.7 COORDINATION

A. Review requirements for sequencing of installation of weather barrier assembly with installation of windows, doors, louvers and flashings to provide a weather-tight barrier assembly.

B. Schedule installation of weather barrier materials and exterior cladding within 9 months of weather barrier assembly installation.

PART 2 - PRODUCTS

2.1 WATER-RESISTIVE BARRIER

A. Building Wrap: ASTM E 1677, Type I air barrier; with flame-spread and smoke-developed indexes of less than 10 and 10, respectively, when tested according to ASTM E 84; UV stabilized; and acceptable to authorities having jurisdiction.

1. Basis-of-Design Product: DuPont (E. I. du Pont de Nemours and Company); Tyvek Commercial Wrap.

2. Water Penetration Resistance: Minimum 280 cm when tested in accordance with AATCC Test Method 127.
3. Water Vapor Transmission: 28 perms, when tested in accordance with ASTM E96, Method B
4. Air Penetration: 0.001 cfm/ft^2 at 75 Pa, when tested in accordance with ASTM E2178. Type I per ASTM E1677. $\leq$0.04 cfm/ft^2 at 75 Pa, when tested in accordance with ASTM E2357.
5. Allowable UV Exposure Time: Not less than three months.

B. Building-Wrap Tape: Pressure-sensitive plastic tape recommended and approved for use by building-wrap manufacturer for sealing joints and penetrations in building wrap.

2.2 MISCELLANEOUS MATERIALS

A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable, butyl rubber compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.030 inch (0.8 mm). Flexible flashings shall be recommended and approved for use by building-wrap manufacturer.

B. Primer for Flexible Flashing: Product recommended by manufacturer of flexible flashing for substrate.

C. Fasteners:

1. Fasteners for Steel Framed Construction: As recommended in writing by manufacturer; 1-5/8 inch rust resistant screw with 2-inch diameter plastic cap or manufacturer approved 1-1/4" or 2" metal gasketed washer.

PART 3 - EXECUTION

3.1 WATER-RESISTIVE BARRIER INSTALLATION

A. Installation, General: Comply with manufacturers written installation instructions to ensure weatherization warranty coverage, as specified.

B. Cover exposed exterior surface of sheathing with water-resistive barrier securely fastened to framing immediately after sheathing is installed.

C. Cover sheathing with water-resistive barrier as follows:

1. Cut back barrier 1/2 inch (13 mm) on each side of the break in supporting members at expansion- or control-joint locations.

2. Apply barrier to cover vertical flashing with a minimum 4-inch (100-mm) overlap unless otherwise indicated.

D. Building Wrap: Comply with manufacturer's written instructions.

1. Seal seams, edges, fasteners, and penetrations with tape.
2. Extend into jambs of openings and seal corners with tape.
3. Overlaps:

   a. Exterior corners: 12 inches, minimum.
   b. Seams: 6 inches, minimum.

4. Attach weather barrier to studs through exterior sheathing. Secure using weather barrier manufacturer recommended fasteners, space 12 -18 inches vertically on center along stud line, and 24 inch on center, maximum horizontally.

5. Seaming: Seal seams of weather barrier with seam tape at all vertical and horizontal overlapping seams. Seal any tears or cuts as recommended by weather barrier manufacturer.

3.2 FLEXIBLE FLASHING INSTALLATION

A. Apply flexible flashing where indicated to comply with manufacturer's written instructions.

1. Prime substrates as recommended by flashing manufacturer.
2. Lap seams and junctures with other materials at least 4 inches (100 mm) except that at flashing flanges of other construction, laps need not exceed flange width.
3. Lap flashing over water-resistive barrier at bottom and sides of openings.
4. Lap water-resistive barrier over flashing at heads of openings.
5. After flashing has been applied, roll surfaces with a hard rubber or metal roller to ensure that flashing is completely adhered to substrates.

END OF SECTION 072500

SECTION 074213 - FORMED METAL WALL PANELS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Preformed, prefinished metal wall system.
2. Preformed, prefinished soffit panels.

1.3 ACTION SUBMITTALS

A. 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.

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

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

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For metal panels to include in maintenance manuals.

1.5 QUALITY ASSURANCE

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

B. Sheet Metal Industry Standard: Comply with Sheet Metal and Air Conditioning Contractors National Association (SMACNA) Architectural Sheet Metal Manual.

1.6 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.

1.7 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.

B. Air Infiltration: Air leakage of not more than 0.06 cfm/sq. ft. (0.3 L/s per sq. m) when tested according to ASTM E 283 at the following test-pressure difference:

1. Test-Pressure Difference: 1.57 lbf/sq. ft. (75 Pa).

C. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 331 at the following test-pressure difference:

1. Test-Pressure Difference: 2.86 lbf/sq. ft. (137 Pa).

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 (67 deg C), ambient; 180 deg F (100 deg C), 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 in side laps. Include accessories required for weathertight installation.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Flush Wall Panel by Petersen Aluminum Corporation.

2. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

   a. Nominal Thickness: 22 Ga.
   b. Exterior Finish: Two-coat fluoropolymer
   c. Color: To match Cardinal Red.

3. Panel Coverage: 12 inch.
4. Panel Height: 1.0 inch (25 mm).
5. Soffit panel to be 750 Soffit System by Petersen Aluminum Corporation or comparable product.
   a. Color of soffit system to match wall panel.

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 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) 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- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, bases, drips, sills, jambs, corners, endwalls, 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.

1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
2. Joint Sealant: ASTM 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.
3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

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. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.

C. 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.

D. 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.

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. Locate and space exposed fasteners in uniform vertical and horizontal alignment. Use proper tools to obtain controlled uniform compression for positive seal without rupture of washer.
4. 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.
5. Flash and seal panels with weather closures at perimeter of all openings.

E. Watertight Installation:

1. Apply a continuous ribbon of sealant or tape to seal lapped joints of metal panels, using sealant or tape as recommend by manufacturer on side laps of nesting-type panels; and elsewhere as needed to make panels watertight.
2. Provide sealant or tape between panels and protruding equipment, vents, and accessories.
3. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.

F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.

1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal wall panel manufacturer; or, if not indicated, provide types recommended by metal panel manufacturer.

G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that 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 (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) 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. Remove and replace metal wall panels where tests and inspections indicate that they do not comply with specified requirements.

C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.

D. 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 074213

SECTION 075323 - ETHYLENE-PROPYLENE-DIENE-MONOMER (EPDM) 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 ethylene-propylene-diene-monomer (EPDM) roofing system.

1.3 DEFINITIONS

A. Roofing Terminology: Definitions in ASTM D 1079 and glossary of NRCA's "The NRCA Roofing and Waterproofing Manual" apply to work of this Section.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.5 INFORMATIONAL SUBMITTALS

A. Manufacturer Certificates: Signed by roofing manufacturer certifying that roofing system complies with requirements specified in "Performance Requirements" Article.

1. Submit evidence of complying with performance requirements.

B. Sample Warranties: For manufacturer's special warranties.

1.6 CLOSEOUT SUBMITTALS

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

B. Executed Warranties.

1.7 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.

C. Source Limitations: Obtain components, including membrane roofing, base flashings, fasteners, roofing accessories, and other components of roofing system from same manufacturer as membrane roofing or from source approved by membrane roofing manufacturer.

1.8 PROJECT 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. Fully adhered single ply roofing systems shall not be installed when temperatures are expected to be below 40^{o} Fahrenheit within 24 hours.

B. Protect existing building, adjacent buildings, walkways, site improvements, exterior plantings, and landscaping from damage or soiling from roofing operations.

C. Maintain access to existing walkways, corridors, and other adjacent occupied or used facilities.

D. Conditions existing at time of inspection for bidding will be maintained by Owner as far as practical.

1.9 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, fasteners, roofing accessories, and other components of roofing system.
2. Warranty Period: 25 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain components including 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: Provide membrane roofing system that is identical to systems that have been successfully tested by a qualified testing and inspecting agency to resist uplift pressure calculated according to ASCE/SEI 7.

D. Provide a UL-classified membrane roofing assembly complying with UL 580, Class 90; membrane roofing system shall bear UL labeling.

1. Membrane roof assembly shall provide uplift pressure resistance of 90 psf when tested according to UL 1897.
2. Hail Resistance: SH.

E. Exterior Fire-Test Exposure: ASTM E 108 or UL 790, Class B; for application and roof slopes indicated; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

F. Fire-Resistance Ratings: Comply with fire-resistance-rated assembly designs indicated. Identify products with appropriate markings of applicable testing agency.

2.3 EPDM ROOFING

A. EPDM: ASTM D 4637, Type I, nonreinforced, uniform, flexible EPDM sheet.

1. Thickness: 60 mils (1.46 mm), nominal.

2. Exposed Face Color: Black.

2.4 AUXILIARY ROOFING MATERIALS

A. General: Auxiliary materials recommended by roofing system manufacturer for intended use and compatible with roofing.

B. Sheet Flashing: 60-mil- (1.5-mm-) thick EPDM, partially cured or cured, according to application.

C. Bonding Adhesive: Manufacturer's standard.

D. Seaming Material: Single-component, butyl splicing adhesive and splice cleaner.

E. Lap Sealant: Manufacturer's standard, single-component sealant colored to match membrane roofing.

F. Water Cutoff Mastic: Manufacturer's standard butyl mastic sealant.

G. Metal Termination Bars: Manufacturer's standard, predrilled stainless-steel or aluminum bars, approximately 1 by 1/8 inch (25 by 3 mm) thick; with anchors.

H. Fasteners: Factory-coated steel fasteners and metal or plastic plates complying with corrosion-resistance provisions in FM Global 4470, designed for fastening membrane to substrate, and acceptable to roofing system manufacturer.

I. Miscellaneous Accessories: Provide pourable sealers, preformed cone and vent sheet flashings, molded pipe boot flashings, preformed inside and outside corner sheet flashings, reinforced EPDM securement strips, T-joint covers, in-seam sealants, termination reglets, cover strips, and other accessories.

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, and curbs are set and braced.
2. Verify that wood blocking, curbs, and nailers are securely anchored to roof deck at penetrations and terminations.

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. 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.

3.3 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.

C. Install roofing and auxiliary materials to tie in to existing roofing to maintain weathertightness of transition and to not void warranty for existing roofing systems.

3.4 ADHERED MEMBRANE ROOFING INSTALLATION

A. Start installation of roofing in presence of roofing system manufacturer's technical personnel.

B. Accurately align roofing, and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

C. 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.

D. In addition to adhering, mechanically fasten roofing securely at terminations, penetrations, and perimeters.

E. Apply roofing with side laps shingled with slope of roof deck where possible.

F. Adhesive Seam Installation: Clean both faces of splice areas, apply splicing cement, and firmly roll side and end laps of overlapping roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing terminations.

1. Apply a continuous bead of in-seam sealant before closing splice if required by roofing system manufacturer.

G. Tape Seam Installation: Clean and prime both faces of splice areas, apply splice tape, and firmly roll side and end laps of overlapping roofing according to manufacturer's written instructions to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of roofing terminations.

H. Repair tears, voids, and lapped seams in roofing that do not comply with requirements.

I. Spread sealant or mastic bed over deck-drain flange at roof drains, and securely seal membrane roofing in place with clamping ring.

3.5 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 splice areas, apply splicing cement, and firmly roll side and end laps of overlapping sheets to ensure a watertight seam installation. Apply lap sealant and seal exposed edges of sheet flashing terminations.

E. Terminate and seal top of sheet flashings and mechanically anchor to substrate through termination bars.

F. Extend roof membrane over parapet walls as recommended per roofing manufacturer’s written instructions.

3.6 FIELD QUALITY CONTROL

A. Final Roof Inspection: Prior to substantial completion, arrange for roofing system manufacturer's technical personnel to inspect roofing installation.

1. Notify Architect and Owner not less than 48 hours in advance of time and date of scheduled roof inspection.
2. Submit copy of written report of manufacturer’s final roofing inspection to Architect and Owner.

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.

3.7 PROTECTING AND CLEANING

A. Protect membrane 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.

1. Punctures: Membrane punctures discovered within one year of the date of Substantial Completion shall be assumed to have been caused by the Contractor during construction of the project and shall be repaired by the Contractor at no cost. Locating and repairing punctures in the roofing membrane within one year of the date of Substantial Completion shall be considered warranty work under the General Contractor's 1-year general building warranty. Installer shall perform emergency callback service during normal working hours with response time of 48 hours or less.

B. Correct deficiencies in or remove membrane roofing system that does not comply with requirements, repair substrates, and repair or reinstall membrane 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.

END OF SECTION 075323

SECTION 076200 - SHEET METAL FLASHING AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following sheet metal flashing and trim:

1. Manufactured reglets.
2. Formed low-slope roof flashing and trim.

1.3 PERFORMANCE REQUIREMENTS

A. General: Install sheet metal flashing and trim to withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Thermal Movements: Provide sheet metal flashing and trim that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing 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 sheet metal and trim thermal movements. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

C. Water Infiltration: Provide sheet metal flashing and trim that do not allow water infiltration to building interior.

1.4 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown unless more stringent requirements are indicated.

PART 2 - PRODUCTS

2.1 SHEET METALS

A. Prepainted, Metallic-Coated Steel Sheet: Steel sheet metallic coated by the hot-dip process and prepainted by the coil-coating process to comply with ASTM A 755/A 755M.

1. Zinc-Coated (Galvanized) Steel Sheet: ASTM A 653/A 653M, G90 (Z275) coating designation; structural quality.
2. Exposed Finishes: Apply the following coil coating:

a. High-Performance Organic Finish: Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions.

1) Fluoropolymer 2-Coat System: Manufacturer's standard HYLAR 5000 or KYNAR 500 2-coat, thermocured system consisting of specially formulated inhibitive primer and fluoropolymer color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight; complying with physical properties and coating performance requirements of AAMA 2604 2605, except as modified below:

a) Humidity Resistance: 1000 hours.
b) Salt-Spray Resistance: 1000 hours.

b. Coping, scupper and fascia cap color: To match Pac-Clad Petersen Aluminum "Cardinal Red"

3. Concealed Finish: Pretreat with 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 (0.013 mm).

2.2 UNDERLAYMENT MATERIALS

A. Polyethylene Sheet: 6-mil- (0.15-mm-) thick polyethylene sheet complying with ASTM D 4397.

B. Felt: ASTM D 226, Type II (No. 30), asphalt-saturated organic felt, non-perforated.

C. Self-Adhering, High-Temperature Sheet: Minimum 30 to 40 mils (0.76 to 1.0 mm) thick, consisting of slip-resisting polyethylene-film top surface laminated to layer of butyl or SBS-modified asphalt adhesive, with release-paper backing; cold applied. Provide primer when recommended by underlayment manufacturer.

1. Thermal Stability: ASTM D 1970; stable after testing at 240 deg F (116 deg C).
2. Low-Temperature Flexibility: ASTM D 1970; passes after testing at minus 20 deg F (29 deg C).

D. Slip Sheet: Building paper, 3-lb/100 sq. ft. (0.16-kg/sq. m) minimum, rosin sized.

2.3 MISCELLANEOUS MATERIALS

A. General: Provide materials and types of fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required for complete sheet metal flashing and trim installation.

B. Fasteners: Wood screws, annular threaded nails, self-tapping screws, self-locking rivets and bolts, and other suitable fasteners designed to withstand design loads.

1. Exposed Fasteners: Heads matching color of sheet metal by means of plastic caps or factory-applied coating.
2. Fasteners for Flashing and Trim: Blind fasteners or self-drilling screws, gasketed, with hex washer head.
3. Blind Fasteners: High-strength aluminum or stainless-steel rivets.

C. Sealing Tape: Pressure-sensitive, 100 percent solids, polyisobutylene compound sealing tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape.

D. Elastomeric Sealant: ASTM C 920, elastomeric polyurethane polymer sealant; of type, grade, class, and use classifications required to seal joints in sheet metal flashing and trim and remain watertight.

E. Epoxy Seam Sealer: Two-part, noncorrosive, aluminum seam-cementing compound, recommended by aluminum manufacturer for exterior nonmoving joints, including riveted joints.

F. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

G. Asphalt Roofing Cement: ASTM D 4586, asbestos free, of consistency required for application.

2.4 FABRICATION, GENERAL

A. General: Custom fabricate sheet metal flashing and trim to comply with recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated. Shop-fabricate items where practicable. Obtain field measurements for accurate fit before shop fabrication.

B. Fabricate sheet metal flashing and trim in thickness or weight needed to comply with performance requirements, but not less than that specified for each application and metal.

C. Fabricate sheet metal flashing and trim without excessive oil canning, buckling, and tool marks and true to line and levels indicated, with exposed edges folded back to form hems.

1. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

D. Sealed Joints: Form non-expansion but movable joints in metal to accommodate elastomeric sealant to comply with SMACNA recommendations.

E. Expansion Provisions: Where lapped or bayonet-type expansion provisions in the Work cannot be used, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with elastomeric sealant concealed within joints.

F. Conceal fasteners and expansion provisions where possible on exposed-to-view sheet metal flashing and trim, unless otherwise indicated.

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

1. Thickness: As recommended by SMACNA's "Architectural Sheet Metal Manual" for application but not less than thickness of metal being secured.

2.5 ROOF DRAINAGE SHEET METAL FABRICATIONS

A. Scuppers and Fascia Caps: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Furnish with 6-inch- (150-mm-) wide joint cover plates.

1. Joint Style: Butt, with 6-inch- (150-mm-) wide exposed cover plates.
2. Fabricate gravel stops, scuppers and fascia caps from the following material:

a. Pre-finished, Metallic-Coated Steel: 0.028 inch (0.71 mm) (24 ga) thick.

2.6 LOW-SLOPE ROOF SHEET METAL FABRICATIONS

A. Copings: Fabricate in minimum 96-inch- (2400-mm-) long, but not exceeding 10-foot- (3-m-) long, sections. Fabricate joint plates of same thickness as copings. Furnish with continuous cleats to support edge of external leg and drill elongated holes for fasteners on interior leg. Miter corners, seal, and solder or weld watertight.

1. Joint Style: Butt, with 6-inch- (150-mm-) wide exposed cover plates.
2. Fabricate copings from the following material:

    a. Pre-finished, Metallic-Coated Steel: 0.028 inch (0.71 mm) (24 ga) thick.

3. Copings at Metal Wall and Soffit Panels: Sheet metal copings and miscellaneous sheet metal trim at locations indicated to receive metal wall panels shall be furnished and installed by this Section.

B. Base Flashing: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) (26 ga.) thick.

C. Counter flashing: Fabricate from the following material:

1. Galvanized Steel: 0.022 inch (0.56 mm) (26 ga.) thick.

D. Flashing Receivers: Fabricate from the following materials:

1. Galvanized Steel: 0.022 inch (0.56 mm) (26 ga.) thick.

2.7 WALL SHEET METAL FABRICATIONS

A. Through-Wall Flashing: Fabricate continuous flashings in minimum 96-inch- (2400-mm-) long, but not exceeding 12-foot- (3.6-m-) long, sections, under copings, at shelf angles, and where indicated. Fabricate discontinuous lintel, sill, and similar flashings to extend 6 inches (150 mm) beyond each side of wall openings. Form with 2-inch- (50-mm-) high, end dams where flashing is discontinuous. Fabricate from the following materials:

1. Pre-finished Metallic-Coated Steel: 0.028 inch (0.71 mm) (24 ga) thick.

B. Opening Flashings in Frame Construction: Fabricate head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings. Form head and sill flashing with 2-inch- (50-mm-) high, end dams. Fabricate from the following materials:

1. Pre-finished Metallic-Coated Steel: 0.028 inch (0.71 mm) (24 ga) thick.

2.8 FINISHES

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

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

C. Appearance of Finished Work: 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 substrates, areas, and conditions, with Installer present, to verify actual locations, dimensions and other conditions affecting performance of work.

1. Verify compliance with requirements for installation tolerances of substrates.
2. Verify that substrate is sound, dry, smooth, clean, sloped for drainage, and securely anchored.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION, GENERAL

A. General: Anchor sheet metal flashing and trim and other components of the Work securely in place, with provisions for thermal and structural movement. Use fasteners, solder, welding rods, protective coatings, separators, sealants, and other miscellaneous items as required to complete sheet metal flashing and trim system.

1. Torch cutting of sheet metal flashing and trim is not permitted.

B. Metal Protection: Where dissimilar metals will contact each other or corrosive substrates, protect against galvanic action by painting contact surfaces with bituminous coating or by other permanent separation as recommended by fabricator or manufacturers of dissimilar metals.

1. Bed flanges in thick coat of asphalt roofing cement where required for waterproof performance.

C. Install exposed sheet metal flashing and trim without excessive oil canning, buckling, and tool marks.

D. Install sheet metal flashing and trim true to line and levels indicated. Provide uniform, neat seams with minimum exposure of solder, welds, and elastomeric sealant.

E. Install sheet metal flashing and trim to fit substrates and to result in watertight performance. Verify shapes and dimensions of surfaces to be covered before fabricating sheet metal.

1. Space cleats not more than 12 inches (300 mm) apart. Anchor each cleat with two fasteners. Bend tabs over fasteners.

F. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (600 mm) of corner or intersection. Where lapped or bayonet-type expansion provisions cannot be used or would not be sufficiently watertight, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with elastomeric sealant concealed within joints.

G. Fasteners: Use fasteners of sizes that will penetrate substrate not less than 1-1/4 inches (32 mm) for nails and not less than 3/4 inch (19 mm) for wood screws.

1. Galvanized or Prepainted, Metallic-Coated Steel: Use stainless-steel fasteners.

H. Seal joints with elastomeric sealant as required for watertight construction.

1. Where sealant-filled joints are used, embed hooked flanges of joint members not less than 1 inch (25 mm) into sealant. Form joints to completely conceal sealant. When ambient temperature at time of installation is moderate, between 40 and 70 deg F (4 and 21 deg C), set joint members for 50 percent movement either way. Adjust setting proportionately for installation at higher ambient temperatures. Do not install sealant-type joints at temperatures below 40 deg F (4 deg C).
2. Prepare joints and apply sealants to comply with requirements in Division 7 Section "Joint Sealants."

I. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2 inches (38 mm) except where pretinned surface would show in finished Work.

1. Do not solder pre-painted, metallic-coated steel sheet.
2. Do not use open-flame torches for soldering. Heat surfaces to receive solder and flow solder into joints. Fill joints completely. Completely remove flux and spatter from exposed surfaces.

3.3 ROOF DRAINAGE SYSTEM INSTALLATION

A. General: Install sheet metal roof drainage items to produce complete roof drainage system according to SMACNA recommendations and as indicated. Coordinate installation of roof perimeter flashing with installation of roof drainage system.

B. Parapet Scuppers: Install scuppers where indicated through parapet. Continuously support scupper, set to correct elevation, and seal flanges to interior wall face, over cants or tapered edge strips, and under roofing membrane.

1. Anchor scupper closure trim flange to exterior wall and seal with elastomeric sealant to scupper.
2. Loosely lock front edge of scupper with conductor head.
3. Seal with elastomeric sealant exterior wall scupper flanges into back of conductor head.

3.4 ROOF FLASHING INSTALLATION

A. General: Install sheet metal roof flashing and trim to comply with performance requirements , sheet metal manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.

B. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated. Interlock bottom edge of roof edge flashing with continuous cleat anchored to substrate at staggered 3-inch (75-mm) centers.

C. Copings: Anchor to resist uplift and outward forces according to recommendations in SMACNA's "Architectural Sheet Metal Manual" and as indicated.

1. Interlock exterior bottom edge of coping with continuous cleat anchored to substrate at 16-inch (400-mm) centers.
2. Anchor interior leg of coping with continuous cleat anchored to substrate at 16-inch (400-mm) centers.

D. Pipe or Post Counterflashing: Install counterflashing umbrella with close-fitting collar with top edge flared for elastomeric sealant, extending a minimum of 4 inches (100 mm) over base flashing. Install stainless-steel draw band and tighten.

E. Counterflashing: Coordinate installation of counterflashing with installation of base flashing. Insert counterflashing in reglets or receivers and fit tightly to base flashing. Extend counterflashing 4 inches (100 mm) over base flashing. Lap counterflashing joints a minimum of 4 inches (100 mm) and bed with elastomeric sealant.

1. Secure in a waterproof manner by means of interlocking folded seam or blind rivets and sealant.

3.5 WALL FLASHING INSTALLATION

A. General: Install sheet metal wall flashing to intercept and exclude penetrating moisture according to SMACNA recommendations and as indicated. Coordinate installation of wall flashing with installation of wall-opening components such as windows, doors, and louvers.

B. Opening Flashings in Frame Construction: Install continuous head, sill, jamb, and similar flashings to extend 4 inches (100 mm) beyond wall openings.

3.6 CLEANING AND PROTECTION

A. Clean and neutralize flux materials. Clean off excess solder and sealants.

B. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

C. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION 076200

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.

1.3 ACTION SUBMITTALS

A. 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.

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

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

1.4 QUALITY ASSURANCE

A. Source Limitations: Obtain each kind 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 or are below 40 deg F (5 deg C).
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.6 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which 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: 5 years from date of Substantial Completion.

B. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:

1. Movement of the structure caused by structural settlement or errors attributable to design or construction resulting in stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
2. Disintegration of joint substrates from natural 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 MATERIALS, 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. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.

C. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.

D. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

E. Colors of Exposed Joint Sealants: As selected by Architect from manufacturer's full range.

2.2 SILICONE JOINT SEALANTS

A. Mildew-Resistant, Single-Component, Acid-Curing Silicone Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Applications: Use at all interior wet locations including joints in restrooms, around plumbing fixtures, and around ceramic tile.

2.3 URETHANE JOINT SEALANTS

A. Single-Component, Nonsag, Urethane Joint Sealant: ASTM C 920, Type S, Grade NS, Class 25, for Use NT.

1. Applications: Use at exterior building joints.

B. Multicomponent, Nonsag, Urethane Joint Sealant: ASTM C 920, Type M, Grade NS, Class 25, for Use NT.

1. Applications: Use at exterior building joints.

C. Multicomponent Pourable Urethane Sealant: ASTM C 920, Type M, Grade P, Class 25, for Use T:

1. Applications: Use at all interior horizontal traffic areas except at wet locations noted above; also use at exterior concrete walkways and curbing.

2.4 LATEX JOINT SEALANTS

A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.

1. Applications: Use at interior building joints except at wet locations noted above.

2.5 JOINT SEALANT BACKING

A. General: Provide sealant backings of material that are non-staining; are compatible with joint substrates, sealants, primers, and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin) Type O (open-cell material) Type B (bicellular material with a surface skin) or any of the preceding types, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

C. 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.

2.6 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: Non-staining, 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 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 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.
3. Remove laitance and form-release agents from concrete.
4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
    a. Metal.
    b. Glass.
    c. Porcelain enamel.

B. Joint Priming: Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.

C. Masking Tape: Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

A. General: Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.

B. Sealant Installation Standard: Comply with recommendations in ASTM C 1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.

C. Install sealant backings of kind indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.

1. Do not leave gaps between ends of sealant backings.
2. Do not stretch, twist, puncture, or tear sealant backings.
3. Remove absorbent sealant backings that have become wet before sealant application and replace them with dry materials.

D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.

E. Install sealants using proven techniques that comply with the following and at the same time backings are

installed:

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.
3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

F. Tooling of Non-sag 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. 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 and remove 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 horizontal nontraffic and traffic isolation and contraction joints in cast-in-place concrete slabs.

1. Joint Sealant: Multicomponent pourable urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer’s full range.

B. Joint-Sealant Application: Exterior joints in metal wall panels.

1. Joint Sealant: Single component nonsag urethane sealant or Multicomponent nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

C. Joint-Sealant Application: Exterior vertical joints between different materials listed above.

1. Joint Sealant: Single component nonsag urethane sealant or Multicomponent nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

D. Joint-Sealant Application: Exterior perimeter joints between doors, windows and louvers and different materials listed above.

1. Joint Sealant: Single component nonsag urethane sealant or Multicomponent nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

E. Joint-Sealant Application: Other exterior joints in vertical and horizontal nontraffic surfaces.

1. Joint Sealant: Single component nonsag urethane sealant or Multicomponent nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

F. Joint-Sealant Application: Vertical control and expansion joints on exposed interior surfaces of exterior walls.

1. Joint Sealant: Single component nonsag urethane sealant or Multicomponent nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer’s full range.

G. Joint-Sealant Application: Interior perimeter joints of exterior openings.

1. Joint Sealant: Single component nonsag urethane sealant or Multicomponent nonsag urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer’s full range.

H. Joint-Sealant Application: Interior joints between plumbing fixtures and adjoining walls, floors, and counters.

1. Joint Sealant: Single-component mildew-resistant acid- curing silicone sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer’s full range.

I. Joint-Sealant Application: Perimeter joints between interior wall surfaces and frames of interior doors & windows.

1. Joint Sealant: Latex sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer’s full range.

J. Joint-Sealant Application: Interior control, expansion, and isolation joints in horizontal traffic surfaces of flooring.

1. Joint Sealant: Single component nonsag urethane sealant or Multicomponent nonsag urethane sealant or Multicomponent pourable urethane sealant.
2. Joint-Sealant Color: As selected by Architect from manufacturer’s full range.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes hollow-metal work.

1.3 DEFINITIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain hollow-metal work from single source from single manufacturer.

2.2 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. Extra-Heavy-Duty Doors and Frames: SDI A250.8, Level 3.

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 (44.5 mm).
    c. Face: Uncoated, cold-rolled steel sheet, minimum thickness of 0.0428 inch (1.09 mm) (18 ga).
    d. Edge Construction: Model 1, Full Flush.
    e. Core: Manufacturer's standard kraft-paper honeycomb, polystyrene, polyurethane, polyisocyanurate, mineral-board, or vertical steel-stiffener core at manufacturer's discretion.

3. Frames:

    a. Materials: Uncoated, steel sheet, minimum thickness of 0.053 inch (1.3 mm) (16 ga).
    b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.3 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.

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 (44.5 mm.)
    c. Face: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm) (16 ga), with minimum A40 (ZF120) coating.
    d. Edge Construction: Model 1, Full Flush.
    e. Core: Polyurethane.

3. Frames:

    a. Materials: Metallic-coated steel sheet, minimum thickness of 0.053 inch (1.3 mm) (16 ga), with minimum A40 (ZF120) coating.
    b. Construction: Full profile welded.

4. Exposed Finish: Prime.

2.4 FRAME ANCHORS

A. Floor Anchors: Formed from same material as frames, minimum thickness of 0.042 inch (1.0 mm), and as follows:

1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.

2.5 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 (12G) 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, hot-dip galvanized according to ASTM A 153/A 153M, Class B.

E. Inserts, Bolts, and Fasteners: Hot-dip 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 (102 mm), as measured according to ASTM C 143/C 143M.

H. Glazing: Comply with requirements in Section 088000 "Glazing."

I. Bituminous Coating: Cold-applied asphalt mastic, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.6 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: Bevel edges 1/8 inch in 2 inches (3.2 mm in 51 mm).
2. Top Edge Closures: Close top edges of doors with inverted closures, except provide flush closures at exterior doors 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. 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: 3 per jamb, equally spaced.
6. Head Anchors: Two anchors per head for frames more than 42 inches (1067 mm) wide and mounted in metal-stud partitions.
7. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers as follows. Keep holes clear during construction. Silencers shall be furnished and installed by this Section.

    a. Single-Door Frames: Drill stop in strike jamb to receive three 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.

2.7 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.

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. The Contractor shall inspect accuracy of all hollow metal frame installations prior to installation of masonry. Submit written inspection report to the Architect and Owner within 24 hours.

D. 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. 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.
    b. Install frames with removable stops located on secure side of opening.
    c. Install door silencers in frames before grouting.
    d. Remove temporary braces necessary for installation only after frames have been properly set and secured.
    e. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
    f. 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 or power actuated fasteners.

3. 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 (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
    b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
    c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
    d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Hollow-Metal Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Between Door and Frame Jambs and Head: 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).
2. At Bottom of Door: 3/4 inch (19.1 mm) 5/8 inch (15.8 mm) plus or minus 1/32 inch (0.8 mm).
3. Between Door Face and Stop: 1/16 inch (1.6 mm) to 1/8 inch (3.2 mm) plus or minus 1/32 inch (0.8 mm).

3.4 ADJUSTING AND CLEANING

A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including hollow-metal work that is warped, bowed, or otherwise unacceptable.

B. Remove grout and other bonding material from hollow-metal work immediately after installation.

C. Prime-Coat 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 081113

SECTION 083313 - COILING COUNTER 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. Counter doors.

1.3 ACTION SUBMITTALS

A. Samples for Initial Selection: Manufacturer's finish charts showing full range of colors and textures available for units with factory-applied finishes.

1. Include similar Samples of accessories involving color selection.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For coiling counter doors to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer for both 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.

PART 2 - PRODUCTS

2.1 MANUFACTURERS, GENERAL

A. Source Limitations: Obtain coiling counter doors from single source from single manufacturer.

2.2 COUNTER DOOR ASSEMBLY

A. Counter Door: Coiling counter door formed with curtain of interlocking metal slats.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Cornell Iron Works, Inc.; Model ESC10.

B. Operation Cycles: Door components and operators capable of operating for not less than 20,000. One operation cycle is complete when a door is opened from the closed position to the fully open position and returned to the closed position.

C. Door Curtain Material: Galvanized steel.

D. Door Curtain Slats: Flat profile slats of 1-1/2-inch (38-mm) center-to-center height.

E. Bottom Bar: Manufacturer's standard continuous channel or tubular shape, fabricated hot-dip galvanized steel and finished to match door.

F. Curtain Jamb Guides: Galvanized steel with exposed finish matching curtain slats. Provide continuous integral wear strips to prevent metal-to-metal contact and to minimize operational noise.

G. Integral Frame, Hood, and Fascia: Galvanized steel.

1. Mounting: Face of wall.

H. Locking Devices: Equip door with slide bolt for padlock.

I. Manual Door Operator: Push-up operation.

J. Curtain Accessories: Equip door with weatherseals push/pull handles.

K. Door Finish:

1. Baked-Enamel or Powder-Coated Finish: Color to be selected from Manufacturer’s full range.
2. Interior Curtain-Slat Facing: Match finish of exterior curtain-slat face.

2.3 DOOR CURTAIN MATERIALS AND CONSTRUCTION

A. Door Curtains: Fabricate coiling counter-door curtain of interlocking metal slats in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:

1. Steel Door Curtain Slats: Zinc-coated (galvanized), cold-rolled structural steel sheet; complying with ASTM A 653/A 653M, with G90 (Z275) zinc coating; nominal sheet thickness (coated) of 0.028 inch (0.71 mm); and as required.
2. Metal Interior Curtain-Slat Facing: Match metal of exterior curtain-slat face.

B. Curtain Jamb Guides: Manufacturer's standard angles or channels and angles of same material and finish as curtain slats unless otherwise indicated, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain.

1. Removable Posts and Jamb Guides: Manufacturer's standard.

2.4 HOODS

A. Integral Frame, Hood, and Fascia: Welded sheet metal assembly of the following sheet metal(s):

1. Galvanized Steel: Hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with

ASTM A 653/A 653M.

2.5 LOCKING DEVICES

A. Slide Bolt: Fabricate with side-locking bolts to engage through slots in tracks for locking by padlock, located on both left and right jamb sides, operable from coil side.

2.6 CURTAIN ACCESSORIES

A. Weatherseals: Equip door with weather-stripping gaskets fitted to entire perimeter of door for air-resistant installation unless otherwise indicated.

1. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous-sheet baffle secured to inside of hood or field- installed on the header.
2. At door jambs, use replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene.

B. Push/Pull Handles: Equip each push-up-operated or emergency-operated door with lifting handles on each side of door, finished to match door.

2.7 COUNTERBALANCING MECHANISM

A. General: Counterbalance doors by means of manufacturer's standard mechanism with an adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to top of curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.

B. Counterbalance Barrel: Fabricate spring barrel of manufacturer's standard hot-formed, structural-quality, seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up curtain without distortion of slats and to limit barrel deflection to not more than 0.03 in./ft. (2.5 mm/m) of span under full load.

C. Counterbalance Spring: One or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Secure ends of springs to barrel and shaft with cast-steel barrel plugs.

D. Torsion Rod for Counterbalance Shaft: Fabricate of manufacturer's standard cold-rolled steel, sized to hold fixed spring ends and carry torsional load.

E. Brackets: Manufacturer's standard mounting brackets of either cast iron or cold-rolled steel plate.

2.8 MANUAL DOOR OPERATORS

A. General: Equip door with manual door operator by door manufacturer.

B. Push-up Door Operation: Design counterbalance mechanism so that required lift or pull for door operation does not exceed 25 lbf (111 N).

2.9 GENERAL FINISH REQUIREMENTS

A. Comply with NAAMM/NOMMA's "Metal Finishes Manual for Architectural and Metal Products (AMP 500-06)" 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, for compliance with requirements for substrate construction and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install coiling counter doors and operating equipment complete with necessary hardware, anchors, inserts, hangers, and equipment supports; according to manufacturer's written instructions and as specified.

B. Install coiling counter doors, hoods, controls, and operators at the mounting locations indicated for each door.

3.3 ADJUSTING

A. Adjust hardware and moving parts to function smoothly so that doors operate easily, free of warp, twist, or distortion.

B. Lubricate bearings and sliding parts as recommended by manufacturer.

3.4 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain coiling counter doors.

END OF SECTION 083313

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and an Architectural Hardware Consultant who is available during the course of the Work to consult with Contractor, Architect, and Owner about door hardware and keying.

1. Warehousing Facilities: In Project's vicinity.
2. Scheduling Responsibility: Preparation of door hardware and keying schedules.
3. Engineering Responsibility: Preparation of data for electrified door hardware, including Shop Drawings, based on testing and engineering analysis of manufacturer's standard units in assemblies similar to those indicated for this Project.

B. Source Limitations: Obtain each type of door hardware from a single manufacturer.

C. Means of Egress Doors: Latches do not require more than 15 lbf (67 N) to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.

D. 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 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 lbf (22.2 N).
2. Comply with the following maximum opening-force requirements:

a. Interior, Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) 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 (75 mm) from the latch, measured to the leading edge of the door.

E. Keying, Shop Drawing Conference: The hardware supplier shall conduct a conference at Project site to verify and coordinate door hardware, lock locations and functions with the Owner. In addition to Owner, Construction Manager, and Architect, conference participants shall also include Installer's Architectural Hardware Consultant. Incorporate conference decisions into final shop drawings after reviewing door hardware system with the Owner 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. Requirements for key control system.
3. Requirements for access control.

1.4 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 to manufacturer of key control system for subsequent delivery to Owner.

1.5 COORDINATION

A. Security: Coordinate installation of door hardware, keying, and access control with Owner's project manager.

1.6 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: years from date of Substantial Completion, unless otherwise indicated.

a. Exit Devices: Two years from date of Substantial Completion.
b. Manual Closers: 10 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. General: Provide door hardware for each door to comply with requirements in this Section and door hardware sets indicated in Part 3 "Door Hardware Sets".

1. Door Hardware Sets: Provide items indicated for each door and each leaf in a pair of doors. See floor plan and door schedule for pairs of doors.
2. Door Hardware sets are a list of door openings, not door or hardware quantities.
3. Door Hardware sets specified herein indicate function(s) of hardware required at each opening; accessory hardware components necessary to provide specified function(s) are considered incidental and shall be provided by this Section to achieve specified function(s).

B. Designations: Requirements for design, function, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Sets" Article. Products are identified by using door

hardware designations, as follows:

1. Named Manufacturers' Products: Provide Manufacturer and product designation as listed for each door hardware item specified. Manufacturers other than those listed will need prior approval.

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. McKinney Products Company; an ASSA ABLOY Group company.
b. Stanley Commercial Hardware; Div. of The Stanley Works.
c. Penrod

B. Hinges General:

1. Exterior doors: Heavy weight hinges for doors up to 40” wide and 90” high: 0.180 inch thickness. Doors over 40” wide or 90” high: 0.190 inch thickness.
2. Interior doors: Standard weight hinges for doors up to 36” wide: 0.134 inch thickness. Doors over 36” wide: heavy weight: 0.180 inch thickness.
3. Quantity: 3 hinges per door for doors up to 90” high, 4 hinges per door for doors over 90” high.

C. Fasteners: Comply with the following:

1. Machine Screws: For metal doors and frames. Install into drilled and tapped holes.
2. Corners: Square 5/32-inch (4-mm) radius.

D. Antifriction-Bearing Hinges:

1. Mounting: Full mortise (butts).
2. Use at all doors scheduled with door closures.
3. Bearing Material: Ball bearing.
4. Grade: Grade 1 (heavy weight) and Grade 2 (standard weight).
5. Base and Pin Metal:

a. Exterior Hinges: Brass with stainless-steel pin body and brass protruding heads.
b. Interior Hinges: Steel with steel pin.

6. Pins: Non-rising loose unless otherwise indicated Non-removable.

a. Outswinging Exterior Doors: Non-removable.

7. Tips: Flat button.
8. Corners: Square 5/32-inch (4-mm) radius.

E. Plain-Bearing Hinges: Grade 3 (standard weight).

1. Mounting: Full mortise (butts).
2. Base and Pin Metal: Steel with steel pin.
3. Pins: Non-rising loose unless otherwise indicated.
4. Tips: Flat button.
5. Corners: Square 5/32-inch (4-mm) radius.

2.3 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 (19-mm) latchbolt throw.
2. Deadbolts: Minimum 1.25-inch (25-mm)bolt throw.

C. Lock Backset: 2-3/4 inches (70 mm), unless otherwise indicated.

D. Provide bored locks and auxiliary locks to accept small interchange cylinder cores.

E. Lock Trim:

1. Levers: Cast.

a. Sargent: L lever design.

2. Escutcheons (Roses): Wrought: Sargent LN Rose design.
3. Dummy Trim: Match lever lock trim and escutcheons.

F. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt 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. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.
3. Aluminum-Frame Strike Box: Manufacturer's special strike box fabricated for aluminum framing.
4. Rabbet Front and Strike: Provide on locksets for rabbeted meeting stiles.

G. Bored Locks: BHMA A156.2; Grade 1; Series 4000. Basis of design: Sargent 11 Line Lever Lock.

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

a. Best Access Systems; Div. of Stanley Security Solutions, Inc.
b. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
c. Schlage Commercial Lock Division; an Ingersoll-Rand company.

2.4 AUXILIARY LOCKS

A. Bored Auxiliary Locks: BHMA A156.5; Grade 1; with strike that suits frame. Basis of design: Sargent 480 Series.

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

a. Best Access Systems; Div. of Stanley Security Solutions, Inc.
b. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
c. Schlage Commercial Lock Division; an Ingersoll-Rand company.

2. Backset: 2-3/4 inches (70 mm).
3. Material: Stainless steel.
4. Deadlocks: Deadbolt operated by key outside and turn inside Classroom function 03.

2.5 LOCK CYLINDERS

A. Lock Cylinders: Tumbler type, constructed from brass or bronze, stainless steel, or nickel silver.

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

following:

a. Best Access Systems; Div. of Stanley Security Solutions, Inc.

B. Standard Lock Cylinders: BHMA A156.5; Grade 1; permanent cores that are interchangeable removable; face finished to match lockset.

1. Number of Pins: Six.
2. Type: Bored Lock type.
3. Lock cylinders must accept small format IC cores.

C. Construction Cores: Contractor shall provide construction cores that are replaceable by permanent cores. Provide 2 construction master keys.

D. Permanent Cores: Provided by Contractor to Owner. Installation of permanent cores will be by the Owner.

2.6 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in the keying conference and as follows:

1. Existing System: Master key or grand master key locks to Owner's existing system.

B. Keys: Nickel Silver

1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:

a. Notation: "DO NOT DUPLICATE"

2. Quantity: In addition to two (2) keys for each lock, provide the following:

a. Cylinder Change Keys: Two
b. Master Keys: Five
c. Grand Master Keys: Five
d. Great-Grand Master Keys: Five

2.7 OPERATING TRIM

A. Operating Trim: BHMA A156.6; stainless steel, unless otherwise indicated.

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

a. Hiawatha, Inc.
b. IVES Hardware; An Ingersoll-Rand Company.
c. Trimco.

B. Flat Push Plates: 0.050 inch (1.3 mm) 4 inches wide by 16 inches high (102 mm wide by 406 mm high) with square corners and beveled edges; secured with exposed screws.

C. Straight Door Pulls: With minimum clearance of 1-1/2 inches (38 mm) from face of door.

1. Type: 3/4-inch (19-mm) constant-diameter pull.
2. Mounting: Surface applied with concealed fasteners.
3. Overall Length: 10 inches.
4. Basis of design Hiawatha #536B-10" for hollow metal doors.

2.8 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: Basis of design: LCN 4041 Super Smoothee.

a. LCN Closers; an Ingersoll-Rand company.
b. Norton Door Controls; an ASSA ABLOY Group company.
c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.

B. Size of Units: Unless otherwise indicated, 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.

C. Surface Closer with Cover: Grade 1; Modern Type with mechanism enclosed in cover.

1. Mounting: Parallel arm. Provide closer to be located on non-public side of door.
2. Type: Regular arm. Provide cushion stop and hold open at locations noted on schedule.
3. Provide heavy duty arms at all exterior locations.
4. Back check: Adjustable, effective between 60 and 85 degrees of door opening.
5. Cover Material: Aluminum metallic paint finish to match hardware finish.
6. Closing Power Adjustment: At least 50 percent more than minimum tested value.
7. Provide separate checking valves for back check, speed and latching adjustment.
8. Drop plates: At aluminum frames provide drop plate as required to attach closure to aluminum frame. Painted finish to match closure cover.

2.9 MECHANICAL STOPS AND HOLDERS

A. Wall-Mounted Stops: BHMA A156.16; polished cast brass, bronze, or aluminum base metal.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Basis of design: Ives #401-1/2

a. Hiawatha, Inc.
b. IVES Hardware; an Ingersoll-Rand company.
c. Stanley Commercial Hardware; Div. of The Stanley Works.
d. Trimco.

B. Wall Bumpers: Grade 1; with rubber bumper; 2-1/2-inch (64-mm) diameter, minimum 3/4-inch (19-mm) projection from wall; with backplate for concealed fastener installation; with concave bumper configuration.

C. Automatic Wall Holder: BHMA A156.16; polished cast brass, bronze, or aluminum base metal.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Basis of design: Ives #WS45X.

a. Hiawatha, Inc.
b. IVES Hardware; an Ingersoll-Rand company.
c. Stanley Commercial Hardware; Div. of The Stanley Works.
d. Trimco.

2.10 OVERHEAD STOPS

A. Overhead Stops and Holders: BHMA A156.8.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Basis of design: Gylnn-Johnson #450S

a. Glynn-Johnson; An Ingersoll-Rand Company.

B. Overhead Surface-Mounted Slide Holders: type 2; Grade 1; hold open and release by push and pull of door unless control is set in inactive position; with stop, shock absorber, and adjustable holding pressure; for single-acting doors opening 110 degrees.

2.11 DOOR GASKETING

A. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) 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. National Guard Products.
b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
c. Reese Enterprises, Inc.

B. General: Provide continuous weather-strip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated or scheduled. Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

1. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame. Design is based on Reese #815.
2. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed. Design is based on Reese#323.

C. Adjustable, Housed, Perimeter Gasketing: Screw-adjustable sponge neoprene gasket material held in place by aluminum housing; fastened to frame stop with screws.

D. Door Sweeps: Neoprene gasket material held in place by flat aluminum housing or flange; surface mounted to face of door with screws.

2.12 THRESHOLDS

A. Thresholds: BHMA A156.21; fabricated to full width of opening indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following: Design is based on Reese #S205.

a. National Guard Products.
b. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
c. Reese Enterprises, Inc.

B. Saddle Thresholds:

1. Type: Fluted top.
2. Base Metal: Aluminum.

2.13 METAL PROTECTIVE TRIM UNITS

A. Metal Protective Trim Units: BHMA A156.6; fabricated from 0.050-inch- (1.3-mm-) thick stainless steel; with manufacturer's standard machine or self-tapping screw fasteners.

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

a. Hiawatha, Inc.
b. IVES Hardware; an Ingersoll-Rand company.
c. Trimco.

B. Kick Plates: 8 inches (203 mm) high by door width with allowance for frame stops. Provide 5” high at stile and rail wood and hollow metal doors.

2.14 FABRICATION

A. Manufacturer's Nameplate: Do not provide products that have manufacturer's name or trade name displayed in a visible location except in conjunction with required fire-rated labels and as otherwise approved by Architect.

1. Manufacturer's identification is permitted on rim of lock cylinders only.

B. 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.

C. 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. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.15 FINISHES

A. Provide finishes complying with BHMA A156.18.

1. BHMA 626: Satin chromium plated over nickel, over brass or bronze base metal.

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.

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.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.

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 work. 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 (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

D. Lock Cylinders: Install construction cores to secure building and areas during construction period.

E. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

F. 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.

G. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

H. 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. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately six months after date of Substantial Completion, Installer's Architectural Hardware Consultant shall examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

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

DoorHardwareGroup 1
Butt hinges
Classroom lock
Closer
Weatherstripping
Door sweep
Threshold
Wall stop

DoorHardwareGroup 2
Butt hinges
Classroom lock
Weatherstripping
Door sweep
Threshold
Automatic wall holder

DoorHardwareGroup 3
Butt hinges
Storeroom lock
Closer
Weatherstripping
Door sweep
Threshold
Overhead stop

DoorHardwareGroup 4
Butt hinges
Dormitory function
Weatherstripping
Door sweep
Threshold
Overhead stop

DoorHardwareGroup 5
Butt hinges
Storeroom lock
Closer
Overhead stop

END OF SECTION 087100

SECTION 092600 - GYPSUM BOARD ASSEMBLIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:

1. Interior gypsum wallboard.
2. Tile backing panels.
3. Cement board shower ceiling assemblies.
4. Non-load-bearing steel framing.

1.3 DEFINITIONS

A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.4 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: For gypsum board assemblies with fire-resistance ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 119 by an independent testing and inspecting agency acceptable to authorities having jurisdiction.

B. Sound Transmission Characteristics: For gypsum board assemblies with STC ratings, provide materials and construction identical to those tested in assembly indicated according to ASTM E 90 and classified according to ASTM E 413 by a qualified independent testing agency.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.

B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

PART 2 - PRODUCTS

2.1 STEEL PARTITION AND SOFFIT FRAMING

A. Components, General: As follows:

1. Comply with ASTM C 754 for conditions indicated.
2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with manufacturer's standard corrosion-resistant zinc coating; ASTM A 653/A 653M, G40 (Z120) minimum.

B. Steel Studs and Runners: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0312 inch (0.791 mm) (20 ga.).

a. Dimpled steel stud or 'equivalent' steel stud framing members not allowed; provide thickness specified.

2. Depth: As indicated on drawings.

C. Deep-Leg Deflection Track: ASTM C 645 top runner with 2-inch- (50.8-mm-) deep flanges.

D. Hat-Shaped, Rigid Furring Channels: ASTM C 645.

1. Minimum Base Metal Thickness: 0.0179 inch (0.45 mm) (25 ga.).
2. Depth: 1-1/2 inches (38.1 mm).

E. Fasteners for Metal Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.

2.2 INTERIOR GYPSUM WALLBOARD

A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.

B. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: 5/8 inch (15.9 mm), Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.
4. Application:

2.3 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.

1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
2. Shapes:

a. Cornerbead.
b. LC-Bead: J-shaped; exposed long flange receives joint compound use where indicated.
c. U-Bead: J-shaped; exposed short flange does not receive joint compound; use at exposed panel edges.
d. Control / expansion joints.

2.4 JOINT TREATMENT MATERIALS

A. General: Comply with ASTM C 475.

B. Joint Tape:

1. Interior Gypsum Wallboard: Paper.
2. Tile Backing Panels: As recommended by panel manufacturer.
3. Cementitious Panels: As recommended by panel manufacturer.

C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Prefilling: At open joints and damaged surface areas, use setting-type taping compound.
2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
3. Fill Coat: For second coat, use drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.

2.5 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 (0.84 to 2.84 mm) thick.

C. Isolation Strip at Exterior Walls:

1. Asphalt-Saturated Organic Felt: ASTM D 226, Type I (No. 15 asphalt felt), non-perforated.

2.6 TEXTURE FINISHES

A. Interior Gypsum Wall Board Finish:

1. Texture: Provide smooth drywall finish at all interior gypsum board partitions scheduled to receive paint, unless indicated otherwise.

2. Primer: As recommended by textured finish manufacturer.

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

3.2 INSTALLING STEEL FRAMING, GENERAL

A. Installation Standards: ASTM C 754, and ASTM C 840 requirements that apply to framing installation.

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

C. Isolate steel framing from building structure at locations indicated to prevent transfer of loading imposed by structural movement.

1. Isolate ceiling assemblies where they abut or are penetrated by building structure.
2. Isolate partition framing and wall furring where it abuts structure, except at floor. Install slip-type joints at head of assemblies that avoid axial loading of assembly and laterally support assembly.

a. Use deep-leg deflection track where indicated.

D. Do not bridge building control and expansion joints with steel framing or furring members. Frame both sides of joints independently.

3.3 INSTALLING STEEL PARTITION AND SOFFIT FRAMING

A. Install tracks (runners) at floors, ceilings, and structural walls and columns where gypsum board assemblies abut other construction.

1. Where studs are installed directly against exterior walls, install asphalt-felt isolation strip between studs and wall.

B. Installation Tolerance: Install each steel framing and furring member so fastening surfaces vary not more than 1/8 inch (3 mm) from the plane formed by the faces of adjacent framing.

C. Extend partition framing full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for gypsum board.

1. Cut studs 1/2 inch (13 mm) short of full height to provide perimeter relief.
2. For partitions that extend to the underside of floor/roof slabs and decks or other continuous solid-structure surfaces to obtain ratings, install framing around structural and other members extending below floor/roof slabs and decks, as needed to support gypsum board closures and to make partitions continuous from floor to underside of solid structure.

D. Install steel studs and furring at the following spacings:

1. Single-Layer Construction: 16 inches (406 mm) o.c., unless otherwise indicated.
2. Multilayer Construction: 16 inches (406 mm) o.c., unless otherwise indicated.
3. Cementitious Backer Units: 16 inches (406 mm) o.c., unless otherwise indicated.

E. Install steel studs so flanges point in the same direction and leading edge or end of each panel can be attached to open (unsupported) edges of stud flanges first.

F. Frame door openings to comply with GA-600 and with gypsum board manufacturer's applicable written recommendations, unless otherwise indicated. 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.

1. Install two studs at each jamb, unless otherwise indicated.
2. Extend jamb studs through suspended ceilings and attach to underside of floor or roof structure above.

G. 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.

3.4 APPLYING AND FINISHING PANELS, GENERAL

A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.

B. Install sound attenuation blankets before installing gypsum panels, unless blankets are readily installed after panels have been installed on one side.

C. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.

D. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.

E. 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.

F. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.

G. Where required to resist the passage of sound, scribe top edge of gypsum board panels to match profile of metal roof deck; scribe panels to within ¼ inch of metal roof deck. Fill void between gypsum board and metal deck with acoustical joint sealant, as specified in Division 07 Section “Joint Sealants.”

H. Form control and expansion joints with space between edges of adjoining gypsum panels.

I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 sq. ft. (0.7 sq. m) in area.
2. Fit gypsum panels around ducts, pipes, and conduits.
3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.

J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.

K. Walls Indicated to Extend / Seal to the Structure Above: 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.

L. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.

1. Space screws a maximum of 12 inches (304.8 mm) o.c. for vertical applications.

M. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) o.c.

3.5 PANEL APPLICATION METHODS

A. Install interior gypsum board in the following locations:

1. Moisture- and Mold-Resistant Gypsum Board: Where indicated.

B. Single-Layer Application:

1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
2. On partitions/walls, apply gypsum panels vertically (parallel to framing), unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.

a. Stagger abutting end joints not less than one framing member in alternate courses of board.
b. At stairwells and other high walls, install panels horizontally, unless otherwise indicated or required by fire-resistance-rated assembly.

C. Multilayer Application on Partitions/Walls: Apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.

D. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.

E. Multilayer Fastening Methods: Fasten base layers and face layers separately to supports with screws.

3.6 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. U-Bead: Use at exposed panel edges.
4. Control Joints: Use where indicated, and according to ASTM C 840.

a. Spacing not to exceed 30 lineal feet between control joints in walls.
b. Spacing not to exceed 50 lineal feet in either direction (2,500 sq ft max.) at ceilings.
c. Consult Architect for exact locations of control joints prior to installation of gypsum board.

3.7 FINISHING GYPSUM BOARD ASSEMBLIES

A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.

B. Prefill open joints and damaged surface areas.

C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.

D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:

1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.

2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.

3. Level 4: Provide smooth Level 4 drywall finish at all panel surfaces that will remain exposed to

view, unless otherwise indicated.

4. Primer and its application to surfaces are specified in Section 099120 "Interior Painting."

E. Glass-Mat, Water-Resistant Backing Panels: Finish according to manufacturer's written instructions.

3.8 FIELD QUALITY CONTROL

A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Architect and Engineer will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.

1. Notify Architect seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
2. Before notifying Architect, complete the following in areas to receive gypsum board ceilings:

a. Installation of 80 percent of lighting fixtures, powered for operation.
b. Installation, insulation, and leak and pressure testing of water piping systems.
c. Installation of air-duct systems.
d. Installation of air devices.
e. Installation of mechanical system control-air tubing.
f. Installation of ceiling support framing.
g. Installation and labeling of acoustical sealant treatment at thru-penetrations and joints.

3.9 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 092600

SECTION 096513 - RESILIENT WALL BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:

1. Resilient base.

1.3 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: 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.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F (10 deg C) or more than 90 deg F (32 deg C).

1.5 PROJECT CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F (21 deg C) or more than 95 deg F (35 deg C), in spaces to receive resilient products during the following time periods:

1. 48 hours before installation.
2. During installation.
3. 48 hours after installation.

B. Until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F (13 deg C) or more than 95 deg F (35 deg C).

C. Install resilient products after other finishing operations, including painting, have been completed.

1.6 EXTRA MATERIALS

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 (3 linear m) for every 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient product installed.

PART 2 - PRODUCTS

2.1 RESILIENT BASE

A. Resilient Base Standard: ASTM F 1861.

1. Material Requirement: Type TV Vinyl, co extruded
2. Manufacturing Method: Group I (solid, homogeneous).
3. Style: Cove (base with toe).

B. Minimum Thickness: 0.125 inch (3.2 mm).

C. Height: 4 inches (102 mm).

D. Lengths: Coils in manufacturer's standard length.

E. Outside Corners: Job formed.

F. Inside Corners: Job formed.

G. Finish: Satin.

H. Colors and Patterns: As selected by Architect from full range of industry colors.

2.2 INSTALLATION MATERIALS

A. Trowelable Leveling and Patching Compounds: Latex-modified, portland cement based or blended hydraulic-cement-based formulation provided or approved by manufacturer for applications indicated.

B. Adhesives: Water-resistant type recommended by manufacturer to suit resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

B. 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.

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

3.2 PREPARATION

A. Prepare substrates according to manufacturer's written instructions to ensure adhesion of resilient products.

B. Concrete Substrates for Accessories: 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 manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by manufacturer.
4. Moisture Testing: Perform tests recommended by manufacturer and as follows. Proceed with installation only after substrates pass testing.

    a. Perform anhydrous calcium chloride test, ASTM F 1869. Proceed with installation only after substrates have maximum moisture-vapor-emission rate of 3 lb of water/1000 sq. ft. (1.36 kg of water/92.9 sq. m) in 24 hours.
    b. Perform relative humidity test using in situ probes, ASTM F 2170. Proceed with installation only after substrates have maximum 75 percent relative humidity level measurement.

C. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound and remove bumps and ridges to produce a uniform and smooth substrate.

D. Do not install resilient products until they are same temperature as the space where they are to be installed.

1. Move resilient products and installation materials into spaces where they will be installed at least 48 hours in advance of installation.

E. Sweep and vacuum clean substrates to be covered by resilient products immediately before installation.

3.3 RESILIENT BASE INSTALLATION

A. Comply with manufacturer's written instructions for installing resilient base. Score base at internal and external corners as recommended by manufacturers.

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 practicable 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. Inside Corners: Use straight pieces of maximum lengths possible.

3.4 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protection of resilient products.

B. Perform the following operations immediately after completing resilient product installation:

1. Remove adhesive and other blemishes from exposed surfaces.
2. Sweep and vacuum surfaces thoroughly.
3. Damp-mop surfaces to remove marks and soil.

C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.

D. Cover resilient products until Substantial Completion.

END OF SECTION 096513

SECTION 099113 - EXTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and the application of paint systems on the following exterior substrates:

1. Steel.
2. Wood.

1.3 DEFINITIONS

A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523.

B. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523.

C. 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. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523.

E. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

F. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials, from the same product run, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Paint: 5 percent, but not less than 1 gal. (3.8 L of each material and color applied).

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than 45 deg F (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.6 FIELD CONDITIONS

A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between

50 and 95 deg F (10 and 35 deg C).

B. Do not apply paints in snow, rain, fog, or mist; when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

C. Colors: To be selected from manufacturer standard colors.

2.2 METAL PRIMERS

A. Primer, Alkyd, Anti-Corrosive for Metal: MPI #79.

2.3 SOURCE QUALITY CONTROL

B. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
1. 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. Wood: 15 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates and paint systems indicated.

B. 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 re-prime 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, "Hand Tool Cleaning."
2. SSPC-SP 3, "Power Tool Cleaning."
3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."

E. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.

F. Wood Substrates:

1. Scrape and clean knots. Before applying primer, apply coat of knot sealer recommended in writing by topcoat manufacturer for exterior use in paint system indicated.
2. Sand surfaces that will be exposed to view, and dust off.
3. Prime edges, ends, faces, undersides, and backsides of wood.
4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions and recommendations in "MPI Manual."

1. Use applicators and techniques suited for paint and substrate indicated.
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. Paint entire exposed surface of window frames and sashes.
5. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
6. 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.

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 to view:

a. Equipment, including panelboards and switch gear.
b. Uninsulated metal piping.
c. Pipe hangers and supports.
d. Metal conduit.
e. Tanks that do not have factory-applied final finishes.

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 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. Steel Substrates:

1. Alkyd System:

a. Prime Coat: Primer, alkyd, anticorrosive for metal, MPI #79.
b. Intermediate Coat: Exterior alkyd enamel matching topcoat.
c. Topcoat: Alkyd, exterior, semi-gloss (Gloss Level 5), MPI #94.

B. Wood Substrates:

1. Latex System:

a. Prime Coat: Primer, latex for exterior wood, MPI #6.
b. Intermediate Coat: Latex, exterior, matching topcoat.
c. Topcoat: Latex, exterior, low sheen (Gloss Level 3-4), MPI #15.

END OF SECTION 099113

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes surface preparation and the application of paint systems on the following interior substrates:

1. Steel.
2. Wood.

1.3 SUBMITTALS

A. Samples for Initial Selection: For each type of product indicated.

1.4 QUALITY ASSURANCE

A. MPI Standards:

1. Products: Complying with MPI standards indicated and listed in "MPI Approved Products List."
2. Preparation and Workmanship: Comply with requirements in "MPI Architectural Painting Specification Manual" for products and paint systems indicated.

1.5 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.

1.6 PROJECT 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.

1.7 EXTRA MATERIALS

A. Furnish extra materials described below that are from same production run (batch mix) as materials applied and that are packaged for storage and identified with labels describing contents.

1. Quantity: Furnish an additional 5 percent, but not less than 1 gal. of each material and color applied.

PART 2 - PRODUCTS

2.1 PAINT, GENERAL

A. Material Compatibility:

1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.

B. Colors: As selected from manufacturer standard colors

2.2 PRIMERS/SEALERS

A. Interior Latex Primer/Sealer: MPI #50.

2.3 METAL PRIMERS

A. Alkyd Anticorrosive Metal Primer: MPI #79.

1. VOC Content: E Range of E1

B. Quick-Drying Alkyd Metal Primer: MPI #76.

1. VOC Content: E Range of E2

2.4 LATEX PAINTS

A. Institutional Low-Odor/VOC Latex (Eggshell): MPI #145 (Gloss Level 3).

1. VOC Content: E Range of E3.
2. Environmental Performance Rating: EPR 4.5.

2.5 ALKYD PAINTS

A. Interior Alkyd (Semigloss): MPI #47 (Gloss Level 5).

1. VOC Content: E Range of E2.
2. Environmental Performance Rating: EPR 3

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of work.

B. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

1. Wood: 15 percent.

C. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

D. Begin coating application only after unsatisfactory conditions have been corrected and surfaces are dry.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates indicated.

B. Remove plates, machined surfaces, and similar items already in place that 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.
2. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

C. Clean substrates of substances that could impair bond of paints, including dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers as required to produce paint systems indicated.

D. Steel Substrates: Remove rust and loose mill scale. Clean using methods recommended in writing by paint manufacturer.

3.3 APPLICATION

A. Apply paints according to manufacturer's written instructions.

1. Use applicators and techniques suited for paint and substrate indicated.
2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.

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 and switch gear.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Tanks that do not have factory-applied final finishes.
   h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.

2. Paint the following work where exposed in occupied spaces:

   a. Equipment, including panelboards.
   b. Uninsulated metal piping.
   c. Uninsulated plastic piping.
   d. Pipe hangers and supports.
   e. Metal conduit.
   f. Plastic conduit.
   g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
   h. 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. Testing of Paint Materials: Owner reserves the right to invoke the following procedure at any time and as often as Owner deems necessary during the period when paints are being applied:
   1. 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.

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:

1. Alkyd System: MPI INT 5.1E.

a. Prime Coat: Alkyd anti-corrosive metal primer.
b. Intermediate Coat: Interior alkyd matching topcoat.
c. Topcoat: Interior alkyd (semigloss).

B. Wood Substrates:

1. Institutional Low-Odor/VOC Latex System: MPI INT 9.2M.

a. Prime Coat: Interior latex primer/sealer.
b. Intermediate Coat: Institutional low-odor/VOC interior latex matching topcoat.
c. Topcoat: Institutional low-odor/VOC interior latex (eggshell)

END OF SECTION 099123

SECTION 099600 - HIGH-PERFORMANCE COATINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes surface preparation and application of high-performance coating systems on the following substrates:

1. Interior Substrates:

a. Concrete masonry units (CMU).

1.3 DEFINITIONS

A. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523.

B. Gloss Level 7: More than 85 units at 60 degrees, according to ASTM D 523.

1.4 ACTION SUBMITTALS

A. Samples for Initial Selection: For each type of topcoat product indicated.

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. Coatings: 5 percent, but not less than 1 gal. (3.8 L) 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 (7 deg C).

1. Maintain containers in clean condition, free of foreign materials and residue.
2. Remove rags and waste from storage areas daily.

1.7 FIELD CONDITIONS

A. Apply coatings only when temperature of surfaces to be coated and surrounding air temperatures are between 50 and 95 deg F (10 and 35 deg C).

B. Do not apply coatings when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.

C. Do not apply exterior coatings in snow, rain, fog, or mist.

PART 2 - PRODUCTS

2.1 HIGH-PERFORMANCE COATINGS, GENERAL

A. MPI Standards: Provide products that comply with MPI standards indicated and are listed in "MPI Approved Products List."

B. Material Compatibility:

1. Provide materials for use within each coating system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
2. For each coat in a coating system, provide products recommended in writing by manufacturers of topcoat for use in coating system and on substrate indicated.
3. Provide products of same manufacturer for each coat in a coating system.

C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction and, for interior coatings applied at project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

1. Flat Paints and Coatings: 50 g/L.
2. Nonflat Paints and Coatings: 150 g/L.
3. Primers, Sealers, and Undercoaters: 200 g/L.
4. Anti-Corrosive and Anti-Rust Paints Applied to Ferrous Metals: 250 g/L.
5. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
6. Pre-Treatment Wash Primers: 420 g/L.
7. Floor Coatings: 100 g/L.
8. Shellacs, Clear: 730 g/L.
9. Shellacs, Pigmented: 550 g/L.

D. Low-Emitting Materials: Interior coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

E. Colors: Interior walls and ceilings to match Diamond Vogel, Antique White

1. BE1625 Base
2. BLK OP6
3. YOX OP6
4. OXR OP1

2.2 INTERIOR PRIMERS/SEALERS

A. Primer Sealer, Latex, Interior: MPI #50.

2.3 EPOXY COATINGS

A. Epoxy, Gloss: MPI #77.

2.4 SOURCE QUALITY CONTROL

A. Testing of Coating Materials: Owner reserves the right to invoke the following procedure:

1. 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 coating materials from Project site, pay for testing, and recoat surfaces coated with rejected materials. Contractor will be required to remove rejected materials from previously coated surfaces if, on recoating with complying materials, the two coatings are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.

1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:

a. Masonry (Clay and CMU): 12 percent.

B. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers.

C. Proceed with coating application only after unsatisfactory conditions have been corrected.

1. Beginning coating application constitutes Contractor's acceptance of substrates and conditions.

3.2 PREPARATION

A. Comply with manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual" applicable to substrates 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 coatings, including dust, dirt, oil, grease, and incompatible paints and encapsulants.

1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce coating systems indicated.

D. Masonry Substrates: Remove efflorescence and chalk. Do not coat surfaces if moisture content or alkalinity of surfaces or if alkalinity of mortar joints exceed that permitted in manufacturer's written instructions.

1. Clean surfaces with pressurized water. Use pressure range of 1500 to 4000 psi (10 350 to 27 580 kPa) at 6 to 12 inches (150 to 300 mm).

3.3 APPLICATION

A. Apply high-performance coatings according to manufacturer's written instructions and recommendations in "MPI Architectural Painting Specification Manual."

1. Use applicators and techniques suited for coating and substrate indicated.
2. Coat surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, coat surfaces behind permanently fixed equipment or furniture with prime coat only.
3. Coat back sides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
4. Do not apply coatings over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.

B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of the same material are to be applied. Tint undercoats to match color of finish coat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.

C. If undercoats or other conditions show through final coat, apply additional coats until cured film has a uniform coating finish, color, and appearance.

D. Apply coatings to produce surface films without cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Produce sharp glass lines and color breaks.

3.4 FIELD QUALITY CONTROL

A. Dry Film Thickness Testing: Owner will engage the services of a qualified testing and inspecting agency to inspect and test coatings for dry film thickness.

1. Contractor shall touch up and restore coated surfaces damaged by testing.
2. If test results show that dry film thickness of applied coating does not comply with coating manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with coating manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

B. After completing coating application, clean spattered surfaces. Remove spattered coatings by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.

C. Protect work of other trades against damage from coating operation. Correct damage by cleaning, repairing, replacing, and recoating, as approved by Architect, and leave in an undamaged condition.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced coated surfaces.

END OF SECTION 099600

SECTION 102113 - PHENOLIC-CORE 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. Phenolic-core toilet compartments configured as toilet enclosures and urinal screens.

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 toilet compartments.

B. Shop Drawings: For toilet compartments.

1. Include plans, elevations, sections, details, and attachment details.
2. Show locations of cutouts for compartment-mounted toilet accessories.
3. Show locations of centerlines of toilet fixtures.
4. Show ceiling, and overhead support or bracing locations.

C. Samples for Initial Selection: For each type of toilet compartment material indicated.

1. Include Samples of hardware and accessories involving material and color selection.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet compartments 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. Door Hinges: One hinge with associated fasteners.
2. Latch and Keeper: One latch and keeper with associated fasteners.
3. Door Bumper: One door bumper with associated fasteners.
4. Door Pull: One door pull with associated fasteners.
5. Fasteners: Ten fasteners of each size and type.

1.6 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 PERFORMANCE REQUIREMENTS

A. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: [25] [75] [200] or less.
2. Smoke-Developed Index: 450 or less.

B. Regulatory Requirements: Comply with applicable provisions in the U.S. Architectural & Transportation Barriers Compliance Board's ADA-ABA Accessibility Guidelines for Buildings and Facilities for toilet compartments designated as accessible.

2.2 PHENOLIC-CORE TOILET COMPARMENT

A. Toilet-Enclosure Style: Overhead braced floor and ceiling anchored.

B. Urinal-Screen Style: Overhead braced

C. Door, Panel, Screen, and Pilaster Construction: Solid phenolic-core panel material with melamine facing on both sides fused to substrate during panel manufacture (not separately laminated), and with eased and polished edges. Provide minimum 3/4-inch- (19-mm-) thick doors and pilasters and minimum 1/2-inch- (13-mm-) thick panels.

D. Pilaster Shoes and Sleeves Caps: Formed from stainless-steel sheet, not less than 0.031-inch (0.79-mm) nominal thickness and 3 inches (76 mm) high, finished to match hardware.

E. Urinal-Screen Post: Manufacturer's standard post design of material matching the thickness and construction of pilasters or with shoe and sleeve cap matching that on the pilaster.

F. Brackets (Fittings):

1. Stirrup Type: Ear or U-brackets, clear-anodized aluminum.

G. Phenolic-Panel Finish:

1. Facing Sheet Finish: One color and pattern in each room.
2. Color and Pattern: As selected by Architect from manufacturer's full range with manufacturer's standard through-color core matching face sheet.
3. Edge Color: Manufacturer's standard.

H. Overhead Cross Bracing for ceiling hung units: As recommended by manufacturer and fabricated from solid polymer.

2.3 HARDWARE AND ACCESSORIES

A. Hardware and Accessories: Manufacturer's standard operating hardware and accessories.

1. Material: Clear-anodized aluminum
2. Hinges: Manufacturer's standard integral hinge for solid-polymer doors.
3. Latch and Keeper: Manufacturer's standard surface-mounted 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 heavy-duty rubber-tipped cast-stainless-steel bumper at out-swinging doors and entrance-screen doors. Mount with through-bolts.
6. Door Pull: Manufacturer's heavy-duty cast-stainless-steel pull at out-swinging doors that complies with regulatory requirements for accessibility. Provide units on both sides of doors at compartments designated as accessible. Mount with through-bolts.

B. Overhead Bracing: Manufacturer's standard continuous, extruded-aluminum head rail with antigrip profile and in manufacturer's standard finish.

C. Anchorages and Fasteners: Manufacturer's standard exposed fasteners of stainless steel, finished to match the items they are securing, with theft-resistant-type heads. Provide sex-type bolts for through-bolt applications. For concealed anchors, use stainless-steel, hot-dip galvanized-steel, or other rust-resistant, protective-coated steel compatible with related materials.

2.4 MATERIALS

A. Aluminum Castings: ASTM B 26/B 26M.

B. Aluminum Extrusions: ASTM B 221 (ASTM B 221M).

C. Brass Castings: ASTM B 584.

D. Brass Extrusions: ASTM B 455.

E. Stainless-Steel Sheet: ASTM A 666, Type 304, stretcher-leveled standard of flatness.

F. Stainless-Steel Castings: ASTM A 743/A 743M.

G. Zamac: ASTM B 86, commercial zinc-alloy die castings.

2.5 FABRICATION

A. Fabrication, General: Fabricate toilet compartment components to sizes indicated. Coordinate requirements and provide cutouts for through-partition toilet accessories where required for attachment of toilet accessories.

B. Overhead-Braced Units: Provide manufacturer's standard corrosion-resistant supports, leveling

mechanism, and anchors at pilasters to suit floor conditions. Provide shoes at pilasters to conceal supports and leveling mechanism.

C. Floor-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for structural connection to floor. Provide shoes at pilasters to conceal anchorage.

D. Ceiling-Hung Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at pilasters for connection to structural support above finished ceiling. Provide assemblies that support pilasters from structure without transmitting load to finished ceiling. Provide sleeves (caps) at tops of pilasters to conceal anchorage.

E. Floor-and-Ceiling-Anchored Units: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of pilasters. Provide shoes and sleeves (caps) at pilasters to conceal anchorage.

F. Urinal-Screen Posts: Provide manufacturer's standard corrosion-resistant anchoring assemblies with leveling adjustment nuts at tops and bottoms of posts. Provide shoes and sleeves caps at posts to conceal anchorage.

G. Door Size and Swings: Unless otherwise indicated, provide 24-inch- (610-mm-) wide in-swinging doors for standard toilet compartments and 36-inch- (914-mm-) wide out-swinging doors with a minimum 32-inch- (813-mm-) wide clear opening for compartments designated as accessible.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions, with Installer present, for compliance with requirements for fastening, support, alignment, operating clearances, and other conditions affecting performance of the Work.

1. Confirm location and adequacy of blocking and supports required for installation.

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

3.2 INSTALLATION

A. General: Comply with manufacturer's written installation instructions. Install units rigid, straight, level, and plumb. Secure units in position with manufacturer's recommended anchoring devices.

1. Maximum Clearances:

a. Pilasters and Panels: 1/2 inch (13 mm).
b. Panels and Walls: 1 inch (25 mm).

2. Stirrup Brackets: Secure panels to walls and to pilasters with no fewer than three brackets attached at midpoint and near top and bottom of panel.

a. Locate wall brackets so holes for wall anchors occur in masonry or tile joints.
b. Align brackets at pilasters with brackets at walls.

3. Full-Height (Continuous) Brackets: Secure panels to walls and to pilasters with full-height brackets.

   a. Locate bracket fasteners so holes for wall anchors occur in masonry or tile joints.
   b. Align brackets at pilasters with brackets at walls.

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 (44 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Secure continuous head rail to each pilaster with no fewer than two fasteners. Hang doors to align tops of doors with tops of panels, and adjust so tops of doors are parallel with overhead brace when doors are in closed position.

C. Floor-Anchored Units: Set pilasters with anchors penetrating not less than 2 inches (51 mm) into structural floor unless otherwise indicated in manufacturer's written instructions. Level, plumb, and tighten pilasters. Hang doors and adjust so tops of doors are level with tops of pilasters when doors are in closed position.

D. Ceiling-Hung Units: Secure pilasters to supporting structure and level, plumb, and tighten. Hang doors and adjust so bottoms of doors are level with bottoms of pilasters when doors are in closed position.

E. Floor-and-Ceiling-Anchored Units: Secure pilasters to supporting construction and level, plumb, and tighten. Hang doors and adjust so doors are level and aligned with panels when doors are in closed position.

F. Urinal Screens: Attach with anchoring devices to suit supporting structure. Set units level and plumb, rigid, and secured to resist lateral impact.

3.3 ADJUSTING

A. Hardware Adjustment: Adjust and lubricate hardware according to hardware manufacturer's written instructions for proper operation. Set hinges on in-swinging doors to hold doors open approximately 30 degrees from closed position when unlatched. Set hinges on out-swinging doors and doors in entrance screens to return doors to fully closed position.

END OF SECTION 102113

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Childcare accessories.

B. Owner-Furnished Material: soap dispenser and toilet paper dispenser are provided by Owner, installed by General Contractor.

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 CLOSEOUT SUBMITTALS

A. Maintenance Data: For toilet and bath accessories to include in maintenance manuals.

1.5 QUALITY ASSURANCE

A. Source Limitations: For products listed together in the same Part 2 articles, obtain products from single source from single manufacturer.

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.

1.6 COORDINATION

A. Coordinate accessory locations with other work to prevent interference with clearances required for access by people with disabilities, and for proper installation, adjustment, operation, cleaning, and servicing of accessories.

1.7 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless Steel: ASTM A 666, Type 304, 0.031-inch (0.8-mm) 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 (0.9-mm) minimum nominal thickness.

D. Galvanized-Steel Sheet: ASTM A 653/A 653M, with G60 (Z180) hot-dip zinc coating.

E. Galvanized-Steel Mounting Devices: ASTM A 153/A 153M, hot-dip galvanized after fabrication.

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, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. A & J Washroom Accessories, Inc.
2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
6. Tubular Specialties Manufacturing, Inc.

B. Grab Bar:

1. Mounting: Flanges with concealed fasteners.

2. Material: Stainless steel, 0.05 inch (1.3 mm) thick.

a. Finish: Smooth, No. 4 finish (satin) on ends and slip-resistant texture in grip area.

3. Outside Diameter: 1-1/2 inches (38 mm).
4. Configuration and Length: As indicated on Drawings.

C. Sanitary-Napkin Disposal Unit:

1. Mounting: Surface mounted.
2. Receptacle: Removable.
3. Material and Finish: Stainless steel, No. 4 finish (satin).
4. Basis of Design: American Specialties, Inc.; 0852

D. Mirror Unit:

1. Frame: Stainless-steel channel.

a. Corners: Manufacturer's standard.

2. Hangers: Produce rigid, tamper- and theft-resistant installation, using method indicated below.

a. One-piece, galvanized-steel, wall-hanger device with spring-action locking mechanism to hold mirror unit in position with no exposed screws or bolts.
b. Wall bracket of galvanized steel, equipped with concealed locking devices requiring a special tool to remove.

3. Size: 18” x 36”

2.3 CHILDCARE ACCESSORIES

A. Diaper-Changing Station:

1. 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 (113-kg) static load when opened.

2. Mounting: Surface mounted, with unit projecting not more than 4 inches (100 mm) from wall when closed.
3. Operation: By pneumatic shock-absorbing mechanism.
4. Material and Finish: HDPE in manufacturer's standard color.
5. Liner Dispenser: Built in.

2.4 FABRICATION

A. General: Fabricate units with tight seams and joints, and exposed edges rolled. Hang doors and access panels with full-length, continuous hinges. Equip units for concealed anchorage and with corrosion-resistant backing plates.

B. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six 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 (1112 N), 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 102800

SECTION 123616 - METAL 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 stainless-steel countertops.

1.3 DELIVERY, STORAGE, AND HANDLING

A. Deliver metal countertops only after casework has been completed in installation areas.

B. Keep finished surfaces covered with polyethylene film or other protective covering during handling and installation.

1.4 FIELD CONDITIONS

A. Field Measurements: Verify actual dimensions of construction to receive metal countertops by field measurements before fabrication.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Stainless-Steel Sheet: ASTM A 240/A 240M, Type 304 with satin finish.

B. Sealant for Countertops: Manufacturer's standard sealant of characteristics indicated below that complies with applicable requirements in Section 079200 "Joint Sealants."

2.2 STAINLESS-STEEL COUNTERTOPS

A. Countertops: Fabricate from 0.062-inch- (1.59-mm-) thick, stainless-steel sheet. Provide smooth, clean exposed tops and edges in uniform plane, free of defects. Provide front and end overhang of 1 inch (25 mm) over the base cabinets.

1. Joints: Fabricate countertops without field-made joints.
2. Weld shop-made joints.
3. Sound deaden the undersurface with heavy-build mastic coating.
4. Extend the top down to provide a 1-inch- (25-mm-) thick edge with a 1/2-inch (12.7-mm) return flange.
5. Form the backsplash coved to and integral with top surface, with a 1/2-inch- (12.7-mm) thick top edge and 1/2-inch (12.7-mm) return flange.
6. Provide raised (marine) edge around perimeter of tops containing sinks; pitch tops containing sinks two ways to provide drainage without channeling or grooving.

2.3 STAINLESS-STEEL FINISH

A. Grind and polish surfaces to produce uniform, directional satin finish matching No. 4 finish, with no evidence of welds and free of cross scratches. Run grain with long dimension of each piece. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces clean.

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 metal countertops.

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

3.2 INSTALLATION

A. Install metal countertops level, plumb, and true; shim as required, using concealed shims.

B. Field Jointing: Where possible, make field jointing in the same manner as shop jointing; use 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.

C. Abut top and edge surfaces in one true plane, with internal supports placed to prevent deflection.

D. 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 CLEANING AND PROTECTION

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 Architect.

C. Protection: Provide 6-mil (0.15-mm) plastic or other suitable water-resistant covering over the countertop surfaces. Tape to underside of countertop at a minimum of 48 inches (1220 mm) o.c. Remove protection at Substantial Completion.

END OF SECTION 123616

SECTION 220010 - PLUMBING SUBMITTALS

PART 1 - GENERAL

1.1 GENERAL

A. Submittals shall include specially prepared technical data for this project, including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form for general application to a range of similar projects.

B. Submittals shall also include product data which includes standard printed information on materials, products and systems; not specially prepared for this project, but with the designation of selections from among available choices for this project clearly identified.

1.2 SUBMITTAL REQUIREMENTS

A. Coordination and Sequencing: Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittals. Coordinate and sequence different categories of submittals for same work, and for interfacing units of work, so that one will not be delayed for coordination of Architect/Engineer's review with another.

B. Preparation of Submittals: Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, submittal name and similar information to distinguish it from other submittals. Show Contractor's executed review and approval marking and providing space for Architect's/Engineer's "Action" marking. Package each submittal appropriately for transmittal and handling. Submittals which are received from sources other than through Contractor's office will be returned by Architect/Engineer "Without Action".

C. Provide Contractor's certification on form, ready for execution, stating that information submitted complies with requirements of contract documents.

D. The Contractor shall be responsible for and bear any expense of alterations to the building or its appurtenances resulting from the substitution of equipment to that specified in the Contract Documents.

E. Review of submittals does not release the Contractor from further satisfactory operating responsibilities. Material and equipment shall be approved for final acceptance when construction is completed and all units and systems have been operated, tested, adjusted and balanced to the satisfaction of the Architect/Engineer. Should proposed approved alternate equipment involve rearrangement of designed equipment, a complete layout of the area involved shall be submitted by the Contractor, and shall be approved in writing before installation of any such items of equipment. Any additional expense involved shall be a Contractor-borne expense.

F. Electronic Submittals: All submittals for shop drawings, O & M Manuals and Record Drawings shall be in electronic PDF format. Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

    a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., USD-22 05 00). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., USD-22 05 00 A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and/or Construction Manager.
4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Architect, Engineer and Owner**,** containing the following information:

    a. Project name.
    b. Date.
    c. Name and address of Architect.
    d. Name of Construction Manager.
    e. Name of Contractor.
    f. Name of firm or entity that prepared submittal.
    g. Names of subcontractor, manufacturer, and supplier.
    h. Category and type of submittal.
    i. Submittal purpose and description.
    j. Specification Section number and title.
    k. Specification paragraph number or drawing designation and generic name for each of multiple items.
    l. Drawing number and detail references, as appropriate.
    m. Location(s) where product is to be installed, as appropriate.
    n. Related physical samples submitted directly.
    o. Indication of full or partial submittal.
    p. Transmittal number, numbered consecutively.
    q. Submittal and transmittal distribution record.
    r. Other necessary identification.
    s. Remarks.

1.3 SUBMITTAL LIST

A. Submittals shall be submitted for, but not limited to, the items listed in each section of the specifications. Submittals, in addition to those listed, may be required by the Architect/Engineer. The following submittal register is a summary list of submittals required for the project.

SUBMITTAL REGISTER	
SECTION	ITEM
220500	Plumbing Pipe and Fittings
220500	Plumbing Valves and Specialties
220500	Meter and Gauges
220500	Plumbing Support and Anchors
220500	Plumbing Identification
220500	Plumbing Access Panels
220500	Joint Sealants
220700	Plumbing Insulation Product Data & Installation Instructions
221000	Potable Water Piping and Fittings
221000	Soil and Waste Piping and Fittings
221000	Fittings
221000	Plumbing Valves, Meters, Mixing Valves, Trap Primers, Interceptors
224000	Plumbing Fixtures & Layout Drawings
224010	Electric Water Heater

END OF SECTION 220010

SECTION 220500 - BASIC PLUMBING MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes the following basic mechanical materials and methods.

1. Piping materials and installation instructions common to most piping systems.

a. Valves:

(1) Gate
(2) Ball
(3) Plug
(4) Globe
(5) Butterfly
(6) Check

b. Valve Tags and Schedule Frames.
c. Piping Specialties:

(1) Pipe escutcheons
(2) Pipeline strainers
(3) Pipe sleeves
(4) Dielectric unions

d. Meters and gauges:

(1) Glass thermometers
(2) Pressure gauges

e. Supports and anchors:

(1) Horizontal-piping hangers and supports
(2) Saddles and shields
(3) Cushion clamps supports
(4) Isolation couplings
(5) Rooftop equipment supports
(6) Rooftop piping supports

2. Mechanical identification.
3. Vibration control:

a. Spring isolators
b. Isolation hangers

c. Flexible pipe connectors

4. Access panels.
5. Nonshrink grout for equipment installations.
6. Joint sealers for sealing around mechanical materials and equipment; and for sealing penetrations in fire and smoke barriers, floors, and foundation walls.
7. Installation requirements common to piping and equipment specification Sections.
8. Concrete equipment base construction requirements.
9. Mechanical demolition.
10. Excavation and backfill.
11. Cutting and patching.
12. Piping tests.

B. Pipe and pipe fitting materials are specified in piping system Sections.

1.3 DEFINITIONS

A. Pipe, pipe fittings, and piping include tube, tube fittings, and tubing.

B. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below the roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels.

C. Exposed Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.

D. Exposed Exterior Installations: Exposed to view outdoors, or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.

E. Concealed Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.

F. Concealed Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants, but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract.

B. Product data for following piping specialties:

1. Valves.
2. Mechanical sleeve seals.
3. Thermometers.
4. Pressure gauges.
5. Identification materials and devices.
6. Vibration Isolators.
7. Access panels.

C. Coordination drawings for access panel and door locations.

1.5 QUALITY ASSURANCE

A. Qualify welding processes and operators for structural steel according to AWS D1.1 "Structural Welding Code Steel."

B. Qualify welding processes and operators for piping according to ASME "Boiler and Pressure Vessel Code," Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions of ASME B31 Series "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for the welding processes involved and that certification is current.

C. MSS Compliance: Mark valves in accordance with MSS-25 "Standard Marking System for Valves, Fittings, Flanges and Unions."

D. ANSI Compliance: For face-to-face and end-to-end dimensions of flanged- or welded-end valve bodies, comply with ANSI B16.10 "Face-to-Face and End-to-End Dimensions of Ferrous Valves."

E. FCI Compliance: Test and rate Y-type strainers in accordance with FCI 73-I "Pressure Rating Standard for Y-type strainers". Test and rate other type strainers in accordance with FCI 78-1 "Pressure Rating Standard for Pipeline Strainers Other than Y-type".

F. UL and FM Compliance: Provide meters, gauges, and supports which are UL-listed and FM approved.

G. MSS Standard Compliance: Provide pipe hangers and supports of which materials, design, and manufacture comply with MSS SP-58.

H. ASME A13.1 for lettering size, length of color field, colors, and viewing angles of identification devices.

I. Equipment Selection: Equipment of greater or larger power, dimensions, capacities, and ratings may be furnished provided such proposed equipment is approved in writing and connecting mechanical and electrical services, circuit breakers, conduit, motors, bases, and equipment spaces are increased. No additional costs will be approved for these increases, if larger equipment is approved. If minimum energy ratings or efficiencies of the equipment are specified, the equipment must meet the design requirements and commissioning requirements.

1.6 AUTOCAD DRAWING FILE REQUESTS

A. As an instrument of service to aid in Shop Drawing Submittals, the Owner will provide AutoCAD drawing files upon request. The files will be sent upon return receipt of the "Request for Drawings" agreement signed by an officer of the requesting firm. The Owner does not assure that the drawings represent all changes, addenda items, change orders or modifications that may have occurred. The drawings are simply a tool for use in producing shop drawing submittals.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Deliver pipes and tubes with factory-applied end-caps. Maintain end-caps through shipping, storage, and handling to prevent pipe-end damage and prevent entrance of dirt, debris, and moisture.

B. Protect stored pipes and tubes from moisture and dirt. Elevate above grade. When stored inside, do not exceed structural capacity of the floor.

C. Protect flanges, fittings, and piping specialties from moisture and dirt.

D. Protect stored plastic pipes from direct sunlight. Support to prevent sagging and bending.

1.8 SEQUENCING AND SCHEDULING

A. Coordinate mechanical equipment installation with other building components.

B. Arrange for chases, slots, and openings in building structure during progress of construction to allow for mechanical installations.

C. Coordinate the installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.

D. Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the Work. Coordinate installation of large equipment requiring positioning prior to closing in the building.

E. Coordinate connection of electrical services.

F. Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies.

G. Coordinate requirements for access panels and doors where mechanical items requiring access are concealed behind finished surfaces.

H. Perform demolition in phases as indicated.

1.9 PROJECT CONDITIONS

A. Conditions Affecting Selective Demolition: The following project conditions apply:

1. Protect adjacent materials indicated to remain. Install and maintain dust and noise barriers to keep dirt, dust, and noise from being transmitted to adjacent areas. Remove protection and barriers after demolition operations are complete.
2. Locate, identify, and protect mechanical services passing through demolition area and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

B. Conditions Affecting Excavations: The following project conditions apply:

1. Maintain and protect existing building services which transit the area affected by selective demolition.

2. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by excavation operations.
3. Existing Utilities: Locate existing underground utilities in excavation areas. If utilities are indicated to remain, support and protect services during excavation operations.
4. Remove existing underground utilities indicated to be removed.

    a. Uncharted or Incorrectly Charted Utilities: Contact Utility Owner immediately for instructions.
    b. Provide temporary utility services to affected areas. Provide minimum of 72-hour notice to the Owner prior to utility interruption.

5. Use of explosives is not permitted.

PART 2 - PRODUCTS

2.1 PIPE AND PIPE FITTINGS

A. Refer to individual piping system specification Sections for pipe and fitting materials and joining methods.

B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

A. Pipe Flange Gasket Materials: Suitable for the chemical and thermal conditions of the piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch (3mm) maximum thickness, except where thickness or specific material is indicated.

    a. Full-Face Type: For flat-face, Class 125 cast-iron and cast-bronze flanges.
    b. Narrow-Face Type: For raised-face, Class 250 cast-iron and steel flanges.

2. ASME B16.20 for grooved, ring-joint, steel flanges.
3. AWWA C110, rubber, flat face, 1/8-inch (3mm) thick, except where other thickness is indicated; and full-face or ring type, except where type is indicated.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, except where other material is indicated.

C. Plastic Pipe Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, except where other type or material is indicated.

D. Solder Filler Metal: ASTM B 32.

1. Alloy Sn95 or Alloy Sn94: Tin (approximately 95%) and silver (approximately 5%), having 0.10% lead content.
2. Alloy Sn50: Tin (50%) and lead (50%) (for use on nonpotable water systems only).

E. Welding Filler Metals: Comply with AWS D10.12 for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

F. Solvent Cements: Manufacturer's standard solvents complying with the following:

1. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235.
2. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM F 493.
3. Poly(Vinyl Chloride) (PVC): ASTM D 2564.
4. PVC to ABS Transition: Made to requirements of ASTM D 3138, color other than orange.

G. Plastic Pipe Seals: ASTM F 477, elastomeric gasket.

H. Flanged, Ductile-Iron Pipe Gasket, Bolts, and Nuts: AWWA C110, rubber gasket, carbon steel bolts and nuts.

I. Couplings: Iron body sleeve assembly, fabricated to match outside diameters of plain-end pressure pipes.

1. Sleeve: ASTM A126, Class B, gray iron.
2. Followers: ASTM A 47 (ASTM A 47M), Grade 32510 or ASTM A 536 ductile iron.
3. Gaskets: Rubber.
4. Bolts and Nuts: AWWA C111.
5. Finish: Enamel paint.

2.3 PIPING SPECIALTIES

A. Pipe Escutcheons:

1. General: Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime paint finish for unoccupied areas.
2. Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide cast brass or sheet brass escutcheons, solid or split hinged.
3. Pipe Escutcheons for Dry Areas: Provide sheet steel escutcheons, solid or split hinged.

B. Low Pressure Pipeline Strainers:

1. General: Provide strainers full line size of connecting piping, with ends matching piping system materials. Select strainers for 125 PSI working pressure, with Type 304 stainless steel screens, with 3/64-inch perforations at 233 per square inch.
2. Threaded Ends, 2-inches and Smaller: Cast-iron body, screwed screen retainer with centered blowdown fitted with pipe plug.
3. Threaded Ends, 2-1/2-inches and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
4. Flanged Ends, 2-1/2-inches and Larger: Cast-iron body, bolted screen retainer with off-center blowdown fitted with pipe plug.
5. Butt Welded Ends, 2-1/2-inches and Larger: Schedule 40 cast carbon steel body, bolted screen retainer with off-center blowdown fitted with pipe plug.
6. Grooved Ends, 2-1/2-inches and Larger: Tee pattern, ductile-iron or malleable-iron body and access end cap, access coupling with EDPM gasket.

C. Dielectric Fittings: Assembly or fitting having insulating material isolating joined dissimilar metals to prevent galvanic action and stop corrosion.

1. Description: Combination of copper alloy and ferrous; threaded, solder, plain, and weld neck end types and matching piping system materials.
2. Insulating Material: Suitable for system fluid, pressure, and temperature.
3. Dielectric Unions: Factory-fabricated, union assembly for 250 PSIG (1725 kPa) minimum working pressure at a 180°F (82°C) temperature.
4. Dielectric Flanges: Factory-fabricated, companion-flange assembly for 150 or 300 PSIG (1035 kPa or 2070 kPa) minimum pressure to suit system pressures.
5. Dielectric-Flange Insulation Kits: Field-assembled, companion-flange assembly, full-face or ring type. Components include neoprene or phenolic gasket, phenolic or polyethylene bolt sleeves, phenolic washers, and steel backing washers.

    a. Provide separate companion flanges and steel bolts and nuts for 150 or 300 PSIG (1035 kPa or 2070 kPa) minimum working pressure to suit system pressures.

6. Dielectric Couplings: Galvanized-steel coupling, having inert and noncorrosive, thermoplastic lining, with threaded ends and 300 PSIG (2070 kPa) minimum working pressure at 225°F (107°C) temperature.
7. Dielectric Nipples: Electroplated steel nipple, having inert and noncorrosive thermoplastic lining, with combination of plain, threaded, or grooved end types and 300 PSIG (2070 kPa) working pressure at 225°F (107°C) temperature.

D. Mechanical Sleeve Seals: Modular, watertight mechanical type. Components include interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve. Connecting bolts and pressure plates cause rubber sealing elements to expand when tightened.

E. Sleeves: The following materials are for wall, floor, slab, and roof penetrations:

1. Steel Sheet-Metal: 24-gauge (0.70mm) or heavier galvanized sheet metal, round tube closed with welded longitudinal joint.
2. Steel Pipe: ASTM A 53, Type E, Grade A, Schedule 40, galvanized, plain ends.
3. Cast-Iron: Cast or fabricated wall pipe equivalent to ductile-iron pressure pipe, having plain ends and integral water stop, except where other features are specified.

2.4 VALVES

A. General: Provide factory-fabricated valves recommended by Manufacturer for use in service indicated. Provide valves of types and pressure ratings indicated; provide proper selection as determined by Installer to comply with Installation requirements. Provide end connections which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is Installer's option.

B. Gate Valves: Comply with the following requirements:

1. Gate Valves - 2-Inches and Smaller: MSS SP-80; Class 125, body and bonnet of ASTM B 62 cast bronze, threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Class 150 valves meeting the above shall be used where pressure requires.
2. Gate Valves - 2-Inches and Smaller: MSS SP-80; Class 150, body and union bonnet as ASTM B 62 cast bronze, threaded or solder ends, solid disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Do not use solder end valves for hot water heating or steam piping applications.
3. Gate Valves - 2-1/2-Inches and Larger: MSS SP-70; Class 125 iron body, bronze mounted, with body and bonnet conforming to ASTM A 126 Class B, flanged ends, and "Teflon" impregnated packing and two-piece backing gland assembly.

C. Ball Valves: Comply with the following requirements:

1. Ball valves - 1-inch and Smaller: Rated for 150 PSI SWP pressure, 600 PSI non-shock WOG pressure; 2-piece construction, bronze body conforming to ASTM B 584 or B61, full port, 316 stainless steel ball, reinforced "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide extended solder ends for condenser water, chilled water, and domestic hot and cold water service; full depth ANSI threaded ends for heating hot water and low pressure steam. Provide 2-inch extended handles of non-thermal conductive material. Valve pressure ratings shall be cast into the body of the valve.
2. Ball Valves - 1-1/4-Inches to 2-Inches: Rated for 150 PSI SWP pressure, 600 PSI non-shock WOG pressure; 2-piece construction, bronze body conforming to ASTM B 584 or B61, full port, 316 stainless steel ball, reinforced and replaceable "Teflon" or "TFE" seats and seals, blowout proof stem, and vinyl-covered steel handle. Provide extended solder ends for condenser water, chilled water, and domestic hot and cold water service; full-depth ANSI threaded ends for heating hot water and low pressure steam. Provide 2-inch extended handles of non-thermal conductive material. Valve pressure ratings shall be cast into the body of the valve.

D. Plug Valves: Comply with the following requirements:

1. Plug Valves - 2-Inches and Smaller: 150 PSI WOG, bronze body, straightaway pattern, square head, threaded ends.
2. Plug Valves - 2-1/2-Inches and Larger: MSS SP-78; 175 PSI WOG, lubricated plug type, semi-steel body, single gland, wrench operated, flanged ends.

E. Globe Valves: Comply with the following requirements:

1. Globe Valves - 2-Inches and Smaller: MSS SP-80; Class 125, body and screwed bonnet of ASTM B 62 cast bronze, threaded or solder ends, brass or replaceable composition disc, copper-silicon alloy stem, brass packing gland, "Teflon" impregnated packing, and malleable iron handwheel. Class 150 valves meeting the above shall be used where pressure requires.
2. Globe Valves - 2-1/2-Inches and Larger: MSS SP-85; Class 125 iron body and bolted bonnet conforming to ASTM A 126, Class B; outside screw and yoke, bronze-mounted, flanged ends, and "Teflon" impregnated packing and two-piece backing gland assembly.

F. Butterfly Valves: Comply with the following requirements:

1. Butterfly Valves - 2-1/2-Inches and Larger: MSS SP-67; 200 non-shock PSI, cast iron body conforming to ASTM A 126, Class B. Valves shall have field replaceable EPDM sleeve, with aluminum bronze disc, 400 Series stainless steel stem, and EPDM O-ring stem seals. Sizes 2-1/2-inch through 6-inches shall have 10-position lever operators with locks, and sizes 8-inch through 24-inch shall have gear operators with position indicator. Provide wafer type valve. Drill and tap valves on dead-end service or requiring additional body strength. Valve shall be capable of bi-directional dead end service with downstream flange removed at full-rated pressure.

G. Check Valves: Comply with the following requirements:

1. Swing Check Valves - 2-Inches and Smaller: MSS SP-80; Class 125, cast bronze body and cap conforming to ASTM B 62, horizontal swing, Y-pattern, with a bronze disc, and having threaded or solder ends. Valve shall be capable of being reground while the valve remains in the line. Class 150 valves meeting the above specifications may be used with threaded end connections where pressure requires or Class 125 valves are not available.

2. Swing Check Valves - 2-1/2-Inches and Larger: MSS SP-71; Class 125 (Class 175 FM approved for fire protection piping systems), ductile iron body and bolted cap conforming to ASTM A 126, Class B; horizontal swing, with a bronze disc with bronze disc ring, and flanged ends. Valve shall be capable of being refitted while the valve remains in the line.
3. Wafer Check Valves: Class 250, ductile iron body; with replaceable bronze seat, and non-slam design lapped and balanced twin bronze flappers and stainless steel trim and torsion spring. Valve shall be designed to open and close at approximately one foot differential pressure.

2.5 VALVE TAGS

A. Brass Valve Tags: Provide 19-gauge polished brass valve tags for all valves with stamp-engraved piping system abbreviation in 1/4-inch high letters and sequenced valve numbers 1/2-inch high, and with 5/32-inch hole for fastener.

1. Provide 1-1/2-inch diameter tags, except as otherwise indicated.
2. Fill tag engraving with black enamel.

B. Valve Tag Fasteners: Manufacturer's standard solid brass chain (wire link or beaded type), or solid brass S-hooks of the sizes required for proper attachment of tags to valves, and manufactured specifically for that purpose.

2.6 VALVE SCHEDULES

A. General: Provide a valve schedule for each piping system on standard size bond paper. Schedule shall include valve identification number, piping system, size and location of valve, normal operating position and additional remarks as required. Identify valve use for emergency shutoff or similar special use.

2.7 VALVE SCHEDULE FRAMES

A. General: For each page of valve schedule, provide glazed display frame, with screws for removable mounting on masonry walls. Provide frames of finished hardwood or extruded aluminum, with SSB-grade sheet glass.

2.8 METERS AND GAUGES

A. Thermometers:

1. General: Provide thermometers of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
2. Case: Die cast aluminum finished in baked epoxy enamel or hard powder coat finish, glass or acrylic front, 9-inches long.
3. Adjustable Joint: Die cast aluminum, finished to match case, 180° adjustment in vertical plane, 360° adjustment in horizontal plane, with locking device.
4. Tube and Capillary: Blue organic-liquid filled, magnifying lens, ±1 scale division accuracy, shock mounted.
5. Scale: Satin faced, non-reflective white aluminum, permanently etched black markings.
6. Stem: Copper-plated steel, brass or die-cast aluminum, for separable socket, length to suit installation.

7. Thermometer Wells: Provide thermometer wells constructed of brass or stainless steel, pressure rated to match piping system design pressure. Provide 2-inch extension for insulated piping. Provide cap fastened to well when used in a non-permanent thermometer location.
8. Thermometer wells shall be installed at each thermometer and at each point where a temperature sensing device is required by the control specifications.
9. Range: Conform to the following:

    a. Hot Water: 30^{o}F to 240^{o}F with 2^{o}F scale divisions.
    b. Chilled Water: 0^{o}F to 100^{o}F with 1^{o}F scale divisions.
    c. Heat Pump Loop Water: 0^{o}F to 160^{o}F with 2^{o}F scale divisions.

10. Acceptable Manufacturers:

    a. Marsh Gauges.
    b. Moeller Instruments.
    c. Miljoco Corporation.
    d. Weiss Instruments.
    e. Winters Instruments.

B. Pressure Gauges:

1. General: Provide pressure gauges of materials, capacities, and ranges indicated, designed and constructed for use in service indicated.
2. Type: General use, ±1% accuracy, ANSI B 40.1 Grade 1A, phosphor bronze bourdon type, bottom connection.
3. Case: Stainless steel, glass or acrylic lens, 4-1/2-inch diameter.
4. Connector: Brass, lower mount with 1/4-inch male NPT.
5. Scale: White coated aluminum, with permanently etched black markings.
6. Accessories:

    a. Provide protective coil siphon when used for steam service.
    b. Provide each gauge with a shut-off needle valve.
    c. Provide pressure snubber where spikes may be present.

7. Range: Conform to the following:

    a. Vacuum: 30-inch Hg - 15 PSI.
    b. Water: 0-100 PSI.

8. Acceptable Manufacturers:

    a. Marsh Gauges.
    b. Moeller Instruments.
    c. Miljoco Corporation.
    d. Weiss Instruments.
    e. Winters Instruments.

2.9 SUPPORTS AND ANCHORS

A. Horizontal-Piping Hangers and Supports:

1. General: Except as otherwise indicated, provide factory- fabricated horizontal-piping hangers and supports complying with MSS SP-58, of one (1) of the following MSS types listed, selected by

Installer to suit horizontal-piping systems, in accordance with MSS SP-69 and manufacturer's published product information. Use only one (1) type by one (1) manufacturer for each piping service. Select size of hangers and supports to exactly fit pipe size for bare piping, and to exactly fit around piping insulation with saddle or shield for insulated piping. Provide copper-plated hangers and supports for copper-piping systems.

2. Adjustable Steel Clevis Hangers: MSS Type 1.
3. Yoke Type Pipe Clamps: MSS Type 2.
4. Steel Double Bolt Pipe Clamps: MSS Type 3.
5. Steel Pipe Clamps: MSS Type 4.
6. Pipe Hangers: MSS Type 5.
7. Trapeze type with horizontal angle iron.

B. Vertical Piping Supports and Braces:

1. General: Support and brace vertical piping at every floor level and at 15 foot intervals where floor to floor level exceeds 15 feet, in compliance with MSS-SP-58. Support riser clamps below piping hubs or couplings.
2. Double-Bolt Riser Clamps: MSS Type 8.

C. Saddles and Shields:

1. General: Except as otherwise indicated, provide saddles or shields under piping hangers and supports, factory-fabricated, for all insulated piping. Size saddles and shields for exact fit to mate with pipe insulation.
2. Protection Saddles: MSS Type 39; fill interior voids with segments of insulation matching adjoining insulation.
3. Protection Shields: MSS Type 40; of length recommended by manufacturer to prevent crushing of insulation.
4. Thermal Hanger Shields: Constructed of 360 degree insert of high density, 100 PSI, water-proofed calcium silicate, encased in 360 degree sheet metal shield. Provide assembly of same thickness as adjoining insulation.

D. Cushion-Clamps: Constructed of material resistant to oils, hydraulic fluids, grease, fuels, common solvents, salt solutions, dilute bases and mineral acids; and not degrade at operating temperature of 275°F.

1. Tube, pipe, and hose lines to be secured using cushions with clamps and anchoring channel or other similar approved equal method.

E. Isolation Couplings: Constructed of material resistant to oils, hydraulic fluids, grease, fuels, common solvents, salt solutions, dilute bases and mineral acids; and not degrade at operating temperature of 275°F.

1. Tube, pipe, and hose lines to be secured using cushions with clamps and anchoring channel or other similar approved equal method. Channel stop required at bottom of coupling on vertical installations.

F. Roof Equipment Supports:

1. General: Construct roof equipment supports using minimum 18-gauge galvanized steel with fully mitered and welded corners, 3-inch cant, internal bulkhead reinforcing, integral base plates, pressure treated wood nailer, and 18-gauge galvanized steel counterflashing.

    a. Configuration: Construct to sizes as indicated, compensate for slope in roof so top of support is dead level.

2. Rooftop Piping Support: Rooftop support block body molded from UV-resistant black polypropylene copolymer with foam base platform of 1 inch thick, 25 PCF density closed cell polystyrene. Block and height extension accessories shall be molded with grooved piping saddles and heavy-duty threaded nut for 3/8-inch and 1/2-inch diameter ready-bolt extensions. Provide adhesive and securing brackets for metal roof and smooth membrane roofing applications.

   a. Support block shall be tested to 0°F against cracking or breakage.
   b. Load bearing capacity: 250 lbs at 6-foot spacing; 450 lbs with galvanized slotted steel strut channel at 6-foot spacing.
   c. Acceptable Manufacturers:

      (1) Dymotek Rooftop Blox.

2.10 MECHANICAL IDENTIFICATION

A. Equipment Markers:

1. General: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive or fasteners to mount on equipment.
2. Coordination: Verify with Owner if equipment bar code system is required for specific applications.
3. Terminology: Match drawing schedules as closely as possible unless directed otherwise by Owner.
4. Data Required:

   a. Equipment Description, i.e. Domestic Water Heater.
   b. Schedule Mark, i.e. DWH-1.

5. Marker Size: 2-1/2- by 4-inches for main control valves; 4-1/2- by 6-inches for equipment.

B. Plastic Pipe Markers:

1. Snap-On Type: Provide manufacturer's standard pre-printed, semi-rigid snap-on, color-coded pipe markers, complying with ANSI A13.1.
2. Small Pipes: For external diameters less than 6-inches (including insulation if any), provide full-band pipe markers, extending 360° around pipe at each location, fastened by the following method:

   a. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 3/4-inch wide; full circle at both ends of pipe marker, tape lapped 1-1/2-inches.

3. Large Pipes: For external diameters of 6-inch and larger (including insulation if any), provide either full-band or strip-type pipe markers, but not narrower than three (3) times letter height (and of required length), fastened by one (1) of the following methods:

   a. Taped to pipe (or insulation) with color-coded plastic adhesive tape, not less than 1-1/2-inches wide, full circle at both ends of pipe marker, tape lapped 3 inches.

4. Lettering: Comply with piping system nomenclature as specified, scheduled or shown on drawings, and abbreviate only as necessary for each application length.

   a. Arrows: Print each pipe marker with arrows indicating direction of flow, either integrally with piping system service lettering (to accommodate both directions), or as separate unit of plastic.

C. Plastic Tape:

1. General: Provide manufacturer's standard color-coded pressure-sensitive (self-adhesive) vinyl tape, not less than 3 mils thick.
2. Width: Provide 1-1/2-inch wide tape markers on pipes with outside diameters (including insulation, if any) of less than 6-inches, 2-1/2-inch wide tape for larger pipes.
3. Color: Comply with ANSI A13.1, or as scheduled below:

ITEM	BAND COLOR
Domestic Cold Water	Green
Domestic Hot Water	Yellow
Natural Gas	Yellow
Insulated Drains and Downspouts	Green

2.11 VIBRATION CONTROL

A. Spring Isolators, Free-Standing: Except as otherwise indicated, provide vibration isolation spring between top and bottom loading plates, and with pad-type isolator bonded to bottom of bottom loading plate. Include studs or cups to ensure centering of spring on plates. Include leveling bolt with lock nuts and washers, centered in top plate, arranged for leveling and anchoring supported equipment as indicated.

1. Include holes in bottom plate for bolting unit to substrate as indicated.

B. Isolation Hangers: Hanger units formed with brackets and including manufacturer's standard compression isolators of type indicated. Design brackets for three (3) times rated loading of units. Fabricate units to accept misalignment of 15^{o} off center in any direction before contacting hanger box, and for use with either rod or strap type members, and including acoustical washers to prevent metal-to-metal contacts.

1. Provide vibration isolation spring with cap in lower part of hanger and rubber hanger element in top, securely retained in unit.
2. Provide neoprene element, with minimum deflection of 0.35-inches, securely retained in hanger box.
3. Provide fiberglass pad or shape, securely retained in unit, with threaded metal top plate.
4. Provide hangers, pre-compressed to rated load to limit deflection during installation. Design so hanger may be released after full load is applied.

C. Flexible Pipe Connectors: Provide neoprene or EDPM construction consisting of multiple plies of nylon tire cord fabric and elastomer molded and cured in hydraulic rubber presses. Provide straight or elbow connector as indicated, rated at 125 PSI at 220^{o}F.

2.12 ACCESS PANELS

A. All panels shall be MILCOR, Style "M" for masonry, Style A for acoustical tile, and Style K for plaster; except that Fire Rated UL 1-1/2 hour and "B" label access panels shall be furnished in fire-rated walls and ceilings as indicated on the Drawings.

B. Access doors shall be 12-inch x 12-inch minimum size for valves and water hammer arrestors and shall be 24-inch x 36-inch for access to equipment and filters.

2.13 GROUT

A. Nonshrink, Nonmetallic Grout: ASTM C 1107, Grade B.

1. Characteristics: Post-hardening, volume-adjusting, dry, hydraulic-cement grout, non-staining, non-corrosive, non-gaseous, and recommended for interior and exterior applications.
2. Design Mix: 5000 PSI (34.50 MPa), 28 day compressive strength.
3. Packaging: Premixed and factory-packaged.

2.14 JOINT SEALERS

A. General: Joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.

B. Colors: As selected by the Architect from manufacturer's standard colors.

C. Elastomeric Joint Sealers: Provide the following types:

1. One-part, non-acid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
2. One-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and non-porous joint substrates; formulated with fungicide; intended for sealing interior joints with non-porous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes.
3. Products: Subject to compliance with requirements, provide the following:

a. One-Part, Non-acid-Curing, Silicone Sealant:

(1) "Dow Corning 790," Dow Corning Corp. (or Equal)

b. One-Part, Mildew-Resistant, Silicone Sealant:

(1) "Dow Corning 786," Dow Corning Corp. (or Equal)

D. Acrylic-Emulsion Sealants: One-part, nonsag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications on interior and protected exterior locations involving joint movement of not more than plus or minus 5%.

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

a. "Chem-Calk 600," Bostic Construction Products Div. (or Equal)

E. Fire-Resistant Joint Sealers: Two-part, foamed-in-place, silicone sealant formulated for use in through-penetration fire-stopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors. Sealants and accessories shall have fire-resistant ratings indicated, as established by testing identical assemblies in accordance with ASTM E 814, by Underwriters' Laboratories, Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

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

a. "Dow Corning Fire Stop Foam," Dow Corning Corp. (or Equal)

PART 3 - EXECUTION

3.1 PIPING SYSTEMS-COMMON REQUIREMENTS

A. General: Install piping as described below, except where system Sections specify otherwise.

B. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated, except where deviations to layout are approved on coordination drawings.

C. Install piping at indicated slope.

D. Install components having pressure rating equal to or greater than system operating pressure.

E. Install piping in concealed interior and exterior locations, except in equipment rooms and service areas.

F. Install piping free of sags and bends.

G. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.

H. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

I. Install piping to allow application of insulation plus 1-inch clearance around insulation.

J. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

K. Install fittings for changes in direction and branch connections.

L. Install couplings according to manufacturer's printed instructions.

M. Install pipe escutcheons for pipe penetrations of concrete and masonry walls, wall board partitions, and suspended ceilings according to the following:

1. Chrome-Plated Piping: Cast-brass, one-piece, with set-screw, and polished chrome-plated finish. Use split-casting escutcheons, where required, for existing piping.
2. Uninsulated Piping Wall Escutcheons: Cast-brass or stamped-steel, with set-screw.
3. Uninsulated Piping Floor Plates in Utility Areas: Cast-iron floor plates.
4. Insulated Piping: Cast-brass or stamped-steel, with concealed hinge, spring clips, and chrome-plated finish.
5. Piping in Utility Areas: Cast-brass or stamped-steel, with set-screw or spring clips.

N. Sleeves are not required for core drilled holes.

O. Permanent sleeves are not required for holes formed by PE plastic (removable) sleeves.

P. Install sleeves for pipes passing through concrete and masonry walls, concrete floor and roof slabs, and where indicated.

1. Cut sleeves to length for mounting flush with both surfaces.

a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2-inches (50mm) above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring where specified.

2. Build sleeves into new walls and slabs as work progresses.
3. Install large enough sleeves to provide 1/4-inch (6mm) annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:

   a. Steel Pipe Sleeves: For pipes smaller than 6-inches.
   b. Steel Sheet-Metal Sleeves: For pipes 6-inches and larger that penetrate gypsum-board partitions.
   c. Cast-Iron Sleeve Fittings: For floors having membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2-inches (50mm) above finished floor level.

4. Except for below-grade wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using elastomeric joint sealants.

Q. Above Grade, Exterior Wall, Pipe Penetrations: Seal penetrations using sleeves and mechanical sleeve seals. Size sleeve for 1-inch (25mm) annular clear space between pipe and sleeve for installation of mechanical seals.

1. Install steel pipe for sleeves smaller than 6-inch.
2. Install cast-iron wall pipes for sleeves 6-inch and larger.
3. Assemble and install mechanical seals according to manufacturer's printed instructions.

R. Below Grade, Exterior Wall, Pipe Penetrations: Install cast-iron wall pipes for sleeves. Seal pipe penetrations using mechanical sleeve seals. Size sleeve for 1-inch (25mm) annular clear space between pipe and sleeve for installation of mechanical seals.

S. Piping Joint Construction: Join pipe and fittings as follows and as specifically required in individual piping system Sections.

1. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.
2. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
3. Soldered Joints: Construct joints according to AWS "Soldering Manual," Chapter 22 "The Soldering of Pipe and Tube."
4. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full inside diameter. Join pipe fittings and valves as follows:

   a. Note the internal length of threads in fittings or valve ends, and proximity of internal seat or wall, to determine how far pipe should be threaded into joint.
   b. Apply appropriate tape or thread compound to external pipe threads (except where dry seal threading is specified).
   c. Align threads at point of assembly.
   d. Tighten joint with wrench. Apply wrench to valve end into which pipe is being threaded.
   e. Damaged Threads: Do not use pipe or pipe fittings having threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

5. Welded Joints: Construct joints according to AWS D10.12 "Recommended Practices and Procedures for Welding Low Carbon Steel Pipe" using qualified processes and welding operators according to the "Quality Assurance" Article.

6. Flanged Joints: Align flange surfaces parallel. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.
7. Plastic Pipe and Fitting Solvent-Cement Joints: Clean and dry joining surfaces by wiping with clean cloth or paper towels. Join pipe and fittings according to the following standards:

    a. Comply with ASTM F 402 for safe handling of solvent-cement and primers.
    b. Acrylonitrile-Butadiene-Styrene (ABS): ASTM D 2235 and ASTM D 2661.
    c. Chlorinated Poly(Vinyl Chloride) (CPVC): ASTM D 2846 and ASTM F 493.
    d. Poly(Vinyl Chloride) (PVC) Pressure Application: ASTM D 2672.
    e. Poly(Vinyl Chloride) (PVC) Non-Pressure Application: ASTM D 2855.
    f. PVC to ABS (Non-Pressure) Transition: Procedure and solvent cement described in ASTM D 3138.

8. Plastic Pipe and Fitting Heat-Fusion Joints: Prepare pipe and fittings and join with heat-fusion equipment according to manufacturer's printed instructions.

    a. Plain-End Pipe and Fittings: Butt joining.
    b. Plain-End Pipe and Socket-Type Fittings: Socket joining.

T. Piping Connections: Except as otherwise indicated, make piping connections as specified below.

1. Install unions in piping 2-inch (50mm) and smaller adjacent to each valve and at final connection to each piece of equipment having a 2-inch (50mm) or smaller threaded pipe connection.
2. Install flanges in piping 2-1/2-inches (65mm) and larger adjacent to flanged valves and at final connection to each piece of equipment having flanged pipe connection.
3. Dry Piping Systems (Gas, Compressed Air, and Vacuum): Install dielectric unions and flanges to connect piping materials of dissimilar metals.
4. Wet Piping Systems (Water and Steam): Install dielectric coupling and nipple fittings to connect piping materials of dissimilar metals.
5. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces.
6. Install isolation valves upstream of all dielectric unions and flanges.

3.2 EQUIPMENT INSTALLATION-COMMON REQUIREMENTS

A. Install equipment to provide the maximum possible headroom where mounting heights are not indicated.

B. Install equipment according to approved submittal data. Portions of the Work are shown only in diagrammatic form. Refer conflicts to the Architect.

C. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, except where otherwise indicated.

D. Install mechanical equipment to facilitate servicing, maintenance, and repair or replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations. Extend grease fittings to an accessible location.

E. Install equipment giving right-of-way to piping systems installed at a required slope.

3.3 VALVE SELECTION

A. Selection of Valve Ends (Pipe Connections): Except as otherwise indicated, select valves with the following ends or types of pipe/tube connections:

1. Copper Tube Size 2-Inch and Smaller: Solder ends, except in heating hot water and low pressure steam service which shall have threaded ends.
2. Steel Pipe Sizes 2-Inch and Smaller: threaded or grooved-end.
3. Steel Pipe Sizes 2-1/2-Inch and Larger: grooved-end or flanged.

3.4 VALVE INSTALLATIONS

A. General Application: Use gate, ball, and butterfly valves for shut-off duty; globe, ball, and butterfly for throttling duty. Refer to piping system specification sections for specific valve applications and arrangements.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves and unions for each fixture and item of equipment in a manner to allow equipment removal without system shut-down. Unions are not required on flanged devices.

D. Install 3-valve bypass around each pressure reducing valve using throttling type valves.

E. Install valves in horizontal piping with stem at or above the center of the pipe, and to allow full stem movement.

F. Installation of Check Valves: Install for proper direction of flow as follows:

1. Swing Check Valves: Install in horizontal position with hinge pin level.
2. Wafer Check Valves: Install between two (2) flanges in horizontal or vertical position.
3. Lift Check Valve: Install in piping line with stem upright and plumb.

G. Valve Schedule:

1. Sectional Valves:

a. 2-inch and Smaller: Ball valves.
b. 2-1/2-inch and Larger: Gate or butterfly valves.

2. Shut-off Valves:

a. 2-inch and Smaller: Ball valves.
b. 2-1/2-inch and Larger: Gate or butterfly valves.

3. Throttling Valves:

a. 2-inch and Smaller: Ball or globe valves.
b. 2-inch and Larger: Globe or butterfly valves.

H. Valve Locations:

1. Plumbing Piping:

a. Sectional Valves: Install on each branch and riser, close to main, where branch or riser serves two (2) or more plumbing fixtures or equipment connections, and elsewhere as indicated.
b. Shut-off Valves: Install on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated.
c. Throttling Valves: As required on plans.

2. Valve Tags:

a. Provide valve tags for all valves and list on Valve Schedule.
b. Install tags on valves in piping systems, except check valves, valves within factory-fabricated equipment units; plumbing fixture supply stops; and HVAC terminal devices.

3.5 VALVE PRESSURE/TEMPERATURE CLASSIFICATION SCHEDULES

	VALVES 2-INCHES AND SMALLER			
SERVICE	GATE	GLOBE	BALL	CHECK
Domestic Hot & Cold Water	125	125	150	125

	VALVES 2-1/2-INCHES AND LARGER			
SERVICE	GATE	GLOBE	BUTTERFLY	CHECK
Domestic Hot & Cold Water	125	125	200	125

3.6 PIPING SPECIALTIES INSTALLATION

A. Y-Type Strainers: Install Y-type strainers full size of pipeline, in accordance with manufacturer's installation instructions. Install pipe nipple and shut-off valve in strainer blow-down connection, full size of connection, except for strainers 2-inch and smaller installed ahead of control valves feeding individual terminals. Where indicated, provide drain line from shut-off valve to plumbing drain, full size of blow-down connection.

1. Locate Y-type strainers in supply line ahead of the following equipment, and elsewhere as indicated, if integral strainer is not included in equipment:

a. Pumps.
b. Temperature control valves.
c. Pressure reducing valves.
d. Temperature or pressure regulating valves.

B. Dielectric Unions: Install at each piping joint between ferrous and nonferrous piping. Comply with manufacturer's installation instructions.

1. Install isolation valves upstream of all dielectric unions.

3.7 METERS AND GAUGES INSTALLATION

A. Glass Thermometers:

1. General: Install glass thermometers in vertical upright position, and tilted so as to be easily read by observer standing on floor.
2. Locations: Install in the following locations, and elsewhere as indicated:

a. At inlet and outlet of each domestic water heater.

B. Pressure Gauges:

1. General: Install pressure gauges in piping tee with pressure gauge cock, located on pipe at most readable position.
2. Locations: Install in the following locations, and elsewhere as indicated:

a. Across suction and discharge of each hydronic pump.
b. At discharge of each pressure reducing valve.
c. At domestic water service entrance.

3.8 SUPPORTS AND ANCHORS INSTALLATION

A. Hangers and Supports:

1. General: Install hangers, supports, clamps and attachments to support piping properly from building structure; comply with MSS SP-69. Arrange for grouping of parallel runs of horizontal piping to be supported together on trapeze type hangers where possible. Install supports with maximum spacings complying with MSS SP-69. Where piping of various sizes is to be supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe. Do not use wire or perforated metal to support piping, and do not support piping from other piping. Piping shall not be supported from bottom cord of bar joist or from metal roof deck, unless approved by Structural Engineer. Piping may be supported at panel points of bar joists.
2. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers and other accessories. Except as otherwise indicated for exposed continuous pipe runs, install hangers and supports of same type and style as installed for adjacent similar piping.
3. Powder-actuated fasteners shall be approved only for installation where load will be applied perpendicular to the fasteners. Powder-actuated fasteners shall not be used where load will be applied to axially to the fasteners.
4. Support fire-water piping independently of other piping.
5. Prevent electrolysis in support of copper tubing by use of hangers and supports which are copper plated, or by other recognized industry methods.

B. Saddles and Shields:

1. Insulated Piping: Comply with the following installation requirements:

a. Shields: Where low-compressive-strength insulation or vapor barriers are indicated on cold or chilled water piping, install coated protective shields. For pipe 8-inch and over, install wood insulation saddles.
b. Saddles: Where insulation without vapor barrier is indicated, install protection saddles.
c. Cushion-Clamps: Comply with manufacturer's installation instructions.
d. Isolation Couplings: Comply with manufacturer's installation instructions.

C. Rooftop Equipment Supports:

1. Comply with manufacturer's installation instructions. Ensure supports are spaced adequately to support equipment and piping within manufacturer's rated loading capacity.

3.9 MECHANICAL IDENTIFICATION INSTALLATION

A. Install equipment markers with permanent adhesive or appropriate fasteners on or near each major item of mechanical equipment

1. Locate markers where accessible and visible.
2. Include markers for the following categories of equipment:

a. Main control and operating valves.
b. Pumps, water heaters, tanks, pressure vessels, humidifiers, water-treatment systems, and similar equipment.

B. Locate pipe markers and color bands as follows wherever piping is exposed to view in occupied spaces, machine rooms, accessible maintenance spaces (shafts, tunnels, plenums) and exterior non-concealed locations.

1. Near each valve and control device.
2. Near each branch, excluding short take-offs for fixtures; mark each pipe at branch, where there could be question of flow pattern.
3. Near locations where pipes pass through walls or floors/ceilings, or enter non-accessible enclosures.
4. At access doors, manholes and similar access points which permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced intermediately at maximum spacing of 50-feet along each piping run, except reduce spacing to 25-feet in congested areas of piping and equipment.
7. On piping above removable acoustical ceilings, except omit intermediately spaced markers.

3.10 VIBRATION CONTROL INSTALLATION

A. General: Except as otherwise indicated, comply with manufacturer's instructions for installation and load application to vibration control materials and units. Adjust to ensure that units have equal deflection, do not bottom out under loading, and are not short-circuited by other contacts or bearing points. Remove space blocks and similar devices intended for temporary support during installation.

B. Install units between substrate and equipment as required for secure operation and to prevent displacement by normal forces, and as indicated.

C. Adjust leveling devices as required to distribute loading uniformly onto isolators. Shim units as required where substrate is not level.

D. Locate isolation hangers as near overhead support structure as possible.

E. Flexible Pipe Connectors: Install on equipment side of shut-off valves, horizontally and parallel to equipment shafts wherever possible.

3.11 ACCESS PANEL INSTALLATION

A. Mechanical Contractor shall locate and furnish for installation by General Contractor, all access panels as required for access to valves and water hammer arresters, dampers, and the proper servicing of equipment and piping installed under this Contract.

3.12 CONCRETE BASES

A. Construct concrete equipment bases of dimensions indicated, but not less than 4-inches larger than supported unit in both directions. Follow supported equipment manufacturer's setting templates for anchor bolt and tie locations. Use 3000 PSI, 28 day compressive strength concrete and reinforcement.

3.13 ERECTION OF METAL SUPPORTS AND ANCHORAGE

A. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.

B. Field Welding: Comply with AWS D1.1 "Structural Welding Code-Steel."

3.14 ERECTION OF WOOD SUPPORTS AND ANCHORAGE

A. Cut, fit, and place wood grounds, nailers, blocking, and anchorage to support and anchor mechanical materials and equipment.

B. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members.

C. Attach to substrates as required to support applied loads.

3.15 SELECTIVE DEMOLITION

A. General: Demolish, remove, demount, and disconnect abandoned plumbing materials and equipment indicated to be removed and not indicated to be salvaged or saved.

B. Materials and Equipment to be Salvaged: Remove, demount, and disconnect existing plumbing materials and equipment indicated to be removed and salvaged, and deliver materials and equipment to the location designated for storage by Owner.

C. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

D. Plumbing Materials and Equipment: Demolish, remove, demount, and disconnect the following items:

1. Inactive and obsolete piping, fittings and specialties, equipment, ductwork, controls, fixtures, and insulation.

    a. Piping embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove materials above accessible ceilings. Drain and cap piping allowed to remain.

3.16 EXCAVATION AND BACKFILL

A. Slope sides of excavations to comply with local codes and ordinances. Shore and brace as required for stability of excavation.

B. Shoring and Bracing: Establish requirements for trench shoring and bracing to comply with local codes and authorities. Maintain shoring and bracing in excavations regardless of time period excavations will be open.

1. Remove shoring and bracing when no longer required. Where sheeting is allowed to remain, cut top of sheeting at an elevation of 30-inches below finished grade elevation.

C. Install sediment and erosion control measures in accordance with local codes and ordinances.

D. Dewatering: Prevent surface water and subsurface or ground water from flowing into excavations and from flooding project site and surrounding area.

1. Do not allow water to accumulate in excavations. Remove water to prevent softening of bearing materials. Provide and maintain dewatering system components necessary to convey water away from excavations.
2. Establish and maintain temporary drainage ditches and other diversions outside excavation limits to convey surface water to collecting or run-off areas. Do not use trench excavations as temporary drainage ditches.

E. Material Storage: Stockpile satisfactory excavated materials where directed, until required for backfill or fill. Place, grade, and shape stockpiles for proper drainage.

1. Locate and retain soil materials away from edge of excavations. Do not store within drip-line of trees indicated to remain.
2. Remove and legally dispose of excess excavated materials and materials not acceptable for use as backfill or fill.

F. Trenching: Excavate trenches for mechanical installations as follows:

1. Excavate trenches to the uniform width, sufficiently wide to provide ample working room and a minimum of 6- to 9-inches clearance on both sides of pipe and equipment.
2. Excavate trenches to depth indicated or required for piping to establish indicated slope and invert elevations. Beyond building perimeter, excavate trenches to an elevation below frost line.
3. Limit the length of open trench to that in which pipe can be installed, tested, and the trench backfilled within the same day.
4. Where rock is encountered, carry excavation below required elevation and backfill with a layer of crushed stone or gravel prior to installation of pipe. Provide a minimum of 6 inches of stone or gravel cushion between rock bearing surface and pipe.
5. Excavate trenches for piping and equipment with bottoms of trench to accurate elevations for support of pipe and equipment on undisturbed soil.

    a. For pipes or equipment 6-inch or larger in nominal size, shape bottom of trench to fit bottom 1/4 of the circumference. Fill unevenness with tampered sand backfill. At each pipe joint over-excavate to relieve the bell or pipe joint of the pipe of loads, and to ensure continuous bearing of the pipe barrel on the bearing surface.

G. Cold Weather Protection: Protect excavation bottoms against freezing when atmospheric temperature is less than 35˚F (2˚C).

H. Backfilling and Filling: Place soil materials in layers to required subgrade elevations for each area classification listed below, using materials specified in Part 2 of this Section.

1. Under walks and pavements, use a combination of subbase materials and excavated or borrowed materials.
2. Under building slabs, use drainage fill materials.

3. Under piping and equipment, use subbase materials where required over rock bearing surface and for correction of unauthorized excavation.
4. For piping less than 30-inches below surface of roadways, provide 4-inch thick concrete base slab support. After installation and testing of piping, provide a 4-inch thick concrete encasement (sides and top) prior to backfilling and placement of roadway subbase.
5. Other areas use excavated or borrowed materials.

I. Backfill excavation as promptly as work permits, but not until completion of the following:

1. Inspection, testing, approval, and locations of underground utilities have been recorded.
2. Removal of concrete formwork.
3. Removal of shoring and bracing, and backfilling of voids.
4. Removal of trash and debris.

J. Placement and Compaction: Place backfill and fill materials in layers of not more than 8-inches in loose depth for material compacted by heavy equipment, and not more than 4-inches in loose depth for material compacted by hand-operated tampers.

K. Before compaction, moisten or aerate each layer as necessary to provide optimum moisture content. Compact each layer to required percentage of maximum dry density or relative dry density for each area classification specified below. Do not place backfill or fill material on surfaces that are muddy, frozen, or contain frost or ice.

L. Place backfill and fill materials evenly adjacent to structures, piping, and equipment to required elevations. Prevent displacement of piping and equipment by carrying material uniformly around them to approximately same elevation in each lift.

M. Compaction: Control soil compaction during construction, providing minimum percentage of density specified for each area classification indicated below:

1. Percentage of Maximum Density Requirements: Compact soil to not less than the following percentages of maximum density for soils which exhibit a well-defined moisture-density relationship (cohesive soils), determined in accordance with ASTM D 698 and not less than the following percentages of relative density, determined in accordance with ASTM D 4253 and ASTM D 4254, for soils which will not exhibit a well-defined moisture-density relationship (cohesionless soils).

    a. Areas Under Structures, Building Slabs and Steps, Pavements: Compact top 12-inches of subgrade and each layer of backfill or fill material to 95% maximum density for cohesive material, or 98% relative density for cohesionless material.
    b. Areas Under Walkways: Compact top 6 inches of subgrade and each layer of backfill or fill material to 95% maximum density for cohesive material, or 98% relative density for cohesionless material.
    c. Other Areas: Compact top 6-inches of subgrade and each layer of backfill or fill material to 85% maximum density for cohesive soils, and 90% relative density for cohesionless soils.

2. Moisture Control: Where subgrade or layer of soil material must be moisture conditioned before compaction, uniformly apply water. Apply water in minimum quantity necessary to achieve required moisture content and to prevent water appearing on surface during, or subsequent to, compaction operations.

N. Subsidence: Where subsidence occurs at mechanical installation excavations during the period 12 months after Substantial completion, remove surface treatment (i.e., pavement, lawn, or other finish), add backfill material, compact to specified conditions, and replace surface treatment. Restore appearance, quality, and condition of surface or finish to match adjacent areas.

3.17 CUTTING AND PATCHING

A. Cut, channel, chase, and drill floors, walls, partitions, ceilings, and other surfaces necessary for mechanical installations. Perform cutting by skilled mechanics of the trades involved.

B. Repair cut surfaces to match adjacent surfaces.

3.18 GROUTING

A. Install nonmetallic nonshrink grout for mechanical equipment base bearing surfaces, pump and other equipment base plates, and anchors. Mix grout according to manufacturer's printed instructions.

B. Clean surfaces that will come into contact with grout.

C. Provide forms for placement of grout, as required.

D. Avoid air entrapment when placing grout.

E. Place grout to completely fill equipment bases.

F. Place grout on concrete bases to provide a smooth bearing surface for equipment.

G. Place grout around anchors.

H. Cure placed grout according to manufacturer's printed instructions.

3.19 PIPING TEST

A. No piping work, fixtures, or equipment shall be concealed or covered until they have been observed by the Engineer's representative, who shall be notified by the Contractor when the work is ready for inspection. All work shall be completely installed, tested as required by this Section and the State Ordinances and State Safety Orders, and shall be leak-tight before inspection is requested. All tests shall be repeated upon request to the satisfaction of those making the inspection.

B. All domestic water piping shall be flushed, tested at 100 PSI and shall be left under pressure of supply main or a minimum of 40 PSI for the balance of the construction period.

C. Piping tests shall be made with the test medium and under test pressures listed in the following table. Use a calibrated Bristol Pressure Recorder, or equal, on all tests. Engineer's representative shall install and remove each chart. Recorder range shall be 0-300 pounds or required range for specific test.

PIPING TESTS

Type of Piping	Test Pressure	Test Medium	Test Period
Soil, Waste, Vent, Rain Water Leaders and Storm Drainage Piping Within Building	Minimum of 10 foot head on each joint with no loss in head	Water	One Hour
Domestic Water 1. Pressure Regulated to and including 80 PSI	150 PSIG	Water	Two Hours
2. Non-regulated above 80 PSI	Twice normal static pressure at the service point	Water	Two Hours

D. Test pressure in lbs. per square inch, or inches of vacuum, gauge, are given as an initial pressure to be applied to lines being tested, together with test medium.

E. Final pressures at the end of test period shall be no more or less than that caused by expansion or contraction of the test medium due to temperature changes.

F. Check of systems during application of test pressures should include visual check for water medium leakage, soap bubble or similar for air and nitrogen medium, and halide torch for refrigerant medium after charging.

G. During heating and cooling cycles, linear expansion shall be checked at all elbows, U-bends, expansion joints, etc., for proper clearance.

END OF SECTION 220500

SECTION 220700 - PLUMBING INSULATION

PART 1 - GENERAL

1.1 GENERAL

A. Plumbing insulation required by this section is indicated on drawings, and by requirements of this section.

1.2 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation.

B. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each plumbing system requiring insulation.

1.3 QUALITY ASSURANCE

A. Furnish insulation and materials bearing the manufacturer's label. Only mechanics skilled at such work shall apply materials. Insulation and materials shall be by one of the manufacturers listed. Specialty material shall be of the manufacturer indicated or approved equal. Fire and smoke hazard classification ratings on insulation, jacket, and adhesive shall conform to NFPA 255, ASTM E 84, or UL-723 as follows:

1. Flame Spread Index not exceeding 25.
2. Fuel Contributed not exceeding 50.
3. Smoke Developed Index not exceeding 50.

B. Certifications: Submit certifications or other data as necessary to show compliance with these specifications and governing regulations. Include proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.

C. Manufacturers: Firms regularly engaged in manufacture of plumbing insulation products, of types and sizes required, whose products have been in satisfactory use in similar service for not less than three (3) years.

D. Subject to compliance with requirements, provide products of one (1) of the following manufacturers:

1. Armacell LLC
2. Dow Chemical Company
3. Einsulation, Inc.
4. Johns-Manville Corp.
5. Keene Corp.
6. Knauf Fiber Glass
7. Owens-Corning Fiberglass Corp.
8. Rubatex Corp.
9. Pittsburg Corning Corp.

E. Thermal Conductivity Average Maximum in Btu-in/hr-ft^2 at 75^{o}F Mean Temperature:

1. Fiberglass Board = 0.26.
2. Fiberglass Blanket = 0.30.
3. Fiberglass Preformed Pipe Insulation = 0.26.
4. Cellular Glass = 0.30.
5. Flexible Elastomeric Cellular = 0.27.
6. Polyisocyanurate = 0.19.
7. Calcium Silicate = 0.60 @ 500°F.

F. Vapor retarder film and tape shall have a maximum permeance of 0.030 perm.

PART 2 - PRODUCTS

2.1 PIPING SYSTEM INSULATION

A. Piping insulation shall be as scheduled below:

	SYSTEM	PIPE SIZE AND LOCATION	INSULATION AND JACKET
1.	Sanitary Drainage from drains serving cooling coil condensate drainage or ice machine drainage and from refrigerated water coolers	Above Ground Piping	1-inch 4-pcf density fiberglass insulation with fire-resistive, ASJ vapor barrier jacket or 1/2-inch fire retardant flexible elastomeric closed-cell plastic foam insulation or 1-inch polyisocyanurate closed cell insulation with vapor retarder film.
2.	Domestic Cold Water (including HVAC Make-up Lines)	Piping in building through 1-1/4-inch	1-inch 4-pcf density fiberglass insulation with fire-resistive, ASJ vapor barrier jacket or 1/2-inch fire retardant flexible elastomeric closed-cell plastic foam insulation or 1-inch polyisocyanurate closed cell insulation with vapor retarder film.
3.	Domestic Cold Water (including HVAC Make-up Lines)	Piping in building 1-1/2 inch and larger	1-inch 4-pcf density fiberglass insulation with fire-resistive, ASJ vapor barrier jacket or 1-inch fire retardant flexible elastomeric closed-cell plastic foam insulation or 1-inch polyisocyanurate closed cell insulation with vapor retarder film.
4.	Domestic Hot and Recirculated Hot Water	Piping in building through 2-inch	1-inch 4-pcf density fiberglass insulation with fire-resistive, ASJ vapor barrier jacket or 1-inch fire retardant flexible elastomeric closed-cell plastic foam insulation or 1-inch polyisocyanurate closed cell insulation with vapor retarder film.
5.	Domestic Hot Water	Piping in building 2 1/2-inch and larger	1-1/2-inch 4-pcf density fiberglass insulation with fire resistive, ASJ vapor barrier jacket or 1-1/2-inch fire

SYSTEM	PIPE SIZE AND LOCATION	INSULATION AND JACKET
		retardant flexible elastomeric closed-cell plastic foam insulation or 1-inch polyisocyanurate closed cell insulation with vapor retarder film.

B. All pre-formed fiberglass and elastomeric closed-cell plastic foam pipe insulation shall be provided with self-adhering and self-sealing overlapping flap.

C. Handicapped Lavatory Drain and P-Trap Assembly and Hot and Cold Water Supply Pipe and Valve Assembly: Insulate handicap lavatory P-trap and angle valve assemblies with the premolded assembly as manufactured by "Truebro" Lav-Guard, Plumberex Pro-Extreme, or approved equal, white color with 3-piece interlocking trap assembly and interlocking angle valve assemblies. Fasteners shall be nylon-type supplied with kit.

D. Insulation of Piping Specialties on Cold Piping Services: Insulate unions, flanges, strainers, flexible connections, hoses, and expansion joints on cold piping services with flexible elastomeric cellular insulation. Thickness of elastomeric cellular insulation shall be equivalent to thickness of insulation on the piping service as specified in this Section or as shown on the drawings. Insulation shall be sealed to provide a vapor tight barrier. Cold piping services include domestic cold water systems.

E. Piping Insulation Omitted:

1. Insulation Omitted Plumbing Systems: Omit insulation on exposed plumbing fixture runouts from faces of wall or floor to fixture; on unions, flanges, strainers, flexible connections, and expansion joints.

F. Insulation Protection:

1. Pipe insulation exposed in finished areas shall be protected with 0.030-inches thick ABS plastic jacketing covers, Ceel-Co 100 Series or approved equal.
2. Pipe insulation on valves, fittings and accessories exposed in equipment rooms, indoor parking garages and other unfinished areas shall be protected with 0.030-inches thick, ultraviolet resistant, PVC plastic jacketing covers, Ceel-Co 300 Series or approved equal.
3. Pipe insulation exposed to weather shall be protected with a pre-fabricated self-adhering and self-sealing sheet type waterproof membrane. Membrane shall be installed according to manufacturer's recommendations for the application at hand. The waterproof membrane shall be Flex-Clad 400 as manufactured by MFM Building Products Corporation of Coshocton, OH or approved equal.
4. Pipe insulation exposed to weather or abuse shall be protected with a factory-fabricated aluminum jacket, 0.032-inch thick. Moisture barrier membrane for insulation exposed to weather shall be 3 MIL thick polyethylene and kraft paper, installed according to manufacturer's recommendations for the application at hand.

PART 3 - EXECUTION

3.1 INSTALLATION OF PIPING INSULATION

A. General: Install insulation products in accordance with manufacturer's written instructions, and in accordance with the MICA National Commercial and Industrial Insulation Standards to ensure that insulation serves its intended purpose.

B. Install insulation on pipe systems subsequent to testing and acceptance of tests.

C. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. The appearance of the completed insulation shall be a significant factor in determining the acceptability of the work.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

F. Where vapor retarders are specified, elbows and fittings shall be wrapped with vapor retarder tape 3-inches wide or shall have PVC jacketing.

G. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation applied to adjoining pipe run. Install factory-molded, pre-cut or job-fabricated units (at installer's option) except where specific form or type is indicated.

H. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

I. Insulated piping systems shall be supported on the exterior of the insulation surface. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation.

J. Metal shields: Conform to table below for minimum length of shield:

PIPE SIZE	INSULATION THICKNESS	LENGTH OF SHIELD
Less than 1”	Up to 1”	3”
1” – 2”	1”	4 1/2”
1” – 2”	1 1/2”	5 1/2”
2 1/2” – 4”	1”	6 1/2”
2 1/2” – 4”	1 1/2”	7 1/2”
2 1/2” – 4”	2”	8 1/2”
2 1/2” – 4”	2 1/2”	9 1/2”

K. Pipe Hanger, Trapeze, and Roller Support Insulation Insert Options:

1. Butt pipe insulation against pipe hanger insulation inserts. Apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3-inch wide vapor barrier tape or band.
2. Pipe insulation shall be inserted inside coupling with insulation contacting internal wall. Secure using anchor channel.

3.2 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 220700

SECTION 221000 - PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of plumbing piping and equipment is indicated on drawings and schedules, and by requirements of this Section.

B. Types of plumbing piping and equipment specified in this Section include the following:

1. Potable Water Piping.
2. Soil and Waste Piping.
3. Storm Piping.
4. Plumbing Equipment:

a. Water Meters
b. Backflow Preventers
c. Pressure Regulating Valves
d. Water Hammer Arresters
e. Drainage Piping Products
f. Automatic Flow Control Valves

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of plumbing piping and equipment-of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: Firm with at least three (3) years of successful installation experience on projects with plumbing piping, and equipment work similar to that required for project.

C. Codes and Standards:

1. Plumbing Code Compliance: Comply with applicable portions of Local, City, and State Plumbing Code pertaining to plumbing materials construction and installation of products.
2. ADA Compliance: Comply with applicable portions of American Disability Act for material construction and installation of products.
3. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products, and installation of plumbing piping, fixtures, and equipment.
4. ASSE Compliance: Comply with applicable ASSE standards pertaining to emergency plumbing equipment.
5. UL and NEMA Compliance: Provide electric motors and electrical components required as part of plumbing equipment, which comply with UL and NEMA standards:
6. ASME Code Symbol Stamps: For the following equipment, comply with ASME Boiler and Pressure Vessel Code for construction, and stamp with ASME Code symbol:

a. Safety relief valves.
b. Expansion tanks.

7. NFPA Compliance: Fabricate and install natural gas systems in accordance with NFPA 54 "National Fuel Gas Code".
8. Utility Compliance: Fabricate and install potable water and natural gas systems in accordance with Local Utility Company requirements.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's plumbing piping and equipment specifications, including installation and start-up instructions, and capacity and ratings, with selection points clearly indicated.

B. Shop Drawings: Submit assembly type shop drawings indicated dimensions, weights, required clearances, and methods of assembly of all components.

C. Wiring Diagrams: Submit ladder-type wiring diagrams for all components, clearly indicating all required field electrical connections.

D. Maintenance Data: Submit maintenance data and parts lists for each item of plumbing piping and equipment. Include "trouble-shooting" maintenance guides. Include this data in maintenance manual.

E. Record Drawings: At project closeout, submit record drawings of installed plumbing piping systems.

1.4 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. General: Provide plumbing piping materials and equipment products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with applicable Plumbing Codes. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in potable water systems. Where more than one (1) type of materials or products is indicated, selection is Installer's option.

2.2 POTABLE WATER PIPING

(Pipe material selected shall be in compliance with all applicable codes.)

A. Interior Water Piping:

1. Tube Size 2-inch and Smaller: Copper tube; Type L, hard-drawn temper; wrought-copper fittings, solder-joints.
2. Tube Size 2-1/2-inch and Larger: Copper tube; Type L, hard-drawn temper; wrought-copper fittings, solder-joints.

3. Pressfit Mechanical Joint Pipe and Fittings, 1/2-inch through 4-inch: Copper tube; Type L, hard-drawings temper; pressfit fittings.
4. Pro Press system by Viega, 1/2-inch through 4-inch: Copper pipe shall be approved Type K or L, conforming to ASTM B 88.

B. Exterior Water Piping and Piping Under Floor Slab:

1. Tube Size 3/4-inch and Smaller: Copper tube; Type K, soft-annealed temper; cast-copper flared tube fittings.
2. Tube Size 1-inch through 2-1/2-inch: Copper tube; Type K, soft-annealed temper; wrought-copper fittings, solder-joints.
3. Pipe Size 3-inch and Larger: Ductile-iron pipe, with cement-mortar lining; Class 150; ductile-iron fittings, with rubber-gasket joints.

C. Water Service Piping:

1. Tube Size 1-inch through 2-1/2-inch: Copper tube; Type K, soft-annealed temper; wrought-copper fittings, solder-joints.
2. Pipe Size 3-inch and Larger: Ductile-iron pipe, with cement-mortar lining; Class 150; ductile-iron fittings, with rubber-gasket joints.

2.3 SOIL AND WASTE PIPING

(Pipe material selected shall be in compliance with all codes.)

A. Aboveground Soil, Waste and Vent Piping:

1. Cast-Iron Soil Pipe: ASTM A 888 and CISPI Standard 301, Service weight, hub-and-spigot cast-iron soil pipe and fittings, with neoprene compression gaskets conforming to ASTM C 564. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF International.
2. Hubless Cast-Iron Soil Pipe: CISPI Standard 301, Service weight, cast-iron soil pipe and fittings, with stainless steel shields and neoprene gaskets conforming to CISPI Standard 310. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF International.
3. PVC, Type DWV Pipe and Fittings: ASTM D 2665 pipe and fittings, with solvent cemented joints; DWV plastic fitting patterns shall conform to ASTM D 3311.

    a. Solvent: ASTM D 2564.

B. Underground Building Drain Piping:

1. Cast-iron Soil Pipe: ASTM A 74, Service weight, hub-and-spigot cast-iron soil pipe and fittings. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF International.

    a. Neoprene Compression Gaskets: ASTM C 564

2. Hubless Cast-iron Soil Pipe and Fittings: ASTM A 888 or CISPI 301, shielded couplings; ASTM C 1277 assembly of metal shield or housing, corrosion-resistant fasteners, and neoprene sleeve with integral, center pipe stop. All pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute and listed by NSF International.

a. Heavy duty shielded stainless steel couplings: With stainless steel shield, stainless steel bands and tightening devices, and virgin neoprene sleeve.

b. Manufacturer: Subject to compliance with requirements, provide heavy duty shielded stainless steel couplings of one (1) of the following:

(1) Anaco-Husky.
(2) Clamp-All Corp.
(3) Mission Rubber Company.
(4) Stant.
(5) Tyler Pipe.

3. PVC Sewer Pipe and Fittings: Conform to ASTM D 2665 for pipe and fittings.

a. Solvent: ASTM D 2564

2.4 PLUMBING EQUIPMENT

A. Water Meter: Furnish and install meter as required by Local Utility Company. Provide roughing-in and bypass for meter in accordance with Utility Company requirements. Meter cost shall be included in Contractor's bid.

1. Acceptable Manufacturers: Subject to compliance with requirements, provide water meters of one (1) of the following:

a. Badger Meter, Inc.
b. Hersey Products Inc.
c. Neptune Water Meter Co.; Subs. Neptune Intl.
d. Rockwell Intl.; Municipal & Utility Div.
e. Zurn Industries Inc.; Hays Fluid Controls Div.

B. Backflow Preventers: Reduced pressure principle assembly consisting of shutoff valves on inlet and outlet, and strainer on inlet. Bronze body construction up to 2" size, epoxy coated cast iron over 2" with bronze, plastic or stainless steel internal parts. Assemblies shall include test cocks, and pressure-differential relief valve located between two (2) positive seating check valves, and comply with requirements of ASSE Standard 1013.

1. Acceptable Manufacturers: Subject to compliance with requirements, provide backflow preventer of one (1) of the following:

a. Conbraco.
b. Febco Sales, Inc.; Subs of Charles M. Bailey Co., Inc.
c. Hersey Products, Inc.
d. ITT Lawler; Fluid Handling Div.
e. Watts Regulator Co.
f. Zurn/Wilkins.

C. Pressure Regulating Valves: Single-seated, direct-operated type; having bronze body with integral strainer, and complying with requirements of ASSE Standard 1003. Select proper size for maximum flow rate and inlet and outlet pressures indicated.

1. Acceptable Manufacturers: Subject to compliance with requirements, provide pressure regulating valves of one (1) of the following:

a. Cash (A. W.) Valve Mfr. Corp.
b. Cla-Val Co.
c. Spence Engineering Co., Inc.
d. Watts Regulator Co.

D. Water Hammer Arrestors: Bellows type, with stainless steel casing and bellows, pressure rated for 250 PSI, tested and certified in accordance with PDI Standard WH-201.

1. Acceptable Manufacturers: Subject to compliance with requirements, provide water hammer arrestors of one (1) of the following:

a. Amtrol, Inc.
b. Josam Co.
c. Mifab, Inc.
d. Smith (Jay R.) Mfg. Co.
e. Wade Division of Tyler Corp.
f. Zurn Industries, Inc.; Hydromechanics Div.
g. Precision Plumbing Products, Inc.
h. Watts Drainage Products.

E. Drainage Piping Products:

1. General: Provide factory-fabricated drainage piping products of size and type indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements and governing regulations.
2. Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1, countersunk head.
3. Floor Cleanouts: Cast-iron body and frame; cleanout plug; adjustable round top as follows: Nickel-Bronze Top: Manufacturer's standard cast unit of the pattern and proper recess to fit floor finish.
4. Wall Cleanouts: Cast-iron body adaptable to pipe with cast-bronze or brass cleanout plug; stainless steel cover including screws.
5. Flashing Flanges: Cast-iron watertight stack or wall sleeve with membrane flashing ring. Provide underdeck clamp and sleeve length as required.
6. Vent Flashing Sleeves: Cast-iron caulking type roof coupling for cast-iron stacks, cast-iron threaded type roof coupling for steel stacks, and cast-bronze stack flashing sleeve for copper tubing.

F. Automatic Flow Control Valves: Class 150, cast-iron housing, stainless steel operating parts; threaded connections for 2-inch and smaller, flanged connections for 2-1/2-inch and larger. Factory set to automatically control flow rates within plus or minus 5% design, while compensating for system operating pressure differential. Provide Y-strainer upstream of valve inlet. Provide pressure/temperature ports on inlet and outlet for flow measuring equipment. Provide a metal identification tag with chain for each valve, factory marked with the zone identification, valve model number, and rate flow in GPM.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Examine areas and conditions under which plumbing piping, fixtures, and equipment are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF POTABLE AND WASTE PIPING

A. General: Install plumbing piping in accordance with all applicable specifications, and in compliance with manufacturer's recommendations.

B. Potable, waste, vent and storm piping shall not be installed within any fire resistive rated assembly wall of two (2) hours or greater.

C. Pressfit systems shall be installed with fitting ends pressed onto the pipe using press tool, jaws and ring sets equipped with the proper size press-jaws in accordance with manufacturer's instruction manual.

D. If plastic pipe is used, provide fire stopping at all floor penetrations with firestop collars and firestop sealant, STI SpecSeal or approved equal.

E. Plastic pipe shall not be installed in Kitchens or Laundry Rooms and in any piping system containing or receiving drainage of liquids at temperatures over 140 $^{\circ}$F. Plastic pipe shall not be installed in supply or return air plenums.

F. CPVC chemical waste pipe shall not be installed in systems subjected to aggressive chemical agents not compatible with CPVC compounds. Install in accordance with manufacturer's instructions and all applicable local codes.

G. Cleanouts for soil, waste, and storm piping:

1. Install in above ground piping and building drain piping as indicated, as required by all applicable Plumbing Codes; and at each change in direction of piping greater than 90^{o}; at minimum intervals of 50-feet for piping 4-inch and smaller and 100-feet for piping larger than 4-inch; and at base of each vertical soil or waste stack.
2. Provide on grade, exterior dual cleanouts on all building storm drains and building sanitary drains. Cleanouts shall be located within 5-feet of exterior wall of building, shall be heavy duty type and shall be set in 24-inch x 24-inch thick concrete pad.
3. Provide access to all cleanouts. Install floor and wall cleanout covers or access panels/doors for concealed piping, select type to match adjacent building finish and as required for wall fire rating.

H. Slope for Soil and Waste Piping: Install piping pitched to drain at uniform slope not less than that indicated by governing plumbing code, or at a minimum, the following:

1. Pipe Size 3-inch and Smaller: 1/4-inch per foot (2% slope).
2. Pipe Size 4-inch to 6-inch: 1/8-inch per foot (1% slope).

I. Solder Joints in Potable Water Systems: All solder for joints in potable water systems shall contain less than 0.2% lead and shall be 95% tin, 5% antimony as manufactured by M.C. Canfield and Sons of Union, New Jersey or approved equal.

J. Hanger and Supports: Conform to table below for maximum spacing of supports:

PIPE MATERIAL	HORIZONTAL IN FEET	VERTICAL IN FEET
Cast-Iron Soil Pipe	5	15
Copper Tubing – 1-1/4-Inches and Smaller	6	10
Copper Tubing - 1-1/2-Inches and Larger	10	10
PVC Plastic Pipe	4	4
Steel Pipe	12	15

K. Waste, Vent, and Water Connections:

1. The minimum size of waste, vent, and water connections to the individual fixtures shall be as follows:

Fixtures	Waste	Vent	C.W.	H.W.
Water Closets (Flush Valve)	4"	1-1/2"	1"	
Urinals	2"	1-1/4"	3/4"	
Flush Rim Sink	4"	1-1/2"	1"	1/2"
Lavatories	1-1/4"	1-1/4"	1/2"	1/2"
Sinks	1-1/2"	1-1/2"	1/2"	1/2"
Service Sinks	3"	1-1/2"	1/2"	1/2"
Janitors Sinks	3"	1-1/2"	1/2"	1/2"
Showers	2"	1-1/2"	1/2"	1/2"
Water Coolers	1-1/4"	1-1/4"	1/2"	1/2"
Water Hydrants			3/4"	

2. The minimum size of underfloor waste connection from any individual fixture shall be 2-inch pipe size, regardless of waste connection size to the fixture.

L. Floor Drains: Set top of floor drain elevation at finished floor elevation. Coordinate with general construction and architectural drawings to provide smooth transition from finished floor to floor drains:

1. Trap all drains connected to the sanitary sewer.
2. Install drain flashing collar or flange so that no leakage occurs between drain and adjoining flooring. Maintain integrity of waterproof membranes, where penetrated.
3. Coordinate drain location with equipment served.

3.3 CONNECTIONS TO EQUIPMENT FURNISHED BY OTHERS

A. Where plans indicate fixtures to be furnished by others, this Contractor shall provide all rough-in, furnish P-traps, stops and supplies and shall connect such fixtures to the plumbing system. Traps and tailpieces shall be of the same material as the pipe.

B. Pipe and fittings exposed in finished areas shall be chrome plated.

3.4 INSTALLATION OF PLUMBING EQUIPMENT

A. Water Meter: Install water meter in accordance with Local Utility Company's installation instructions, and comply with requirements.

B. Backflow Preventers: Install backflow preventers at water service entrance and at each connection to mechanical equipment and systems, and in compliance with the plumbing code and authority having jurisdiction. Locate backflow preventer serving equipment in same room as equipment being connected. Pipe relief outlet without valves, to nearest floor drain.

C. Pressure Regulating Valve: Install pressure regulating valves with inlet and outlet shutoff valves, and balance cock bypass. Install pressure gage on valve outlet.

D. Water Hammer Arrestors: Install water hammer arrestors with isolation valve for all quick-closing type valves. Locate water hammer arrestors per manufacturer's recommendations.

E. Install wall outlet boxes recessed in wall. Install 2-by-4-inch fire-retardant-treated-wood blocking wall reinforcement between studs.

3.5 FIELD QUALITY CONTROL

A. General: Do not enclose, cover, or put into operation piping systems until they have been inspected and approved by the authority having jurisdiction.

B. Inspect, test, and purge natural gas systems according to NFPA 54, Part 4 "Gas Piping Inspection, Testing, and Purging" and Local Gas Utility requirements.

1. Repair leaks and defects with new materials, and retest system until satisfactory results are obtained.
2. Report test results promptly and in writing to the Architect and the authority having jurisdiction.

C. Test water distribution piping as follows:

1. Test for leaks and defects in new water distribution piping systems and parts of existing systems that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of system tested.
2. Leave uncovered and unconcealed in new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose work that has been covered or concealed before it has been tested and approved for testing.
3. Cap and subject the piping system to a static water pressure of 50 PSIG above the operating pressure without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four (4) hours. Leaks and loss in test pressure constitute defects that must be repaired.
4. Repair leaks and defects with new materials and retest system or portion thereof until satisfactory results are obtained.
5. Prepare reports for tests and required corrective action.

D. Drainage and Vent Piping System Tests: Test drainage and vent systems according to procedures or authority having jurisdiction or, in absence of published procedure, as follows:

1. Test for leaks and defects in new drainage and vent piping systems and parts of existing systems that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
2. Leave uncovered and unconcealed in new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose for testing work that has been covered or concealed before it has been tested and approved.
3. Rough Plumbing Test Procedure: Except for outside leaders and perforated or open-jointed drain tile, test piping of plumbing drainage and venting systems on completion of roughing-in piping installation. Tightly close all openings in piping system and fill with water to point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before inspection starts through completion of inspection. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and their traps filled with water, test connections and prove gastight and watertight. Plug stack openings on roof and building drain where it leaves the building and introduce air into the system equal to pressure of 1-inch water column. Use a U-tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects, using new materials and retest system or portion thereof until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

3.6 CLEANING

A. Clean and disinfect water distribution piping as follows:

1. Purge new potable water distribution piping systems and parts of existing potable water systems that have been altered, extended, or repaired prior to use.
2. Use purging and disinfecting procedure prescribed by authority having jurisdiction or, if a method is not prescribed by that authority, the procedure described in either AWWA C 651 or AWWA C 652 or as described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill system or part thereof with water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) and allow to stand for 24 hours.
    c. Drain system or part thereof of previous solution and refill with water/chlorine solution containing at least 200 parts per million of chlorine. Isolate and allow to stand for three (3) hours.
    d. Flush system with clean, potable water until chlorine does not remain in water coming from system following allowed standing time.
    e. Submit water samples in sterile bottles to authority having jurisdiction. Repeat procedure if biological examination made by the authority shows evidence of contamination.

3.7 COMMISSIONING

A. Piping Systems and Fixtures:

1. Fill water piping. Check components and fixtures to determine that they are not air bound and that piping is full of water.
2. Perform the following steps before putting into operation:

    a. Close drain valves, hydrants, and hose bibbs.
    b. Open shutoff valves to fully open position.
    c. Open throttling valves to proper setting.
    d. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
    e. Remove and clean strainer screens. Close drain valves and replace drain plugs.

3. Check plumbing specialties and verify proper settings, adjustments and operation.

    a. Water-Pressure Regulators: Set outlet pressure at 80 PSIG maximum, unless otherwise indicated.

4. Energize pumps and verify proper operation.

END OF SECTION 221000

SECTION 224000 - PLUMBING FIXTURES

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of plumbing fixtures is indicated on drawings and schedules, and by requirements of this Section.

B. Types of plumbing fixtures, specified in this Section include the following:

1. Plumbing Fixtures.
2. Stainless Steel Sinks:
3. Mop Service Basins:
4. Faucets:
5. Flush Valves:
6. Water Closet Seats:
7. Water Coolers:
8. Fixture Supports:
9. Floor Drains and Drainage Piping Products:
10. Drain Boxes:
11. Hose Bibbs, Wall Hydrants, Yard Hydrants:

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fixtures, of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: Firm with at least three (3) years of successful installation experience on projects with plumbing piping, fixtures, and equipment work similar to that required for project.

C. Codes and Standards:

1. Plumbing Code Compliance: Comply with applicable portions of Local, City, and State Plumbing Code pertaining to plumbing materials construction and installation of products.
2. ADA Compliance: Comply with applicable portions of American Disability Act for material construction and installation of products.
3. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products, and installation of plumbing piping, fixtures, and equipment.
4. UL and NEMA Compliance: Provide electric motors and electrical components required as part of plumbing equipment, which comply with UL and NEMA standards:

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's plumbing fixture specifications, including installation and start-up instructions, and capacity and ratings, with selection points clearly indicated.

B. Shop Drawings: Submit assembly type shop drawings indicated dimensions, weights, required clearances, and methods of assembly of all components.

C. Maintenance Data: Submit maintenance data and parts lists for each item of plumbing piping, fixtures, and equipment. Include "trouble-shooting" maintenance guides. Include this data in maintenance manual.

1.4 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. General: Provide factory-fabricated fixture products of sizes, types, pressure ratings, temperature ratings, and capacities as indicated. Where not indicated, provide proper selection as determined by Installer to comply with installation requirements. Provide materials and products complying with applicable Plumbing Codes. Provide sizes and types matching piping and equipment connections; provide fittings of materials which match pipe materials used in potable water systems. Where more than one (1) type of materials or products is indicated, selection is Installer's option.

2.2 PLUMBING FIXTURES

A. General: Provide factory-fabricated fixtures of type, style and material indicated. For each type fixture, provide fixture manufacturer's standard trim, carrier, seats, and valves as indicated by their published product information; either as designed and constructed, or as recommended by manufacturer, and as required for a complete installation. Where more than one (1) type is indicated, selection is Installer's option; but all fixtures of same type must be furnished by single manufacturer. Where type is not otherwise indicated, provide fixtures complying with governing regulations.

B. Materials: Unless otherwise specified, comply with applicable Federal Specification WW-P-541/-Series sections pertaining to plumbing fixtures, fittings, trim, metals and finishes. Comply with requirements of WW-P-541/-specification relative to quality of ware, glazing, enamel, composition and finish of metals, air gaps, and vacuum breakers, even though some plumbing fixtures specified in this Section are not described in WW-P-541/-.

C. Supplies and Stops: All fixtures shall be provided with supplies with stops.

1. Stops shall be chrome-plated solid brass with brass stems and chloramine-chlorine resistant washers. Stops shall be keyed when installed in public restrooms.
2. Supplies shall be chloramine-chlorine resistant braided stainless steel flexible connectors.

D. Traps: Traps shall be provided for all fixtures without integral traps.

1. P-traps shall be adjustable chrome plated heavy cast brass with 17 gauge tubular wall end, brass slip nuts, and brass flanges.
2. Sink end waste kits shall have cast brass tee and 17 gauge tubular waste arm and brass slip nuts.

E. Vacuum Breakers: All plumbing fixtures with hose attachment capability including hand held shower units with flexible hose shall be equipped with vacuum breaker.

F. Fixture Carriers and Supports: Provide carriers and supports for all fixtures requiring same. Provide factory-fabricated carrier extension kits per manufacturer's recommendations required to accommodate depth of wall or plumbing chase.

G. Fixture Schedules: Comply with fixture requirements contained in fixture schedule as indicated on drawings. Plumbing fixtures shall be of one (1) of the manufacturers indicated and in accordance with the information and manufacturer's catalog numbers indicated. Where manufacturer's catalog numbers have been updated or deleted, fixtures shall be of similar configuration and of similar or better quality than that indicated.

H. Acceptable Manufacturers: Subject to compliance with requirements, provide plumbing fixtures and trim of one (1) of the following:

1. Lavatories, Service Sinks, Water Closets, Urinals, Bath Tubs:

    a. American Standard; U.S. Plumbing Products.
    b. Crane Co.
    c. Eljer Plumbingware Div.; Household International Co.
    d. Kohler.
    e. Toto.
    f. Zurn.

2. Stainless Steel Sinks:

    a. American Standard; U.S. Plumbing Products.
    b. Elkay Mfg. Co.
    c. Moen; Div. of Stanadyne.
    d. Just Manufacturing Co.

3. Mop Service Basins:

    a. Acorn Engineering
    b. American Standard; U.S. Plumbing Products.
    c. Bradley Corp.
    d. Crane Co.
    e. Eljer Plumbingware Div.; Household International Co.
    f. Fiat Products.
    g. Mustee.
    h. Stern-Williams

4. Faucets:

    a. American Standard; U.S. Plumbing Products.
    b. Chicago Faucet Co.
    c. Delta Faucet Co.; Div. of Masco Corp.
    d. Eljer Plumbingware Div.; Household International Co.
    e. Elkay Mfg. Co.
    f. Kohler.
    g. Moen.
    h. Speakman.
    i. Symmons.
    j. T & S Brass
    k. Toto.
    l. Zurn.

5. Flush Valves:

    a. Delta Faucet Co.; Div. of Masco Corp.
    b. Sloan Valve Co.
    c. Toto
    d. Zurn.

6. Water Closet Seats:

    a. Bemis Mfg. Co.
    b. Beneke Corp.
    c. Forbes-Wright Industries, Inc.; Church Products.
    d. Olsonite Corp.; Olsonite Seats.

7. Water Coolers:

    a. Acorn Engineering
    b. Elkay Mfg. Co.
    c. Filtrine Manufacturing Co.
    d. Halsey Taylor Div.; Household International Co.
    e. Haws Drinking Faucet Co.
    f. Oasis – Reg. Trademark of Ebco Mfg. Co.

8. Fixture Supports:

    a. Josam Mfg. Co.
    b. Mifab, Inc.
    c. Tyler Pipe.
    d. Watts Drainage Products.
    e. Zurn Industries, Inc.; Hydromechanics Div.

9. Floor Drains and Drainage Piping Products:

    a. Josam Mfg. Co.
    b. Mifab, Inc.
    c. Smith (Jay R.) Mfg. Co.
    d. Wade Div., Tyler Pipe.
    e. Watts Drainage Products.
    f. Zurn Industries, Hydromechanics Div.

10. Drain Boxes:

    a. Acorn Engineering.
    b. Guy Gray, Inc.; IPS Corp.
    c. Metcraft, Inc.

11. Hose Bibbs, Wall Hydrants, Utility Hydrants:

    a. Josam Mfg. Co.
    b. J.R. Smith Mfg. Co.
    c. Prier.
    d. Wade Div., Tyler Pipe.
    e. Watts Drainage Products.
    f. Woodford Mfg. Co.

g. Zurn Industries.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Examine areas and conditions under which plumbing fixtures, are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF PLUMBING FIXTURES

A. General: Install plumbing fixtures of types indicated where shown and at indicated heights; in accordance with fixture manufacturer's written instructions, roughing-in drawings, and with recognized industry practices. Ensure that plumbing fixtures comply with requirements and serve intended purposes. Comply with applicable requirements of the National Uniform Code pertaining to installation of plumbing fixtures.

B. Fasten plumbing fixtures securely to indicated supports or building construction; and ensure that fixtures are level and plumb. Secure plumbing supplies behind or within wall construction so as to be rigid, and not subject to pull or push movement.

C. Protect installed fixtures from damage during construction period. Provide protective inserts for bathtubs and shower bases designed to prevent scratching of finished surface.

D. Supplies and Stops: All fixtures shall be provided with supplies with stops.

E. Traps: Provide traps for all fixtures without integral traps.

3.3 COMMISSIONING

A. Piping Systems and Fixtures:

1. Fill water piping. Check components and fixtures to determine that they are not air bound and that piping is full of water.
2. Perform the following steps before putting into operation:

    a. Close drain valves, hydrants, and hose bibbs.
    b. Open shutoff valves to fully open position.
    c. Open throttling valves to proper setting.
    d. Remove plugs used during testing of piping and plugs used for temporary sealing of piping during installation.
    e. Remove and clean strainer screens. Close drain valves and replace drain plugs.

3. Check plumbing specialties and verify proper settings, adjustments and operation.

    a. Water-Pressure Regulators: Set outlet pressure at 80 PSIG maximum, unless otherwise indicated.

4. Energize pumps and verify proper operation.

DRINKING FOUNTAIN: DF-1

COMPLIES WITH A.D.A. HANDICAPPED REQUIREMENTS WHEN INSTALLED PER MANUFACTURER'S RECOMMENDATIONS

FIXTURE
TWO-LEVEL WHEELCHAIR ACCESS DRINKING FOUNTAIN WITH FRONT PUSH BAR CONTROL AND SELF CLOSING VALVE (FREE OF LEAD CONTAINING BRASS PARTS). MEETS A.D.A. REQUIREMENTS. PROVIDE WALL MOUNTING BRACKET.
FINISH: STAINLESS STEEL POLISHED TO A CHROME FINISH
ELKAY EDFP217C.

FLOORDRAIN: FD-1

FIXTURE

DUCO CAST IRON FLOOR DRAIN, TWO-PIECE BODY WITH DOUBLE DRAINAGE FLANGE, INVERTABLE NON-PUNCTURING FLASHING COLLAR, SEEPAGE OPENINGS, BOTTOM OUTLET AND ADJUSTABLE NICKEL BRONZE ROUND STRAINER.
J.R. SMITH 2005-A-NB.

FLOORDRAIN: FD-2

FIXTURE

MEDIUM DUTY CAST IRON FLOOR DRAIN, TWO-PIECE BODY WITH DOUBLE DRAINAGE FLANGE, NON-PUNCTURING FLASHING COLLAR, SEEPAGE OPENINGS, BOTTOM OUTLET, 8 1/2"∅ ROUND CAST IRON TOP AND REMOVABLE SEDIMENT BUCKET.

J.R. SMITH 2110-B.

FLOORSINK: FS-1

FIXTURE
8 1/2" SQUARE, 6" MEDIUM DEEP CAST IRON FLANGED RECEPTOR WITH ACID RESISTANT COATED INTERIOR, BOTTOM OUTLET, ALUMINUM INTERNAL DOME STRAINER, NICKEL BRONZE RIM AND SECURED 3/4 GRATE. LESS SEEPAGE HOLES.
J.R. SMITH 3100-NB-13.

LAVATORY: L-1

(MOUNT @ A.D.A. HEIGHT WHERE APPLICABLE)

FIXTURE
20" x 18" SIZE, VITREOUS CHINA, WALL HUNG LAVATORY (COMPLIES WITH ADA) WITH BACK, PUNCHED FOR CONCEALED ARM CARRIER, ANTI-SPLASH RIM AND FRONT OVERFLOW.
AMERICAN STANDARD "LUCERNE" 0355.012.
KOHLER "KINGSTON" K-2005.

TRIM
CHROME PLATED BRASS, SINGLE HANDLE METERING LAVATORY FAUCET, .5 GPM (1.9 LPM) VANDAL RESISTANT AERATOR, ADA COMPLIANT, ADJUSTABLE CYCYE TIME WITH AUTOMATIC SHUT-OFF, ½" SUPPLY SHANK
MOEN 8894, 4" DECK PLATE 99551.

COMPLETE WITH SOLID BRASS STOPS WITH ALL BRASS STEMS AND CHLORAMINE-CHLORINE RESISTANT WASHERS. CHLORAMINE-CHLORINE RESISTANT BRAIDED STAINLESS STEEL OR POLYMER FLEXIBLE CONNECTORS. CAST BRASS SOLID TOP OPEN GRID P.O. PLUG WITH 6" 17 GAUGE TAILPIECE WITH CAST BRASS LOCKNUT. HEAVY CAST BRASS ADJUSTABLE P-TRAP WITH 17 GA TUBULAR WALL BEND AND BRASS SLIP NUTS. (ALL BRASS MATERIALS SHALL BE CHROME PLATED)

PROVIDE TRUEBRO "LAV-GUARD2" MODEL #102 E-Z.

CARRIER
FOR BLOCK WALL CONSTRUCTION:
WALL-MOUNT, SINGLE LAVATORY CARRIER WITH CONCEALED ARMS, LEVELING AND SECURING SCREWS AND ADJUSTABLE WALL PLATE.
SEE SPECIFICATIONS FOR APPROVED MANUFACTURERS.
VERIFY WALL THICKNESS PRIOR TO ORDERING CARRIER(S).

FOR STUD WALL CONSTRUCTION:
FLOOR-MOUNT, SINGLE LAVATORY CARRIER WITH CONCEALED ARMS, LEVELING AND SECURING SCREWS, STRUCTURAL UPRIGHTS AND BLOCK BASES.
SEE SPECIFICATIONS FOR APPROVED MANUFACTURERS.
VERIFY WALL THICKNESS PRIOR TO ORDERING CARRIER(S).



MOPSERVICEBASIN: MSB-1

FIXTURE
24" x 24" x 12" HIGH, ONE PIECE TERRAZZO MOP SERVICE BASIN WITH FACTORY INSTALLED DRAIN WITH COMBINATION DOME STRAINER AND LINT BASKET FOR 3" CAULK JOINT. CAULK ALL EDGES WHERE BASIN MEETS WALL WITH COLOR MATCHED SILICONE SEALANT.
FIAT TSB-100.

TRIM
COMBINATION SERVICE SINK FITTING WITH VACUUM BREAKER, TOP WALL BRACE, 3/4" HOSE THREAD SPOUT WITH BUCKET HOOK AND FLANGED FEMALE ADJUSTABLE ARMS WITH INTEGRAL CHECK STOPS.
DELTA 28T9.

COMPLETE WITH: 24" LONG x 3" WIDE 18 GAUGE MOP HANGER.
FIAT #889-CC.

30" LONG FLEXIBLE HEAVY DUTY 5/8" RUBBER HOSE WITH 3/4" BRASS COUPLING AT ONE END AND RUBBER GRIP HOSE BRACKET.
FIAT #832-AA.

12" HIGH HEAVY GAUGE STAINLESS STEEL WALL GUARDS.
FIAT #MSG 2424.

SINK: S-1

FIXTURE
MANUFACTURER: SPG INTERNATIONAL, LLC
UNIVERSAL STAINLESS ECONOMY HAND SINK, WALL MODEL, 12” WIDE X 10” FRONT-TO-BACK X 6” DEEP, NON-DRIP EDGE ON 3 SIDES, INCLUDES SPLASH MOUNTED FAUCET, BASKET DRAIN AND WALL BRACKETS, STAINLESS STEEL CONSTRUCTION, NSF, CSA
T&S BRASS MODEL B-1115 FAUCET, 6” SWING NOZZLE, SPLASH MOUNTED

COMPLETE WITH SOLID BRASS STOPS WITH ALL BRASS STEMS AND CHLORAMINE-CHLORINE RESISTANT WASHERS, CHLORAMINE-CHLORINE RESISTANT BRAIDED STAINLESS STEEL FLEXIBLE CONNECTORS (SUPPLY TUBES), HEAVY DUTY FORGED BRASS BASKET STRAINER WITH BRASS BASKET, CAST BRASS LOCK AND COUPLING NUTS, BRASS 4" 17 GAUGE TAILPIECE, HEAVY CAST BRASS ADJUSTABLE P-TRAP WITH 17 GAUGE TUBULAR WALL BEND AND BRASS ESCUTCHEONS. (ALL BRASS MATERIALS SHALL BE CHROME PLATED)

URINAL: UR-1

FIXTURE
WALL HUNG, VITREOUS CHINA, TOP SPUD, FLUSHING RIM, LOW CONSUMPTION (0.125 GPF) WASHOUT FLUSH ACTION, 2" THREADED OUTLET CONNECTION AND TWO WALL HANGERS.
KOHLER "BARDON" MODEL #K-4904-ET-0

TRIM
EXPOSED, QUIET, DIAPHRAGM TYPE, ¾" TOP SPUD, CHROME PLATED URINAL FLUSHOMETER, WITH 0.125 GALLON PER FLUSH. DUAL FILTERED BY-PASS DIAPHRAGM, STOP SEAT, AND VACUUM BREAKER, SHALL BE CHLORAMINE RESISTANT MATERIALS. COURTESY FLUSH, NON-HOLD OPEN TRUE MECHANICAL OVERRIDE, FIXED METERING BYPASS, I.P.S. WHEEL HANDLE BAK-CHEK ANGLE STOP, ADJUSTABLE TAILPIECE, SPUD COUPLING AND FLANGE, SWEAT SOLDER ADAPTER WITH COVER TUBE AND CAST SET SCREW WALL FLANGE.
SLOAN ROYAL MODEL 186-0.125

CARRIER
FOR STUD WALL/PLUMBING CHASE CONSTRUCTION:
FLOOR-MOUNTED SINGLE URINAL CARRIER WITH HANGER PLATE, BEARING PLATE, ADJUSTABLE SUPPORTING RODS, STRUCTURAL UPRIGHTS, WELDED FEET AND SUPPLY PIPE SUPPORT. ALL PORTIONS OF CARRIER SHALL BE CONCEALED WITHIN WALL/PIPE CHASE CONSTRUCTION.
SEE SPECIFICATIONS FOR APPROVED MANUFACTURERS.
VERIFY WALL/CHASE THICKNESS PRIOR TO ORDERING CARRIER(S).

FOR BLOCK WALL CONSTRUCTION:
WALL-MOUNTED SINGLE URINAL CARRIER WITH HANGER PLATES AND ADJUSTABLE SUPPORTING RODS.
SEE SPECIFICATIONS FOR APPROVED MANUFACTURERS.
VERIFY BLOCK WALL THICKNESS PRIOR TO ORDERING CARRIER(S).

VALVEBOX: VB-1

FIXTURE
TOP SUPPLIED, METAL RECESED CABINET, SINGLE VALVE OUTLET BOX. CORROSION RESISTANT DIPPED GALVANIZED STEEL FINISH, 20 GAUGE BOX, 18 GAUGE FACEPLATE. ICE MAKER BOX COMPLETE WITH STOP VALVE.
GUY GRAY BIM875 OR APPROVED EQUAL.

MOUNT AT 48" A.F.F. OR AS RECOMMENDED BY REFRIGERATOR MANUFACTURER.

WATERCLOSET: WC-1

INSTALL PER A.D.A. HANDICAP REQUIREMENTS: TOP OF SEAT AT 17 TO 19" A.F.F.

FIXTURE
VITREOUS CHINA, TOP SPUD, SIPHON JET, ELONGATED BOWL WALL HANGING WATER SAVER CLOSET LOW CONSUMPTION (1.28 GPF) FULLY GLAZED 2" BALLPASS TRAPWAY, 10-1/2" x 9" WATER SURFACE, AND BOLT CAPS.
KOHLER "KINGSTON" K-4325.

TRIM
EXPOSED, QUIET, DIAPHRAGM TYPE, CHROME PLATED FLUSHOMETER, WITH 1.28 GALLON PER FLUSH. DUAL FILTERED BY-PASS DIAPHRAGM, STOP SEAT AND VACUUM BREAKER SHALL BE CHLORAMINE RESISTANT MATERIALS. ADA COMPLIANT METAL OSCILLATING NON-HOLD-OPEN HANDLE. VANDAL RESISTANT STOP CAP. ADJUSTABLE TAILPIECE
SLOAN ROYAL MODEL 111-1.28

CARRIER
ADJUSTABLE HEIGHT FOR FIXTURE SPECIFIED, VERIFY WALL CONSTRUCTION AND PLUMBING ARRANGEMENT AS SHOWN ON ARCHITECTURAL PLANS AND RISER PRIOR TO ORDERING. ALL PORTIONS OF CARRIER SHALL BE CONCEALED IN WALL CONSTRUCTION. USE WIDE CHASE CARRIER OPTIONS WHEN WALL OR CHASE EXCEEDS MOUNTING STUD LENGTH. SEE SPECIFICATIONS. INSTALL ANCHOR FOOT ON ALL WATER CLOSET FIXTURE CARRIERS.

COMMERCIAL WEIGHT SOLID PLASTIC OPEN FRONT LESS COVER FOR ELONGATED BOWL. LARGE INTEGRAL BUMPER SHALL BE COLOR-MATCHED MOLDED PLASTIC. HINGES TO FEATURE EXTERNAL CHECK AND INTERNAL SELF-SUSTAINING MECHANISMS IN BOTH HINGES. COLOR SHALL BE WHITE. CHURCH MODEL #295SSC.

WATERHAMMERARRESTER: WHA-1

FIXTURE
SHOCK ABSORBER WITH STAINLESS STEEL SHELL, HYDRO-PNEUMATIC CUSHION OF ARGON GAS AND PURE GLYCERINE, ELASTOMER, BELLOWS, STAINLESS STEEL ADAPTER AND MALE THREADED PLUG.
J.R. SMITH SERIES 5000.

ACCESS PANEL
8"x8"-16 GAUGE STEEL DOOR AND FRAME WITH CONCEALED HINGE AND SCREWDRIVER OPERATED LATCH. TYPE 304 STAINLESS STEEL WITH NO. 4 FINISH.
J.R. SMITH 4762-08x08.

END OF SECTION

SECTION 224010 - DOMESTIC WATER HEATERS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of domestic water heaters and equipment is indicated on drawings and schedules, and by requirements of this section.

B. Types of equipment specified in this section include the following:

1. Electric Water Heaters.

C. Provide the following electrical work as work of this section, complying with requirements of electrical sections:

1. Water heater manufacturer shall provide control wiring schematic for water heater shutdown switches located at mechanical room exit doors as shown on the drawings. Shutdown control system shall comply with ASME CSD-1, latest edition "Controls and Safety Devices for Automatically Fired Boilers". Mechanical Contractor shall provide the switches and all required control wiring. All wiring shall be in conduit. A stainless steel guard shall be provided to prevent accidental operation of switches. Switches shall have engraved nameplates to identify switch as "Water Heater Emergency Shutdown".

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of high efficiency gas-fired water heaters of types, materials and sizes required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Installer's Qualifications: Firm with at least three (3) years of successful installation experience on projects with high efficiency gas-fired water heaters similar to that required for project.

C. Codes and Standards:

1. Plumbing Code Compliance: Comply with applicable portions of Local, City, and State Plumbing Code pertaining to plumbing materials construction and installation of products.
2. UL and NEMA Compliance: Provide electric motors and electrical components required as part of plumbing equipment, which have been listed and labeled by the following Underwriter's Laboratories Standards and comply with NEMA standards:

a. UL 1453, “Electric Booster and Commercial Storage Tank Water Heaters.”

3. ANSI Compliance: Comply with ANSI Z223.1 (NFPA 54) "National Fuel Gas Code", as applicable to installation of gas-fired water heaters.
4. AGA and NSF Labels: Provide gas-fired water heaters that have been listed and labeled by American Gas Association and National Sanitation Foundation.
5. ASME Code Symbol Stamps: For the following equipment, comply with ASME Boiler and Pressure Vessel Code for construction, and stamp with ASME Code symbol:

a. Commercial water heaters.

b. Safety relief valves.
c. Expansion tanks.

6. NFPA Compliance: Fabricate and install natural gas systems in accordance with NFPA 54 "National Fuel Gas Code".
7. Utility Compliance: Fabricate and install potable water and natural gas systems in accordance with Local Utility Company requirements.
8. ASHRAE Standards: Provide water heaters with performance efficiencies not less than prescribed in ANSI/ASHRAE/IES 90A.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's domestic water heaters, including installation and start-up instructions, and capacity and ratings, with selections clearly indicated.

B. Shop Drawings: Submit assembly type shop drawings indicated dimensions, weights, required clearances, and methods of assembly of all components.

C. Wiring Diagrams: Submit ladder-type wiring diagrams for all components, clearly indicating all required field electrical connections.

D. Maintenance Data: Submit maintenance data and parts lists for each item of domestic water heaters. Include "trouble-shooting" maintenance guides. Include this data in maintenance manual.

E. Record Drawings: At project closeout, submit record drawings of installed domestic water heater systems.

1.4 WARRANTY

A. General Warranty: The special warranty specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Water Heater Warranty

1. Special Warranty: Submit a written warranty executed by manufacturer agreeing to repair or replace water heaters and accessories that fail in materials or workmanship within specified warranty period. Failures include, but are not limited to, tanks, coils, heat exchangers, and burners. This warranty is in addition to, and not a limitation of, other rights Owner may have against Contractor under Contract Documents.
2. Warranty Period: Five (5) years after date of Substantial Completion.

C. Tank Warranty Period: Five (5) years after date of Substantial Completion.

D. Labor Replacement Allowance: Provide Labor Replacement Allowance of $1,000 for installing contractor if water heater requires replacement during the initial three (3) year warranty.

PART 2 - PRODUCTS

2.1 MATERIALS AND PRODUCTS

A. Electric Water Heaters:

1. General: Provide electric water heaters of size, capacity, and electrical characteristics as indicated on drawings. Comply with ASHRAE/IES 90A for energy efficiency. Provide UL listing.
2. Heater: Working pressure of 150 PSI; magnesium anode rod; glass lining on internal surfaces exposed to water.
3. Heating Elements: Low watt density with zinc-plated copper sheath; double element, non-simultaneous operation.
4. Safety Controls: Equip with high-temperature cutoff for each element, factory-wired.
5. Jacket: Equip with full size control compartments with front panel opening. Insulate tank with vermin-proof glass fiber insulation. Provide outer steel jacket with baked enamel finish.
6. Warranty: Furnish five (5) year limited warranty for tank leakage.
7. Accessories: Provide brass drain valve; 3/4-inch relief valve; cold water dip tube.
8. Controls: Provide thermostat for each element, factory-wired.
9. Manufacturer: Subject to compliance with requirements, provide electric water heaters as one (1) of the following:

    a. Bradford – White Corp.
    b. A.O. Smith, Consumer Products Div.
    c. Rheem Water Heaters Div., City Investing Co.
    d. Ruud Water Heaters Div., City Investing Co.
    e. State Industries
    f. Viking Superior Corp.

B. Automatic Flow Control Valves: Class 150, cast-iron housing, stainless steel operating parts; threaded connections for 2-inch and smaller, flanged connections for 2-1/2-inch and larger. Factory set to automatically control flow rates within plus or minus 5% design, while compensating for system operating pressure differential. Provide Y-strainer upstream of valve inlet. Provide pressure/temperature ports on inlet and outlet for flow measuring equipment. Provide a metal identification tag with chain for each valve, factory marked with the zone identification, valve model number, and rate flow in GPM.

PART 3 - EXECUTION

3.1 EXAMINATION

A. General: Examine areas and conditions under which domestic water heaters are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

B. Electric Water Heaters:

1. General: Install electric water heaters as indicated, in accordance with manufacturer's installation instructions, and in compliance with applicable codes.
2. Support: Set units on concrete pads, orient so controls and devices needing service and maintenance have adequate access. Level and plumb unit.
3. Electric Supply: Furnish wiring diagram to electrical installer. Refer to electrical sections for wiring of units.

4. Piping: Connect hot and cold water piping to units with shutoff valves and dielectric unions. Connect recirculating water line to unit with shutoff valve, check valve, and union.
5. Install thermometers on water heater inlet and outlet piping.
6. Start-Up: Start-up, test, and adjust electric water heaters in accordance with manufacturer's start-up instructions. Check and calibrate controls.

3.2 FIELD QUALITY CONTROL

A. General: Do not enclose, cover, or put into operation domestic water heaters until they have been inspected and approved by the authority having jurisdiction.

B. Inspect, test, and purge natural gas systems according to NFPA 54, Part 4 "Gas Piping Inspection, Testing, and Purging" and Local Gas Utility requirements.

C. Repair leaks and defects with new materials, and retest system until satisfactory results are obtained.

D. Report test results promptly and in writing to the Architect and the authority having jurisdiction.

3.3 COMMISSIONING

A. Domestic Water Heaters:

1. Test and adjust operating and safety controls. Replace damaged and malfunctioning controls and equipment.
2. Train Owner's maintenance personnel on procedures and schedules related to startup and shutdown, troubleshooting, servicing, and preventive maintenance.
3. Review data in the operation and maintenance manuals. Refer to Division 01 77 00 – Project Closeout
4. Schedule training with Owner with at least seven (7) days' advance notice.
5. Perform the following final checks before startup:

    a. Fill water heaters with water.
    b. Check for piping connection leaks.
    c. Check for adequate combustion air.
    d. Check for clear relief valve inlets, outlets, and drain piping.
    e. Check operation of pumps and circulators.
    f. Test operation of safety controls, relief valves, and devices.

6. Perform the following startup procedures:

    a. Adjust operating controls.
    b. Adjust hot-water-outlet temperature settings.

END OF SECTION 224010

SECTION 230000 - MECHANICAL GENERAL PROVISIONS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. This section applies to all mechanical work.

B. The general provisions of the Contract, including General and Supplementary Conditions and General Requirements apply to all mechanical work.

C. Each specification section within their respective Division shall be coordinated with all other sections in that division for related work.

D. The project documents contemplate the complete installation of the systems described herein, or shown on the drawings, so that at the conclusion of the construction, the systems will be turned over to the Owner complete and ready for safe, efficient operation.

E. The Contractor shall be obliged to furnish and install all such items normally included on systems of this type, which while not mentioned directly herein are obviously essential to the installation and operation of the systems, and which are normally furnished on installations of this type.

1.2 COORDINATION OF WORK

A. General: The Contractor shall recognize that the Contract Documents are diagrammatic in showing certain physical relationships that must be established within the mechanical and electrical work, and in its interface with other work including utilities and that such establishment is the exclusive responsibility of the Contractor. This Contractor shall be responsible for work fitting in place without conflict with other trades, where proper planning could avoid interference. This Contractor shall examine the locations and verify all measurements, distances, elevations and existing conditions before starting work. Because the drawings are diagrammatic and on a small scale, all rises, drops, offsets, etc., have not been shown. The Contractor shall agree to provide and install the necessary piping, fittings, valves, ducts, duct fittings and offsets, and other specialties to suit such conditions without additional cost to the Owner. Mechanical drawings shall not be used for general construction dimensions or for type of material used for general construction. For exact building layout, dimensions and building materials used, Contractor shall refer to Architectural Drawings.

1.3 QUALITY ASSURANCE

A. Contractor shall comply with all State, and local codes and ordinances.

B. Contractor shall make application for, obtain and pay for all required permits and certificates of inspection of the work.

C. All equipment, materials, and installation procedures shall comply with standards listed within each specification.

D. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

E. Install equipment and materials to provide required access for servicing and maintenance.

1.4 SUBMITTALS

A. Operation and Maintenance Manuals:

1. Prepare and submit three (3) copies of operation and maintenance instructions for all mechanical equipment furnished. One copy will remain on record in the Engineer's office. Organize maintenance and operating manual information into suitable sets of manageable size, and bind into individual binders properly identified and indexed (thumb-tabbed). Include emergency instructions, spare parts listing, copies of warranties, wiring diagrams, recommended "turn-around" cycles, inspection procedures, shop drawings, product data, signed letters of certification of inspection and similar application information. Bind each manual of each set in a heavy-duty, 3-ring vinyl-covered binder, and include pocket folders for folded sheet information. Mark identification on both front and spine of each binder.
2. Content: Operations and maintenance manual content is specified in individual Specification Sections to be reviewed at the time of Section submittals. Submit reviewed content formatted and organized as required by this Section. Engineer will comment on content of operations and maintenance submittals and indicate where revisions or re-submittals are required. Clarify and update reviewed content to correspond to revisions and field conditions.
3. Organization: Organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:

    a. Title Page, including name and address of project and Owner, and contact information for Contractor, Construction Manager and Architect.
    b. Table of Contents, including each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.
    c. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
    d. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.

4. Format: Assemble each manual into a composite electronically indexed file. Submit on digital media acceptable to Architect/Engineer. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically linked operation and maintenance directory. Enable inserted reviewers comments on draft submittals.

B. Record Drawings:

1. Provide one (1) set of mechanical drawings marked-up with actual installation locations. Give special attention to the complete and accurate recording of underground conduit, piping and ductwork, other concealed and non-accessible work, branching arrangement and valve location for piping systems, locations of dampers and coils in duct systems, locations of control system sensors and other control devices, and work of change orders where not shown accurately by Contract Documents.

C. Contract Document Discrepancies:

1. If Contract Document requirements appear to make it impossible to produce first class work, or should discrepancies appear among Contract Documents, request interpretation before proceeding with work. If Contractor fails to make such request, no excuse will thereafter be entertained for failure to carry out work in satisfactory manner. Should conflict occur in or between drawings and

specifications, Contractor is deemed to have estimated on more expensive way of doing work unless he shall have asked for and obtained written decision before submission of proposal as to method or materials required.

D. The Contractor shall be responsible for and bear any expense of alterations to the building or its appurtenances resulting from the substitution of equipment to that specified in the Contract Documents.

E. Review of shop drawings does not release the Contractor from further satisfactory operating responsibilities. Material and equipment shall still be required to meet the requirements of the Construction Documents and shall be approved for final acceptance when construction is completed and all units and systems have been operated, tested, adjusted and balanced to the satisfaction of the Architect/Engineer. Should proposed approved alternate equipment involve rearrangement of designed equipment, a complete layout of the area involved shall be submitted by the Contractor, and shall be approved in writing before installation of any such items of equipment. Any additional expense involved shall be a Contractor-borne expense.

1.5 FEES, PERMITS AND LICENSES

A. The Contractor shall obtain and pay for all fees, permits, licenses for services to the building required. Capital facilities utility service charges are to be paid directly by Owner, not part of the Construction Contract.

B. The Contractor shall maintain all necessary signal lights and guards against danger and use all proper means for the safety of the public.

C. The Contractor shall pay for opening and repairing all pavement cuts.

D. The Contractor shall furnish to the Architect/Engineer copies of all fees, permits and licenses required for all mechanical work herein specified before any mechanical work is started.

1.6 AUTOCAD DRAWING FILE REQUESTS

A. As an instrument of service to aid in Shop Drawing Submittals, the Owner will provide AutoCAD drawing files upon request. The files will be sent upon return receipt of the "Request for Drawings" agreement signed by an officer of the requesting firm. The Owner does not assure that the drawings represent all changes, addenda items, change orders or modifications that may have occurred. The drawings are simply a tool for use in producing shop drawing submittals.

1.7 ELECTRICAL COORDINATION

A. General: Mechanical Contractor shall coordinate with Electrical Contractor for proper electrical power characteristics to all mechanical equipment which require electrical power connection. Unless specifically shown otherwise Electrical Contractor shall provide all power connections required to provide power to the equipment and Mechanical Contractor shall provide all equipment and electrical wiring required for all start-stop control and safety interlock functions required for all equipment.

B. Types of work, normally recognized as electrical but provided as mechanical, specified or partially specified in this section, include but are not necessarily limited to the following:

1. Motors for mechanical equipment.
2. Starters for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
3. Wiring from motors to disconnect switches or junction boxes for motors of mechanical equipment, but only where specifically indicated to be furnished integrally with equipment.
4. Furnish and install all electrical control circuit conduits and wiring and control devices required to perform the equipment control functions, including float control switches, flow control switches, and similar mechanical/electrical devices provided for mechanical systems.

C. Emergency Shutdown Switches: Mechanical Contractor shall coordinate with Electrical Contractor for proper shutdown switches to all mechanical, kitchen or foodservice equipment which require emergency shutdown. Types of equipment provided by mechanical, kitchen or foodservice equipment suppliers, include but are not necessarily limited to the following:

1. Water Heaters.

D. Mechanical/Electrical Coordination Schedule: See schedule on drawings for further Mechanical/Electrical coordination requirements.

1.8 ELECTRIC MOTORS

A. Basic Motor Requirements

1. Basic requirements apply to mechanical equipment motors, unless otherwise indicated.
2. Motors 1 HP and Larger: Polyphase.
3. Motors smaller than 1 HP: Single-phase.
4. Frequency Rating: 60 Hz.
5. Voltage Rating: Determined by voltage of circuit to which motor is connected.
6. Service Factor: According to NEMA MG 1, unless otherwise indicated.
7. Capacity and Torque Characteristics: Rated for continuous duty and sufficient to start, accelerate, and operate connected loads at designated speeds, in indicated environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.
8. Enclosure: Open dripproof, unless otherwise indicated.

B. Polyphase Motors:

1. Description: NEMA MG-1, medium induction motor.

    a. Design Characteristics: NEMA MG-1, Design B, unless otherwise indicated.
    b. Premium Energy-Efficient Design: All motors.
    c. Stator: Copper windings, unless otherwise indicated. Multispeed motors have separate winding for each speed.
    d. Rotor: Squirrel cage, unless otherwise indicated.
    e. Bearings: Double-shielded, prelubricated ball bearings suitable for radial and thrust loading.
    f. Temperature Rise: Match insulation rating, unless otherwise indicated.
    g. Insulation: Class F, unless otherwise indicated.

2. Motors Used with Reduced-Inrush Controllers: Match wiring connection requirements for indicated controller, with required motor leads brought to motor terminal box to suit control method.
3. Motors Used with Variable-Frequency Controllers: Definite-purpose inverter-fed motors in accordance with NEMA MG-1, Part 31. Ratings, characteristics, and features coordinated with and approved by controller manufacturer.

    a. Critical vibration frequencies are not within operating range of controller output.
    b. Temperature Rise: Match rating for Class B insulation.
    c. Insulation: Class H.
    d. Thermal Protection: Where indicated, conform to NEMA MG-1 requirements for thermally protected motors.
    e. Motor Shaft Grounding: For motors controlled by variable frequency drives, provide factory installed shaft grounding that requires no maintenance for the service life of the motor.

4. Rugged-Duty Motors: Where indicated, motors are totally enclosed with 1.25 minimum service factor, greased bearings, integral condensate drains, and capped relief vents. Windings are insulated with non-hygroscopic material. External finish is chemical-resistant paint over corrosion-resistant primer.
5. Source Quality Control: Perform the following routine tests according to NEMA MG-1:

    a. Measurement of winding resistance.
    b. No-load readings of current and speed at rated voltage and frequency.
    c. Locked rotor current at rated frequency.
    d. High-potential test.
    e. Alignment.

C. Single-Phase Motors:

1. Type: As indicated or selected by manufacturer from one (1) of the following, to suit starting torque and other requirements of specific motor application.

    a. Permanent-split capacitor.
    b. Split-phase start, capacitor run.
    c. Capacitor start, capacitor run.

2. Shaded-Pole Motors: Do not use, unless motors are smaller than 1/20 HP.
3. Thermal Protection: Where indicated or required, internal protection automatically opens power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal protection device automatically resets when motor temperature returns to normal range, unless otherwise indicated.
4. Bearings: Ball-bearing type for belt-connected motors and other motors with high radial forces on motor shaft. Sealed, prelubricated sleeve bearings for other single-phase motors.

1.9 CONTROL PANEL NAMEPLATE

A. General: Mechanical equipment furnished with industrial control panel, as defined by NEC Article 409, shall be provided with a factory installed nameplate with markings as indicated by NEC 409.10, identifying the following for the equipment electrical power supply. Refer to the Mechanical/Electrical Coordination Schedule for minimum short circuit current rating (SCCR) value.

1. Current, phase to phase.

2. Voltage, phase to phase.
3. Three-phase real power (kW).
4. Three-phase reactive power (kVAR).
5. Short circuit current rating (A).

1.10 CLEANING AND PROTECTION

A. General: During handling and installation of work at project site, each Contractor shall clean and protect work in progress and adjoining work on a basis of perpetual maintenance. Apply suitable protective covering on newly installed work where reasonably required to ensure freedom from damage or deterioration at time of substantial completion; otherwise, clean and perform maintenance on newly installed work as frequently as necessary through remainder of construction period. Adjust and lubricate operable components to ensure operability without damaging effects.

1.11 TEMPORARY HEATING, COOLING AND VENTILATION

A. Existing mechanical systems may be used for temporary heating, cooling and ventilation during construction. New mechanical systems shall not be used for temporary heating, cooling and ventilation. All costs associated with providing temporary heating, cooling and ventilation during construction shall be the responsibility of the Contractor.

1.12 PROJECT CLOSEOUT

A. Closeout Equipment/Systems Operations: Sequence operations properly so that work of project will not be damaged or endangered. Coordinate with seasonal requirements. Operate each item of equipment and each system in a test run of appropriate duration with the Owner's operating personnel present, to demonstrate sustained, satisfactory performance. Adjust and correct operations as required for proper performance. Clean and lubricate each system, and replace dirty filters, excessively worn parts and similar expendable items of the work.

B. Operating Instructions: Conduct a full-day walk-through instruction seminar for the Owner's personnel to be involved in the continued operation and maintenance of mechanical equipment and systems. Explain the identification system, operational diagrams, emergency and alarm provisions, sequencing requirements, seasonal provisions, security, safety, efficiency and similar features of the systems.

1.13 FINAL COMPLETION

A. The Mechanical Contractors shall not call for a final completion check until the entire Mechanical and Electrical Equipment and Systems have been installed, adjusted, balanced and in full and complete satisfactory operation and the following certifications of inspection from equipment suppliers have been completed and submitted to the Architect/Engineer. Certifications of Inspections for Mechanical Equipment are required on the following items of equipment:

1. Plumbing fixtures and equipment (Local Representative)
2. Domestic water heaters (Local Representative)
3. Air terminal devices (Local Representative).
4. Fans (Local Representative)
5. Ductless split system air conditioning units (Local Representative)

B. The Certifications shall consist of letters signed by Factory-Trained and -Authorized Service Engineers stating the following:

1. They have inspected all of their equipment on the project.
2. They approve the condition of the equipment and its installation.
3. They have fully checked its operation and certify that it is operating properly.
4. They have noted any problems, conditions or objections that could lead to future operating problems.

C. Documentation of the signed letters of Certification of Inspection shall be furnished in the Operations and Maintenance Manuals, included with the associated equipment.

1.14 FINAL PAYMENT

A. Final Payment will not be made until the Contractor has satisfactorily completed all final inspection items.

1.15 GUARANTEE

A. The one (1) year guarantee period shall not start until the project is fully completed and the Contractor has received the Final Payment and Certificate of Completion.

B. All equipment and all work shall be fully guaranteed, parts, and labor, for one (1) full year from the date of the Certificate of Completion. Repairs made during this period must be fully guaranteed for an additional one (1) year period from the date of repairs.

C. The Mechanical Contractor has the full responsibility to guarantee all equipment and work and shall assume full responsibility to repair any equipment at his cost that the manufacturer refuses to guarantee.

D. The Owner has the right to order repairs to any equipment or work provided hereon and to charge the Contractor for same if repairs are not made by the Contractor within a reasonable period of time not to exceed 24 hours during an emergency or 72 hours on a non-critical item.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 PAINTING AND FINISHING

A. Painting of exposed mechanical work is specified and performed under other divisions of these specifications.

B. Factory finishes, shop priming, and special protective coatings are specified in the individual equipment specification sections.

C. Where factory finishes are provided on equipment and no additional field painting is specified, all marred or damaged surfaces shall be touched up or refinished so as to leave a smooth, uniform finish at the time of final inspection.

D. Paint inside of ductwork black, where it can be seen from occupied spaces through diffusers, grilles or louvers (under any lighting condition).

3.2 COMMISSIONING

A. Attached to this section are examples of commissioning forms to be completed by the Contractor. Contractor shall review such sections for responsibilities and compliance as part of the commissioning process.

END OF SECTION 230000

SECTION 230010 - MECHANICAL SUBMITTALS

PART 1 - GENERAL

1.1 GENERAL

A. Submittals shall include specially prepared technical data for this project, including drawings, diagrams, performance curves, data sheets, schedules, templates, patterns, reports, calculations, instructions, measurements and similar information not in standard printed form for general application to a range of similar projects.

B. Submittals shall also include product data which includes standard printed information on materials, products and systems; not specially prepared for this project, but with the designation of selections from among available choices for this project clearly identified.

1.2 SUBMITTAL REQUIREMENTS

A. Coordination and Sequencing: Coordinate preparation and processing of submittals with performance of the work so that work will not be delayed by submittals. Coordinate and sequence different categories of submittals for same work, and for interfacing units of work, so that one will not be delayed for coordination of Architect/Engineer's review with another.

B. Preparation of Submittals: Provide permanent marking on each submittal to identify project, date, Contractor, Subcontractor, submittal name and similar information to distinguish it from other submittals. Show Contractor's executed review and approval marking and providing space for Architect's/Engineer's "Action" marking. Package each submittal appropriately for transmittal and handling. Submittals which are received from sources other than through Contractor's office will be returned by Architect/Engineer "Without Action".

C. Provide Contractor's certification on form, ready for execution, stating that information submitted complies with requirements of contract documents.

D. The Contractor shall be responsible for and bear any expense of alterations to the building or its appurtenances resulting from the substitution of equipment to that specified in the Contract Documents.

E. Review of submittals does not release the Contractor from further satisfactory operating responsibilities. Material and equipment shall be approved for final acceptance when construction is completed and all units and systems have been operated, tested, adjusted and balanced to the satisfaction of the Architect/Engineer. Should proposed approved alternate equipment involve rearrangement of designed equipment, a complete layout of the area involved shall be submitted by the Contractor, and shall be approved in writing before installation of any such items of equipment. Any additional expense involved shall be a Contractor-borne expense.

F. Electronic Submittals: All submittals for shop drawings, O & M Manuals and Record Drawings shall be in electronic PDF format. Identify and incorporate information in each electronic submittal file as follows:

1. Assemble complete submittal package into a single indexed file incorporating submittal requirements of a single Specification Section and transmittal form with links enabling navigation to each item.
2. Name file with submittal number or other unique identifier, including revision identifier.

a. File name shall use project identifier and Specification Section number followed by a decimal point and then a sequential number (e.g., USD-23 05 00). Resubmittals shall include an alphabetic suffix after another decimal point (e.g., USD-23 05 00 A).

3. Provide means for insertion to permanently record Contractor's review and approval markings and action taken by Architect and/or Construction Manager.

4. Transmittal Form for Electronic Submittals: Use software-generated form from electronic project management software acceptable to Architect, Engineer and Owner**,** containing the following information:

a. Project name.
b. Date.
c. Name and address of Architect.
d. Name of Construction Manager.
e. Name of Contractor.
f. Name of firm or entity that prepared submittal.
g. Names of subcontractor, manufacturer, and supplier.
h. Category and type of submittal.
i. Submittal purpose and description.
j. Specification Section number and title.
k. Specification paragraph number or drawing designation and generic name for each of multiple items.
l. Drawing number and detail references, as appropriate.
m. Location(s) where product is to be installed, as appropriate.
n. Related physical samples submitted directly.
o. Indication of full or partial submittal.
p. Transmittal number, numbered consecutively.
q. Submittal and transmittal distribution record.
r. Other necessary identification.
s. Remarks.

1.3 SUBMITTAL LIST

A. Submittals shall be submitted for, but not limited to, the items listed in each section of the specifications. Submittals, in addition to those listed, may be required by the Architect/Engineer. The following submittal register is a summary list of submittals required for the project.

SUBMITTAL REGISTER	
SECTION	ITEM
230000	O&M Manuals
230000	Record Drawings
230000	Certification of Inspection
230500	Valves
230500	Piping Specialties
230500	Meters and Gauges
230500	Supports and Anchors
230500	Mechanical Identification
230500	Vibration Control
230500	Access Panels
230500	Joint Sealants
233400	Fans

SUBMITTAL REGISTER	
SECTION	ITEM
233400	Roof Curbs
238126	Ductless Split Systems
238126	Ductless Split System Accessories

END OF SECTION 230010

SECTION 230700 - HVAC INSULATION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. HVAC Piping Insulation.
2. Insulation Accessories.

1.2 SUBMITTALS

A. Shop Drawing Submittals:

1. Product Data: Submit manufacturer's technical product data and installation instructions for each type of mechanical insulation and accessory.
2. Submit schedule showing manufacturer's product number, k-value, thickness, and furnished accessories for each mechanical system requiring insulation.

1.3 QUALITY ASSURANCE

A. Furnish insulation and materials bearing the manufacturer's label. Only mechanics skilled at such work shall apply materials. Insulation and materials shall be by one of the manufacturers listed. Specialty material shall be of the manufacturer indicated or approved equal. Fire and smoke hazard classification ratings on insulation, jacket, and adhesive shall conform to NFPA 255, ASTM E 84, or UL-723 as follows:

1. Flame Spread Index not exceeding 25.
2. Smoke Developed Index not exceeding 50.

B. Certifications: Submit certifications or other data as necessary to show compliance with these specifications and governing regulations. Include proof of compliance for test of products for fire rating, corrosiveness, and compressive strength.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.5 COORDINATION

A. Coordinate size and location of supports, hangers, and insulation shields.

B. Coordinate clearance requirements with piping Installer for piping insulation application, duct Installer for duct insulation application, and equipment Installer for equipment insulation application. Establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.6 SCHEDULING

A. Schedule insulation application after pressure testing systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products by one of the following:

1. Armacell LLC.
2. Dow Chemical Company.
3. Johns-Manville Corp.
4. Keene Corp.
5. Knauf Fiber Glass.
6. Nomaco K-Flex.
7. Owens-Corning Fiberglass Corp.
8. Pittsburg Corning Corp.

2.2 MATERIALS

A. Thermal Conductivity Average Maximum in Btu-in/hr-ft² at 75ºF Mean Temperature:

1. Fiberglass Board = 0.26.
2. Fiberglass Blanket = 0.30.
3. Fiberglass Preformed Pipe Insulation = 0.26.
4. Cellular Glass = 0.30.
5. Flexible Elastomeric Cellular = 0.27.
6. Polyisocyanurate = 0.19.
7. Calcium Silicate = 0.60 @ 500ºF.

B. Vapor retarder film and tape shall have a maximum permeance of 0.030 perm.

C. All pre-formed pipe insulation shall be provided with self-adhering and self-sealing overlapping flap.

D. Pipe Insulation Protection:

1. Pipe insulation exposed in finished areas shall be protected with 0.030 inches thick PVC plastic jacketing covers, Ceel-Co 100 Series or approved equal.
2. Pipe insulation exposed in mechanical and electrical equipment rooms, indoor parking garages and other unfinished areas 8’-0” or less above finish floor shall be protected with 0.030 inches thick, ultraviolet resistant, PVC plastic jacketing covers, Ceel-Co 300 Series or approved equal.
3. Pipe insulation exposed to weather shall be 1-inch, 3.0 – 6.0-pcf closed cell fiber free elastomeric. Adhere insulation roll to the duct per manufacturer’s recommendation. The insulation shall be as manufactured by HT Armaflex or approved equal.

PART 3 - EXECUTION

3.1 PIPING INSULATION SCHEDULE

A. Refrigerant Suction Piping – 1-1/2-inch and smaller.

1. Elastomeric closed-cell plastic foam: 1-inch thick.
2. Polyisocyanurate closed-cell: 1-inch thick with vapor retarder film.

3.2 EQUIPMENT INSULATION SCHEDULE

A. VAV Terminal Unit Reheat Coils

1. Fiberglass Blanket: 2-inch thick 0.75-pcf density with heavy duty FSK vapor barrier.

3.3 EXAMINATION

A. Examine substrates and condition for compliance with requirements for installation and other conditions affecting performance of insulation application.

1. Verify that systems and equipment to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.
3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.4 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

3.5 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation products in accordance with manufacturer's written instructions, and in accordance with the MICA National Commercial and Industrial Insulation Standards to ensure that insulation serves its intended purpose.

B. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of equipment, ducts and fittings, and piping including fittings, valves, and specialties.

C. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of equipment, duct system, and pipe system as specified in insulation system schedules.

D. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

E. Install insulation with longitudinal seams at top and bottom of horizontal runs.

F. Install multiple layers of insulation with longitudinal and end seams staggered.

G. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

H. Keep insulation materials dry during application and finishing.

I. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

J. Install insulation with least number of joints practical.

K. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

L. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

M. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

N. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

O. For above ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.

P. Provide neatly beveled edge at interruptions of insulation.

3.6 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions. Terminate insulation at fire damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

1. Comply with requirements in Division 07 for firestopping and fire-resistive joint sealers.

3.7 INSTALLATION OF PIPING INSULATION

A. Install insulation on pipe systems subsequent to testing and acceptance of tests.

B. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. The appearance of the completed insulation shall be a significant factor in determining the acceptability of the work.

C. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

D. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

E. Where vapor retarders are specified, elbows and fittings shall be wrapped with vapor retarder tape 3-inches wide or shall have PVC jacketing.

F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation applied to adjoining pipe run. Install factory-molded, pre-cut or job-fabricated units (at installer's option) except where specific form or type is indicated.

G. Insulation of Piping Specialties on Cold Piping Services: Insulate union, flanges, strainers, flexible connections, hoses, and expansion joints on cold piping services with flexible elastomeric cellular insulation. Thickness of flexible elastomeric cellular insulation shall be equivalent to thickness of insulation on the piping service as specified in this Section or as shown on the drawings. Insulation shall be sealed to provide a vapor tight barrier. Cold piping services include chilled water systems, and geothermal heat pump water loop systems.

H. Piping Insulation Omitted: Omit insulation on hot piping within radiation enclosures or unit cabinets.

I. Insulated piping systems shall be supported on the exterior of the insulation surface. Install protective metal shields and insulated inserts wherever needed to prevent compression of insulation.

J. Metal shields: Conform to table below for minimum length of shield:

PIPE SIZE	INSULATION THICKNESS	LENGTH OF SHIELD
Less than 1”	Up to 1”	3”
1”-2”	1”	4-1/2”
1”-2”	1-1/2”	5-1/2”

K. Pipe Hanger, Trapeze, and Roller Support Insulation Inserts: Butt pipe insulation against pipe hanger insulation inserts. Apply wet coat of vapor barrier lap cement on butt joints and seal joints with 3-inch wide vapor barrier tape or band.

3.8 PROTECTION AND REPLACEMENT

A. Protection: Provide protection for insulation work during remainder of construction period, to avoid damage and deterioration.

B. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

END OF SECTION 230700

SECTION 233400 - FANS AND ROOF CURBS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of fans and accessories work is indicated by drawings and schedules and by requirements of this section.

B. Types of fans and accessories required for this Project include the following:

1. Fans:

a. Centrifugal Roof Ventilators.

2. Hoods (Intake and Relief Gravity Ventilators).
3. Prefabricated Curbs.

C. Provide the following electrical work as work of this section, in compliance with electrical specifications:

1. Fans: Control and interlock wiring between operating controls, indicating devices, unit temperature control panels, and fan starters.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of fans of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. AMCA Compliance: Test and rate fans in accordance with AMCA Standards. Fans shall bear AMCA 300 certified rating seal.
2. UL and NEMA Compliance: Provide electrical components required as part of fans which have been listed and labeled by UL and comply with NEMA Standards.
3. NEC Compliance: Comply with National Electrical Code (NFPA 70) as applicable to installation and electrical connections of ancillary electrical components of fans.
4. UL 762: UL listing for grease removal (kitchen hood fans).

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, weight loadings, required clearances, and methods of assembly of components.

C. Maintenance Data: Submit maintenance data and parts list for each fan, control, and accessory; including "trouble-shooting" maintenance guide. Include this data and product data in maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

A. Handle fans and components carefully to prevent damage, breaking, denting and scoring. Do not install damaged units or components; replace with new.

B. Store fans and components in clean, dry place. Protect from weather, dirt, fumes, water, construction debris and physical damage.

C. Comply with Manufacturer's rigging and installation instructions for unloading fans and moving units to final location for installation.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide fans and hoods of one (1) of the following:

1. Centrifugal Roof Ventilators:

a. Acme
b. Carnes Company, Inc.
c. Cook (Loren) Co.
d. Essick Air Products, Breidert.
e. Greenheck Fan Corp.
f. ILG Industries, Inc.
g. Jenn Industries, Inc.
h. Nailor Industries.
i. Penn Barry.
j. S and P Fans.
k. Twin City Fan.

2.2 CENTRIFUGAL ROOF VENTILATORS

A. General: Except as otherwise indicated, provide standard prefabricated centrifugal ventilator units of type and size indicated, modified as necessary to comply with requirements, and as required for complete installation. All kitchen hood exhaust fans shall be UL listed for grease removal in accordance with UL 762.

B. Centrifugal Roof Ventilators: Provide centrifugal roof type, curb mounted, power ventilators of type, size and capacity as scheduled, and as specified herein.

1. Type: Centrifugal fan, direct or belt driven as scheduled. Provide aluminum, galvanized-steel or fiberglass weatherproof housings as scheduled. Provide square base to suit roof curb. Provide permanent split-capacitor type motor for direct driven fans; capacitor-start, induction-run type motor for belt driven fans.

a. Housing Design: Hooded dome type.

2. Electrical: For fractional HP motors (3/4 HP and below), motor shall be factory wired to single-gang weatherproof switch box integral with unit. Provide thermal overload protection in fan motor. Provide conduit chase within unit for electrical connection.
3. Bird Screens: Provide removable bird screens, 1/2-inch mesh, 16-gage aluminum or brass wire.
4. Dampers: Provide and install normally closed electric motorized damper with linkage in curb base. Provide and install transformer if required. Damper to open when fan is energized.
5. Inlet Grille: Provide aluminum 1/2-inch mesh egg-crate type inlet grille.

2.3 PREFABRICATED ROOF CURBS

A. General: Provide manufacturer's standard shop-fabricated units, modified if necessary to comply with requirements.

B. Fabricate structural framing for units of structural quality sheet steel (ASTM A 570, Grade 40), formed to profiles indicated or, if not indicated, to manufacturer's standard profiles for coordination with roofing, insulation and deck construction. Include 45 degree cant strips and deck flanges with offsets to accommodate roof insulation. Weld corners and seams to form watertight units.

1. Clean and paint units with manufacturer's standard rust- inhibitive metal primer paint.

C. Reinforce continuous runs of over 3-feet-0-inches length, by inserting welded stiffeners of heavy-gage with flanges as required to provide sufficient rigidity and strength to withstand maximum lateral forces in addition to superimposed vertical loads.

D. Sloping Roof Decks: For deck slopes of 1-inch per foot and more, fabricate support units to form level top edge.

E. Gage and Height: Fabricate units of metal gage and to height above roof surface as indicated here, unless shown elsewhere on drawings.

1. Exhaust Fan and Relief Fan Curbs: 14-gage, 20-inch height.

F. Provide treated wood nailer, not less than 1-5/8-inch thick and of width indicated, but not less than width of support wall assembly. Anchor nailer securely to top of metal frame unit.

G. Provide lumber pressure treated with water-borne preservatives for "above ground" use, complying with AWPB LP-2.

H. Insulate units inside structural support wall with rigid glass fiber insulation board of approximately 3-lb. density and 1-1/2-inch minimum thickness, except as otherwise indicated.

I. Provide support liners where shown, formed of 22-gage galvanized sheet metal, mill phosphatized, flanged at lower edges.

1. Extend support liners through deck construction to coordinate with ductwork below as indicated.
2. Use perforated metal for support liners, with approximately 1000, 3/32-inch diameter holes per sq. ft., to provide sound absorbing surfaces.
3. Provide sound insulation insert for curbs so indicated. Construct of 1-inch thick rigid fiberglass panels secured in galvanized-steel framework, with rounded edges to minimize air flow resistance.

J. Metal Deck Reinforcement: Where indicated as integral part of support units, provide channel-shaped metal deck closure strips to reinforce opening through metal decking. Fabricate strips from 14-gage metal to match metal and finish of curb units, except as otherwise indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas and conditions under which fans and accessories are to be installed. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF FANS

A. General: Install fans where indicated, in accordance with equipment manufacturer's published installation instructions and with recognized industry practices, to ensure that units comply with requirements and serve intended purposes.

B. Coordination: Coordinate with other work, including ductwork, floor construction, roof decking and piping, as necessary to interface installation of fans with other work.

C. Access: Provide access space around fans for service as indicated, but in no case less than that recommended by manufacturer.

D. Mounting: Mount fans on vibration isolators, in accordance with manufacturer's instructions.

E. Electrical Wiring: Install electrical devices furnished by manufacturer but not specified to be factory-mounted. Furnish copy of manufacturer's wiring diagram submittal to Electrical Installer.

1. Verify that electrical wiring installation is in accordance with manufacturer's submittal and installation requirements of electrical specifications. Do not proceed with equipment start-up until wiring installation is acceptable to equipment installer.

F. Duct Connections: Provide ductwork, accessories and flexible connections as indicated.

3.3 INSTALLATION OF HOODS AND ROOF CURBS

A. General: Install hoods and roof curbs per manufacturer's recommendation. Coordinate with Roofing Contractor for proper curb installation.

B. Roof Penetrations & Ductwork for Outdoor & Return Air cannot be within four feet of any 2 hour fire resistant rated wall.

3.4 FIELD QUALITY CONTROL

A. Testing: Upon completion of installation of fans, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning units, then retest to demonstrate compliance.

3.5 EXTRA STOCK

A. Provide one (1) spare set of belts for each belt-driven fan. Obtain receipt from Owner that belts have been received.

END OF SECTION 233400

SECTION 238126 - DUCTLESS SPLIT-SYSTEM AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Extent of ductless split-system air-conditioning unit work required by this section is indicated on drawings and schedules, and by requirements of this section.

B. Types of ductless split-system air-conditioning units specified in this section include the following:

1. Split-system air-conditioning units.

C. Number of indoor units operating from one (1) outdoor unit include the following:

1. Single zone.

D. Units are designed for exposed or concealed mounting.

E. Electrical Coordination

1. Provide the following electrical work as work of this section, in compliance with electrical specifications:

a. Provide electrical disconnect switches.

2. See Mechanical/Electrical Coordination Schedule on drawings for further clarification.

F. Refer to Division 23 Section Mechanical General Provisions for equipment certification requirements.

G. Refer to other Division 23 Sections for piping required external to ductless split-system air-conditioning units for installation.

1.2 QUALITY ASSURANCE

A. Manufacturer's Qualifications: Firms regularly engaged in manufacture of ductless split-system air-conditioning units, of types and capacities required, whose products have been in satisfactory use in similar service for not less than five (5) years.

B. Codes and Standards:

1. Listing and Labeling: Provide electrically operated components specified in this Section that are listed and labeled.

a. The Terms "Listed" and "Labeled": As defined in the National Electrical Code, Article 100.

2. Comply with NFPA 70.

1.3 SUBMITTALS

A. Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, dimensions, required clearances, weights, furnished specialties and accessories; and installation and start-up instructions.

B. Shop Drawings: Submit shop drawings detailing the mounting, securing and flashing of the units to the roof structure. Indicate coordinating requirements with roof membrane system.

C. Wiring Diagrams: Submit manufacturer's electrical requirements for power supply wiring for ductless split-system air-conditioning units. Submit manufacturer's ladder-type wiring diagrams for interlock and control wiring. Clearly differentiate between portions of wiring that are factory-installed and portions to be field-installed.

D. Operation and Maintenance Data: Submit maintenance data and parts list for each ductless split-system air-conditioning unit, control, and accessory; including "troubleshooting" maintenance guide, servicing guide, and preventive maintenance schedule and procedures. Include this data and product data in Maintenance.

E. Warranty: Special warranty specified in this section.

1.4 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.

1. Warranty Period: Five (5) years from date of Substantial Completion.

1.5 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Filters: One (1) set of filters for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Carrier Air Conditioning
2. Daikin Industries
3. Friedrich Air Conditioning Company
4. Lennox Industries
5. LG
6. Mitsubishi Electronics America, Inc.; HVAC Division.
7. Sanyo Fisher (U.S.A.) Corp.
8. Enviromaster International, EMI

2.2 WALL-MOUNTED, EVAPORATOR-FAN COMPONENTS

A. Cabinet: Enameled steel with removable panels on front and ends in color selected by Architect and discharge drain pans with drain connection.

B. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240 and with thermal-expansion valve.

C. Electric Coil: Helical, nickel-chrome, resistance-wire heating elements with refractory ceramic support bushings; automatic-reset thermal cutout; built-in magnetic contactors; manual-reset thermal cutout; airflow proving device; and one-time fuses in terminal box for overcurrent protection.

D. Fan: Direct drive, centrifugal fan.

E. Fan Motors:

1. Special Motor Features: Multitapped, multispeed with internal thermal protection and permanent lubrication.

F. Filters: Permanent, cleanable.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

A. Casing: Steel, finished with baked enamel in color selected by Architect, with removable panels for access to controls, weep holes for water drainage and mounting holes in base. Provide brass service valves, fittings and gage ports on exterior of casing.

B. Compressor: Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay and contactor.

1. Compressor Type: Rotary.
2. Two-speed compressor motor with manual-reset high-pressure switch and automatic-reset low-pressure switch.

C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240 and with liquid subcooler.

D. Heat Pump Components: Reversing valve and low-temperature air cut-off thermostat.

E. Fan: Aluminum-propeller type directly connected to motor.

F. Motor: Permanently lubricated, with integral thermal-overload protection.

G. Low Ambient Kit: Permits operation down to 40 ˚F.

H. Low Ambient Kit: Permits operation down to 0 ˚F with optional wind baffles.

I. Mounting Base: Polyethylene.

2.4 ACCESSORIES

A. Thermostat: Low voltage, wall mounted with subbase to control compressor and evaporator fan.

B. Wireless Remote Control: Infrared remote control with LCD display of temperature, fan speed, timer, louver control and night setback.

C. Automatic-reset timer to prevent rapid cycling of compressor.

D. Outside Air Intake: Outside air duct connection to connect field-supplied ductwork.

E. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized and sealed; factory-insulated suction line with flared fittings at both ends.

F. Integrated condensate drain pump: Drain pump built into evaporator-fan unit to lift condensate 20-inches from drain pan.

G. Electric resistance heating: Supplemental electric heating capacity as indicated on the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roof for compliance with requirements for conditions affecting installation and performance of compressor-condenser units. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install units according to manufacturer's written instructions.

B. Install units level and plumb, maintaining manufacturer's recommended clearance.

C. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.

D. Install ground-mounted, compressor-condenser components on 4-inch thick, reinforced concrete base; 4-inches larger on each side than unit.

E. Install ground-mounted, compressor-condenser components on polyethylene mounting base.

F. Install and connect pre-charged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.3 CONNECTIONS

A. Drawings indicate the general arrangement of piping, fittings and specialties. The following are specific connection requirements:

1. Install piping to allow service and maintenance.

B. Drainage Fittings and Soldered Joints: Extend condensate drain to nearest equipment drain or floor drain. Construct vented, deep trap at connection to drain pan and install cleanouts at changes in direction. Terminate to suit local code requirements, except where stricter methods are indicated.

3.4 COMMISSIONING

A. Verify that installation is as indicated and specified.

B. Complete manufacturer's installation and startup checks and perform the following:

1. Inspect for visible damage to unit casing.
2. Inspect for visible damage to compressor, air-cooled condenser coil, and fans.
3. Verify that clearances have been provided for servicing.
4. Check that labels are clearly visible.
5. Clean compressor-condenser unit and inspect for construction debris.
6. Verify that controls are connected and operable.
7. Remove shipping bolts, blocks, and tie-down straps.
8. Verify that filters are installed.

C. Start unit according to manufacturer's written instructions.

1. Perform starting of refrigeration in summer only.
2. Complete startup sheets and attach copy with Contractor's startup report.

D. Check and record performance of interlocks and protection devices; verify sequences.

E. Operate unit for an initial period as recommended or required by manufacturer.

F. Simulate maximum cooling demand and check the following:

1. Compressor refrigerant suction and hot-gas pressures.
2. Short circuiting air through condenser.

G. After starting and performance testing, change filters, vacuum cooling and condenser coils and lubricate bearings.

3.5 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test and adjust field-assembled components and equipment installation, including connections and to assist in field testing. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

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, start units to confirm proper motor rotation and unit operation.
3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate and maintain units.

END OF SECTION 238126

SECTION 260500 - GENERAL ELECTRICAL

PART 1 - GENERAL

1.1 RESPONSIBILITIES

A. The Bidding Requirements, Conditions of Contract, General Specifications and General Requirements, and this Division shall be binding on the Contractor and shall apply to all electrical work to be completed under this section.

B. The Contractor shall be responsible for the work from the date of his Contract until its acceptance by the Owner and must make good all damages sustained from whatever cause. He shall use proper care and diligence in bracing and securing all parts of the work and shall in all cases judge as to the amount of protection required.

1.2 ORDINANCES, LAWS AND CODES

A. All work shall conform to the rules and regulations of the National Electrical Code, Local Code, "Occupational Safety and Health Act" and the State Fire Marshall's Office. All certificates of approval shall be delivered to the Engineer before final payment will be made.

B. Should any change in the drawings and/or specifications be required to conform to the above mentioned laws and ordinances, the Engineer shall be notified by the Bidder prior to the Bid Date, that the necessary changes may be completed. After the Bid Date, all work necessary to meet the requirements shall be at Contractor's expense, with no additional cost to the Owner.

C. The Contractor shall pay all fees, permits, or taxes for inspections, etc., in connection with the work under this Contract.

1.3 DATA AND MEASUREMENT

A. The data given herein and on the drawings is as exact as could be secured insofar as building construction and existing conditions are concerned. Extreme accuracy is not guaranteed. The drawings and specifications are intended for the assistance of the Contractor in achieving the end result. Exact locations, measurements, distance, levels, etc., will be governed by conditions at the Job Site.

B. The Contractor shall verify that the size of the equipment supplied by the selected manufacturers does not exceed the available mounting space.

C. The Engineer reserves the right to change location or size of conduits, outlets, fixtures or other pieces of equipment as may be necessary to avoid conflicts. No extra compensation will be allowed for such changes unless additional cost to the Contractor is caused.

D. The Bidder shall visit the Project Site that he may have knowledge of conditions at the Job Site and adapt his work to such conditions.

1.4 DRAWINGS AND SPECIFICATIONS

A. Anything mentioned in this specification and not shown on the drawings or vice versa shall be of like effect, as shown or mentioned in both. In any case of discrepancy or differences in the figures, drawings or specifications, the Bidder shall promptly report such discrepancies to the Engineer who shall make a decision in writing. Any adjustment by the Contractor without this decision shall be at the expense of the Contractor.

1.5 QUALITY OF WORKMANSHIP

A. The Contractor shall give his personal superintendence and direction to the work. He shall also keep a competent foreman or superintendent on the Project.

B. All equipment, controls and junction boxes shall be located for ready access, operation, repair or maintenance.

C. Any additional drawings necessary for the prosecution of the work will be furnished by the Engineer as promptly as possible. The Contractor shall request any additional instructions needed and shall do no work without drawings and instructions.

D. Any discrepancies between the Drawings shall be reported to the Engineer prior to the Bid Date.

1.6 GUARANTEE

A. This Contractor shall guarantee all materials, workmanship, and the successful operation of all apparatus furnished and installed by him for a period of one (1) year from the date of the final acceptance of the whole work, and shall guarantee to repair or replace at his own expense any part of the apparatus which may show defect during that time, provided such defect is, in the opinion of the Engineer, due to imperfect material or workmanship and not to carelessness or improper operation. Guarantee period for the replacement shall begin with the date of replacement.

B. The Owner shall notify the Contractor of any failure of any part or parts which occur during the guarantee period.

C. The Contractor shall also guarantee the systems and the apparatus to be working properly to meet all conditions as specified.

1.7 SHOP DRAWINGS

A. Shop Drawings shall be submitted in accordance with the requirements of Paragraph "Shop Drawings" of the General Conditions. The Contractor shall submit Shop Drawings of all fabricated work and equipment to be purchased. Data shall be sufficiently completed to permit evaluation and comparison with specified equipment and material. Each item shall be prepared as a separate submittal, not grouped or bound with other items.

B. <u>All drawings shall bear the Contractor’s stamp of approval and must be dated.</u>

C. Shop Drawings shall include, but not be limited to the following:

1. Medium Voltage Cables

2. Wire Conductors
3. Overcurrent Protective Device Coordination Studies
4. Occupancy Sensors
5. Panelboards
6. Wiring Devices and Device Wallplates
7. Fuses
8. Disconnect Switches
9. Lighting Fixtures (Luminaires)
10. Lamps and Ballasts
11. Telecommunications Systems

D. A notation shall be made on each item submitted as to its specified use or description of specific location in the work.

E. None of the preceding items shall be purchased, delivered to the site or installed until the item has been properly submitted in writing and reviewed by the Engineer.

F. Submittals shall be made even though the item is exactly as specified.

G. Should the Contractor fail to comply with any of the requirements as stated, the Engineer reserves the right to select a full line of materials, appliances and equipment, which shall be final and binding upon the Contractor.

1.8 SUBMITTAL DATA

A. Review of submittal data is only for general conformance with the design concept of the Project and general compliance with the information given in the Contract Documents. Any action shown is subject to the requirements of the plans and specifications. Contractor is responsible for: Dimensions, which shall be confirmed and correlated at the job site; fabrication processes and techniques of construction; coordination of his work with that of all other trades and the satisfactory performance of his work.

B. Contractor will be limited to one (1) review on a singular piece of equipment.

C. The listing of a manufacturer as "acceptable" does not imply automatic compliance with Contract Documents. It is the sole responsibility of the Contractor to insure that any price quotations received and submittals made are for equipment/systems, which meet or exceed the specifications included herein.

1.9 EQUAL MANUFACTURERS/EQUIPMENT

A. Any requests for manufacturer/equipment to be considered as equal other than as specified herein shall be submitted to the Engineer not less than 10 days prior to Bid Date.

B. Requests for review shall be sufficiently complete to permit evaluation and comparison with specified equipment and material.

1.10 AUTOCAD DRAWING FILE REQUESTS

A. As an instrument of service to aid in Shop Drawing Submittals, the Owner will provide AutoCAD drawing files upon request. The files will be sent upon return receipt of the "Request for Drawings" agreement signed by an Officer of the requesting firm. The Owner does not assure that the drawings represent all changes, addenda items, change orders or modifications that may have occurred. The drawings are simply a tool for use in producing shop drawing submittals.

PART 2 - PRODUCTS

2.1 PROTECTION OF FIXTURES AND WARES

A. This Contractor shall apply the necessary protective coverage to fixtures and other equipment to prevent scratches and mars to such equipment as a result of falling objects or work of other trades.

2.2 STORAGE

A. This Contractor shall provide and be responsible for safe storage of his materials and such storage shall not interfere with the work of others or progress of the Project in any manner.

2.3 EQUIPMENT ENCLOSURES

A. Provide enclosures, which mate properly with the equipment to be enclosed and are NEMA rated to suit the atmospheric conditions of the equipment surroundings.

PART 3 - EXECUTION

3.1 COORDINATION

A. Before installing any work, this Contractor shall coordinate the electrical work with all other Contractors on the Project, and the City Code enforcing department.

B. All electrical work shall be installed in proper sequence and so arranged with other trades that there will be no delay in the proper installation and completion of any part or parts of all piping systems and mechanical equipment.

C. This Contractor shall carefully examine the drawings and shall be responsible for the proper fitting of equipment and conduit as indicated without major alteration. If alterations are required, a detailed drawing of the proposed departure due to actual field conditions or other causes shall be submitted to the Engineer for approval.

D. Whenever interferences might occur, before installing any of the work in question, the Electrical Contractor shall consult with other Contractors and shall come to an agreement with them as to the exact location and level of his conduit, light fixtures and/or parts of his installation.

E. Where recessed electrical devices (speakers, fixtures, etc.) are installed in fire-rated ceilings, Contractor shall provide an enclosure approved by authorities having jurisdiction to surround each device as required to maintain the fire integrity rating of the ceiling. Adequate clearance between device and enclosure shall be provided in accordance with device manufacturer's recommendations. Verify clearance requirements with device manufacturer prior to installation of fixture.

F. Multiwire branch circuits as defined by the National Electrical Code (circuits with common neutral) shall not be used. Exception: Where an equipment manufacturer requires a multiwire branch circuit for only one utilization equipment and where all ungrounded conductors of that circuit are opened simultaneously by the branch circuit overcurrent device.

G. A cable or raceway type wiring method, installed in exposed or concealed locations near metal-corrugated sheet roof decking, shall be installed and supported so the nearest outer surface of the cable or raceway is not less than 6-inches from the nearest surface of the roof decking. Exception: Rigid metal conduit and intermediate metal conduit shall not be required to maintain this clearance.

H. All changes in the work of this Contractor, caused by his neglect to follow these instructions, shall be made at this Contractor's expense.

3.2 CONNECTIONS FOR EQUIPMENT

A. Coordinate the hook up of the following equipment with the Contractor required to furnish and install them. See the appropriate sections in the General Construction Work specifications for further information.

1. Owner Furnished Equipment
2. Pre-fabricated press box at bleachers
3. Scoreboards and athletic equipment

B. Verify fuse and/or circuit breaker requirements for electrical connections to equipment and provide overcurrent devices accordingly.

C. The plans indicate the locations of system devices. The Contract shall include the wiring system required to interconnect the indicated devices to result in a complete, operating system. The interconnecting wiring shall be in conformity with the requirements of the manufacturer of the equipment as well as with other requirements set out herein. The basic wiring method to be employed is indicated herein. The Contractor's Shop Drawing submittal shall indicate the specific routing and type of wireway and the number and type of conductors to be installed.

3.3 WORK ON EXISTING SITE

A. It shall be the responsibility of each Bidder to fully inform himself of any and all conditions which influence or are influenced by work contemplated by these specifications and accompanying drawings. The submission of a proposal by any Bidder will be construed as an admission by him that he has examined and is fully familiar with the premises and all conditions thereon and adjacent thereto, and has included in this proposal a proper and adequate amount to cover rearrangement of old work for the proper installation and operation of the new and existing equipment as shown on the drawings specified herein or as required. Such work shall be neatly and properly done.

B. Maintain existing electrical service and feeders to occupied areas and operational facilities, unless otherwise indicated or when authorized otherwise in writing by Owner or Engineer. Provide temporary service during interruptions to existing facilities. When necessary, schedule momentary outages for replacing existing wiring systems with new wiring systems. When that "cutting-over" has been successfully accomplished, remove, relocate or abandon existing wiring as indicated. Outages shall be during off-hours and at the convenience of the Owner.

C. The operation of all special systems shall be maintained, including but not limited to fire alarm, telephone, communication, data, security, emergency call, etc. Provide temporary connections/equipment as necessary for required sequence of construction. Any necessary momentary outages shall be scheduled with the Owner prior to starting such work.

3.4 DEMOLITION AND REMOVAL OF EXISTING EQUIPMENT AND MATERIALS

A. Existing conduits made spare by demolition work shall be removed unless concealed in existing construction.

B. All conduits and conductors shown to be reused shall be thoroughly tested and checked for insulation breakdown and continuity.

C. Electrical items must be removed where they interfere with or are not concealed by new construction such as new ceilings, walls, etc.

D. Existing fixtures, outlets, receptacles and other equipment and material shall be relocated, removed, reconnected or left in place as indicated on the drawings. Where an existing device is shown removed from an existing circuit, new wiring shall be provided as required to insure continuity of existing circuit. If existing devices or other electrical items, such as electrically operated equipment interfere with the location of a new partition, relocation of existing equipment, new equipment, etc., the existing items including electrical components of electrically operated equipment shall be disconnected and removed or satisfactorily relocated and reconnected even though not specifically indicated on the drawings. All material removed which is considered salvageable by the Owner and is not specifically designated to be reused on the drawings or not practical to be reused shall remain in the property of the Owner and shall be neatly stockpiled in a specially designated location.

3.5 TEMPORARY WIRING

A. Provide temporary electrical service having a main disconnect and distribution panel. The size of the service shall be coordinated with the General Contractor. From the panel provide wiring for luminaires and receptacles. All receptacles shall be equipped with ground fault circuit protection in accordance with NEC requirements. Protect temporary wiring from mechanical injury. Provide welding circuits as required.

B. Owner’s high voltage electrical distribution system may be tapped for temporary power. Provide all transformers and distribution equipment.

1. Provide independent meter for temporary power electrical consumption.

C. Temporary wiring materials are not to be installed as part of the permanent wiring system.

D. Include all work necessary to connect, disconnect, and remove temporary wiring.

3.6 CLEANING

A. This Contractor shall at all times keep the premises free of all waste or surplus materials, rubbish and debris which is caused by his employees or resulting from his work.

B. After all equipment and fixtures have been installed and building is ready for occupancy, the Electrical Contractor shall remove all stickers, rust stains, labels, temporary covers, plaster marks, paint spots, etc. All foreign matter and water shall be blown out or flushed out of all conduits, panels, motors, devices, switches, fixtures, etc.

C. Identification plates and trims on all equipment shall be free of paint and polished.

D. The Contractor shall leave the electrical portion of the work in a safe clean and very neat condition ready for operation.

3.7 RECORD DRAWINGS

A. The Contractor shall maintain an up-to-date set of plans and specifications on the Job Site. He shall mark all Addendum Items and any field changes on this set and see that a copy of all changes is furnished to the Engineer at the end of the Project.

B. The drawings shall also include as-built conditions such as equipment locations, routing of service entrance and major feeders, etc.

3.8 INSTRUCTION IN OPERATION BOOKS AND SPARE PARTS

A. After all tests and adjustments have been made, the Contractor shall furnish the necessary qualified personnel to place the special systems in continuous operation, during which time he shall provide complete Operating and Maintenance Instructions to the Owner's representative with an outline of instructions in written form. These personnel shall reserve adequate time to instruct an Owner's representative on proper operation (including all phases of the system and each of its component parts).

B. Contractor shall furnish Owner with three (3) sets of all operating instructions, maintenance instruction and spare parts lists of all equipment furnished under this Contract. Lists shall include current unit prices and source of supply for each item of operable equipment.

3.9 FIRESTOPPING

A. Openings around electrical penetrations through fire-resistant rated walls, partitions, floors or ceilings shall be firestopped using listed materials to maintain the fire rating. Installation shall be done in accordance with manufacturer's recommendations. Materials shall be UL Listed and labeled and FM approved for fire ratings consistent with penetrated barriers.

1. Foamed-in-place type firestopping shall only be permitted in concealed-from-view locations. Sealant type firestopping shall be used in exposed-to-view locations.
2. Conduit sleeves (2-inch and larger) and similar penetrations of fire-rated walls, floors or ceilings shall be sealed by a method that permits cables to be easily added or removed without damage to the firestopping materials. Products similar to Grace Construction Products Flamesafe Bags, Specified Technologies, Inc. EZ Path Fire Rated Pathway and Wiremold Flamestopper FS Series are acceptable when rated for the application. Coordinate requirements with product manufacturer and

authority having jurisdiction; maintain or exceed rating of penetrated surface. Foamed in place or sealant type firestopping are not acceptable at these locations.

3.10 TESTS AND ADJUSTMENTS

A. Upon completion of installation of electrical connections, and after circuitry has been energized with rated power source test connections to demonstrate capability and compliance with requirements. Ensure that direction of rotation of each motor fulfills requirement. Correct malfunctioning units at site, then retest to demonstrate compliance.

B. During the progress and after completion of the work included under this specification, the Contractor shall make all required tests at his own expense in the presence of the Engineer as required hereinafter and by local ordinances, codes, laws, and regulations. Such tests shall be in accordance with other sections of this division. The Engineer shall be notified five (5) days in advance as to the time when such tests are to be performed that a representative of the Engineer may be present.

END OF SECTION 260500

SECTION 260513 - MEDIUM-VOLTAGE CABLES

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 cables and related terminations and accessories for medium-voltage electrical distribution systems.

1.3 DEFINITIONS

A. NETA ATS: Acceptance Testing Specification.

1.4 SUBMITTALS

A. Product Data: For each type of cable indicated. Include terminations for cables and cable accessories.

1.5 QUALITY ASSURANCE

A. Installer: Engage a cable splicer, trained and certified by splice material manufacturer, to install, splice, and terminate medium-voltage cable.

B. Installer Experience:

1. Cable installer personnel proposed to work on this job shall have a minimum of 5-years' experience making similar types of terminations.

C. Source Limitations: Obtain cables and accessories through one source from a single manufacturer.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with IEEE C2 and NFPA 70.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Electric Service: Do not interrupt electric service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary electric service according to requirements indicated:

1. Notify Architect no fewer than three (3) working days in advance of proposed interruption of electric service.
2. Do not proceed with interruption of electric service without written permission.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

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

1. Cables:

a. General Cable Technologies Corporation.
b. Kerite Co. (The); Hubbell Incorporated.
c. Hendrix Wire and Cable.
d. Pirelli Cables & Systems NA.
e. Rome Cable Corporation.
f. Southwire Company.

2. Cable Terminating Products and Accessories:

a. G&W Electric Company.
b. Raychem Corp.; Telephone Energy and Industrial Division; Tyco International Ltd.
c. RTE Components; Cooper Power Systems, Inc.
d. Thomas & Betts Corporation.
e. Thomas & Betts Corporation/Elastimold.
f. 3M; Electrical Products Division.

2.2 CABLES

A. Cable Type: MV105.

B. Comply with UL 1072, AEIC CS 8, ICEA S-93-639, and ICEA S-97-682.

C. Conductor: Copper.

D. Conductor Stranding: Compact round, concentric lay, Class B.

E. Strand Filling: Conductor interstices are filled with impermeable compound.

F. Conductor Insulation: Ethylene-propylene rubber.

1. Voltage Rating: 15 kV.
2. Insulation Thickness: 133 percent insulation level.

G. Shielding: Copper tape, helically applied over semiconducting insulation shield.

H. Cable Jacket: Sunlight-resistant PVC.

2.3 SOLID TERMINATIONS

A. Shielded-Cable Terminations: Comply with the following classes of IEEE 48. Insulation class is equivalent to that of cable. Include shield ground strap for shielded cable terminations.

1. Class 1 Terminations: Modular type, exterior rated, with built-in stress control and silicone sealing compounds, furnished as a kit, with stress-relief tube; multiple, molded-silicone rubber, insulator modules, nontracking skirt modules; shield ground strap; and compression-type connector. Terminations prestretched on a removable core. 3M Cold Shrink QT-III skirted termination or approved equivalent.

2.4 SEPARABLE INSULATED CONNECTORS (ELBOWS)

A. Description: Modular system, complying with IEEE 386, with disconnecting, single-pole, cable terminators and with matching, stationary, plug-in, dead-front terminals designed for cable voltage and for sealing against moisture.

B. Terminations at Distribution Points: Modular type, dead-front, consisting of terminators installed on cables.

C. Load-Break Cable Terminators: Elbow-type units, 15 kV, with 200-A load make/break and continuous-current rating; coordinated with insulation diameter, conductor size, and material of cable being terminated. Include test point on terminator body that is capacitance coupled. Elbow shall have grounding provisions and pulling eye; cable seal shall be cold-shrink type.

D. Test-Point Fault Indicators: Applicable current-trip ratings and arranged for installation in test points of load-break separable connectors, and complete with self-resetting indicators capable of being installed with shotgun hot stick and tested with test tool.

E. 3M Series 5810 with features specified, or approved equivalent.

2.5 SURGE ARRESTORS

A. Medium Voltage Surge Arrestors: Provide MOV type surge arrestors on open position of medium voltage loop switch in medium voltage transformers.

B. Load Break Elbows: Surge arrestors shall be elbow plug-on type.

2.6 ARC-PROOFING MATERIALS

A. Tape for First Course on Metal Objects: 10-mil thick, corrosion-protective, moisture-resistant, PVC pipe-wrapping tape.

B. Arc-Proofing Tape: Fireproof tape, flexible, conformable, intumescent to 0.3 inch thick, compatible with cable jacket. 3M Scotch 77 tape or approved equivalent.

C. Glass-Cloth Tape: Pressure-sensitive adhesive type, 1/2 inch wide. 3M Scotch 69 tape or approved equivalent.

2.7 SOURCE QUALITY CONTROL

A. Test and inspect cables according to ICEA S-97-682 before shipping.

B. Test strand-filled cables for water-penetration resistance according to ICEA T-31-610, using a test pressure of 5 psig (35 kPa).

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install cables according to IEEE 576.

B. Handle cable carefully at all times to avoid damage. Seal the ends of the cable at all times against moisture with suitable end caps. Where it is necessary to cut the cable, terminate or seal ends immediately after the cutting operation. Inspect cable carefully as it is removed from the reel during pulling operations to be certain that it is free from visible defects.

C. Conductors shall be stored in an ambient temperature recommended by the conductor manufacturer to prevent the conductor insulation from being brittle and damaged during installation.

D. Proof conduits prior to conductor installation by passing a wire brush mandrel and then a rubber duct swab through the conduit. Separate the wire brush and the rubber swab by 48 to 72 inches on the pull rope.

1. Wire Brush Mandrel: Consists of a length of brush approximately the size of the conduit inner diameter with stiff steel bristles and an eye on each end for attaching the pull ropes. If an obstruction is felt, pull the brush back and forth repeatedly to break up the obstruction.
2. Rubber Duct Swab: Consists of a series of rubber discs approximately the size of the conduit inner diameter on a length of steel cable with an eye on each end for attaching the pull ropes. Pull the rubber duct swab through the duct to extract loose debris from the duct.

E. Pull Conductors: Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

1. Where necessary, use manufacturer-approved pulling compound or lubricant that will not deteriorate conductor or insulation.
2. Use pulling means, including fish tape, cable, rope, and basket-weave cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to cable.

F. In manholes, basements, handholes, and pull boxes train cables around walls by the longest route from entry to exit and support cables at intervals adequate to prevent sag. Sufficient slack, and in no case less than 36”, shall be left at all risers, transformers, switches, manholes, handholes, pull boxes, and termination points.

G. Support cables according to Division 26 Section "Supporting Devices."

H. Cables shall be continuous and unspliced.

I. Install terminations at ends of conductors and seal cable ends with standard kits.

J. Arc Proofing: Arc proof high-voltage cable at locations not protected by conduit or termination materials, such as handholes, manholes, switch basements, termination compartments, and free-air. In addition to arc-proofing tape manufacturer's written instructions, apply arc proofing as follows:

1. Clean cable sheath.
2. Wrap metallic cable components with 10-mil pipe-wrapping tape.
3. Smooth surface contours with electrical insulation putty.
4. Apply arc-proofing tape in one half-lapped layer with coated side toward cable.
5. Band arc-proofing tape with 1-inch- wide bands of half-lapped, adhesive, glass-cloth tape 2 inches o.c.

K. Seal around cables passing through fire-rated elements.

L. Ground shields of shielded cable at terminations. Ground metal bodies of terminators, cables, separable insulated-connector fittings, and hardware.

M. Ground surge arrestors in medium voltage transformers.

N. Install fault indicators on elbows.

O. Identify cables according to Division 26 Section "Electrical Identification."

P. Phase out and identify cables using materials and methods that match and mate with existing identification schemes used on campus. Materials and methods shall be permanent and weatherproof. Include conductor size in identification.

3.2 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Perform each visual and mechanical inspection and electrical test stated in NETA ATS. Certify compliance with test parameters.
2. After installing medium-voltage cables and before electrical circuitry has been energized, test for compliance with requirements.
3. Perform direct-current High Potential test of each new conductor according to NETA ATS, Ch. 7.3.3. Do not exceed cable manufacturer's recommended maximum test voltage.

B. Remove and replace malfunctioning units and retest as specified above.

C. Prepare test and inspection reports.

END OF SECTION 260513

SECTION 260519 - WIRE CONDUCTORS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of electrical wire work is indicated by drawings and schedules. Wires shall be single, insulated conductors, field-installed in continuous raceways unless specified otherwise.

B. Types of electrical wire and connectors specified in this section include the following:

1. Copper conductors.
2. Tap type connectors.
3. Wirenut connectors.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products of one (1) of the following (for each type of wire and connector):

1. Wire:

a. Apex Wire Corp.
b. American Insulated Wire Corp.
c. Belden Div; Cooper Industries.
d. Brand-Rex Div; Pyle National Co.
e. Cerro Wire Corp.
f. Cleveland Insulated Wire Co.
g. General Corporation.
h. Helix Wire Corporation.
i. Houston Wire
j. Indiana Insulated Wire Inc.
k. Laribee Wire Manufacturing Co., Inc.
l. Madison Wire Corp.
m. Okonite Co.
n. Pirelli Corp.
o. Radix Wire Co.
p. Rome Corp.
q. Southwire Company.
r. Triangle PWC, Inc.

2. Connectors:

a. AMP, Inc.
b. Appleton Electric Co; Emerson Electric Co.
c. Buchanan Co.
d. Burndy Corporation.
e. Brand-Rex Div. Pyle National Co.

f. Electrical Products Div; Midland-Ross Corp.
g. General Electric Co.
h. Gould, Inc.
i. Ideal Industries, Inc.
j. Leviton Mfg Company.
k. 3M Company
l. O-Z/Gedney Co.
m. Southport Industries Inc.
n. Square D Company.
o. Thomas and Betts Corp.

2.2 WIRES AND CONNECTORS

A. General: All reference to size in these specifications or on drawings is for copper conductors. Provide electrical wires and connectors of manufacturer's standard materials, as indicated by published product information; designed and constructed as recommended by manufacturer, for a complete installation and for application indicated. Provide copper conductors with conductivity of not less than 98% at 20°C (68°F).

B. Building Wires: Provide factory-fabricated wires of sizes, ampacity rating, and materials for applications and services indicated. Where not indicated, provide proper wire selection as determined by Installer to comply with project's installation requirements, NEC and NEMA Standards.

C. Connectors: Provide UL-type factory-fabricated, metal connectors of sizes, ampacity ratings, materials, types and classes for applications and for services indicated. Where not indicated, provide proper selection as determined by Installer to comply with project's installation requirements, NEC and NEMA Standards.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRES

A. General: Install electrical wires and wiring connectors as indicated, in compliance with applicable requirements of NEC, NEMA, UL and NECA's "Standard of Installation" and in accordance with recognized industry practices.

B. Minimum wire size shall be 12 AWG. All wire 12 AWG shall be solid, all 10 AWG and larger shall be stranded. Install all wires in continuous raceways.

C. All service entrance wiring shall be type XHHW-2.

D. All feeder and branch circuit wiring shall be type THHN-2/THWN-2, except as otherwise indicated.

E. All underground wiring or wiring in wet locations shall be type XHHW-2.

F. Pull conductors simultaneously where more than one (1) is being installed in same raceway.

G. Use pulling compound or lubricant, where necessary; compound used must not deteriorate conductor or insulation. Use of soap will not be permitted as pulling lubricant.

H. Insulation on conductors shall be permanently marked with wire size, insulation type, voltage range and manufacturer's name. The insulation on conductors shall be color coded as follows:

1. 120/208-volt circuit: Phase A - Black; Phase B - Red; Phase C – Blue; Neutral – White; Ground – Green. Provide neutral conductors with colored stripe corresponding to associated branch circuit phase conductor.
2. 277/480-volt circuit: Phase A – Brown; Phase B – Orange; Phase C – Yellow; Neutral – Gray; Ground - Green.

I. The phase conductors shall be tagged and shall remain the same throughout the circuit.

J. Switch legs shall be color coded to distinguish them from Hot or Phase Conductors.

K. Switch legs occurring in the same box or enclosure shall be color coded separately.

L. Exceptions to the color coding as listed above shall be as follows:

1. Wiring for special systems shall be color coded or labeled as required by the manufacturer.

M. Use pulling means including fish tape, cable, rope and basket weave wire grips which will not damage wires or raceway.

N. Keep conductor splices to minimum.

O. Install splices and taps which possess equivalent-or-better mechanical strength and insulation ratings than conductors being spliced.

P. Use splice and tap connectors which are compatible with conductor material.

Q. All splices and taps shall be made in outlet, junction and pull boxes. Splices on circuit wiring shall be of the pigtail type using solderless connectors. Larger sizes of conductors requiring uninsulated connectors of the bolt type shall be taped with pressure sensitive vinyl tape.

R. Use mechanical wirenut type connectors for branch circuit splice connections. Push-in or crimp-on style branch circuit splice connectors shall not be allowed. Use waterproof sealed wirenut connectors at damp locations, wet locations, or inside enclosures where enclosures are exposed to weather.

S. For branch circuit wiring, conductor fill per conduit run shall not contain more than eight (8) current carrying wires, provided the wire size is derated as required by the National Electrical Code. Conduits containing both circuit switch legs and/or traveler wires may contain more than the number stated above, providing the conduit is of adequate size and the wire size is derated as required by the National Electrical Code. Whenever a 120-volt, single phase branch circuit is over 70-feet in length or a 277-volt, single phase branch circuit is over 150-feet in length, and the load is in excess of 50% of the branch circuit protective device, the conductors shall be increased one (1) size to the first outlet box unless specifically noted otherwise. For special systems conductor fill of conduit is per manufacturers specifications furnished with each system, noted on the drawings or shall be as required by code.

T. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A and B.

3.2 FIELD QUALITY CONTROL

A. Prior to energization of circuitry, check installed wires with megohm meter to determine insulation resistance levels to ensure requirements are fulfilled.

B. Prior to energization, test wires for electrical continuity and for short-circuits.

C. Subsequent to wire hook-ups, energize circuitry and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units and then retest to demonstrate compliance.

END OF SECTION 260519

SECTION 260526 - GROUNDING

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of grounding work is indicated by drawings, schedules, and as specified herein.

B. Types of grounding specified in this section include the following:

1. Solid grounding
2. Telecommunications grounding.

C. Requirements of this section apply to electrical grounding work specified elsewhere in these specifications.

PART 2 - PRODUCTS

2.1 GROUNDING SYSTEMS

A. Materials and Components:

1. General: Except as otherwise indicated, provide electrical grounding systems indicated; with assembly of materials, including, but not limited to, cables/wires, connectors, terminals (solderless lugs), grounding rods/electrodes, bonding jumper braid and additional accessories needed for complete installation. Where more than one type unit meets indicated requirements, selection is Installer's option. Where materials or components are not indicated, provide products complying with NEC, UL, IEEE and established industry standards for applications indicated.

B. Conductors: Provide copper electrical grounding conductors for grounding connections, matching power supply wiring materials and sized according to NEC or as indicated. All conduits shall contain a minimum of one (1) separate insulated equipment grounding conductor identified and sized according to NEC or as indicated.

C. Bonding Jumper Braid: Copper braided tape, constructed of 30-gage bare copper wires and properly sized for indicated applications.

D. Flexible Jumper Strap: Flexible flat conductor, 480 strands of 30-gage bare copper wire; 3/4-inch wide, 9-1/2-inches long; 48,250cm. Protect braid with copper bolt hole ends with holes sized for 3/8-inch dia. bolts.

E. Bonding Plates, Connectors, Terminals and Clamps: Provide electrical bonding plates, connectors, terminals, lugs and clamps as recommended by bonding plate, connector, terminal and clamp manufacturers for indicated applications.

F. Ground Bars: Copper, sizes as indicated. Factory drilled hole pattern as selected by Owner.

G. High Compression Irreversible Connections: Factory system of components and special tools leaving positive identification of proper compression on final connector. Use two-hole lugs for bolted lug connectors. Burndy Hy-Ground high compression irreversible connector system and installation tools.

H. Ground Rods:

1. Ground Rods: Steel with copper welded exterior, 3/4-inch dia. x 10-feet unless otherwise indicated.
2. Sectional Ground Rods: Non-threaded, steel with copper welded exterior, 3/4-inch dia. x 10-feet, total length as indicated on Drawings. Join sections with bronze threadless couplings.

I. Electrical Grounding Connection Accessories: Provide electrical insulating tape, heat-shrinkable insulating tubing, welding materials, and bonding straps as recommended by accessories manufacturers for type of services indicated.

J. Exothermic Welded Connections: Comply with AWS Code for procedures, appearance, and quality of welds; and methods used in correcting welding work. Provide welded connections where grounding conductors connect to underground grounding rods or electrodes.

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer must examine areas and conditions under which electrical grounding connections are to be made and notify Contractor in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF ELECTRICAL GROUNDING

A. General: Install electrical grounding systems as indicated, in accordance with applicable portions of NEC, with NECA's "Standard of Installation" and in accordance with recognized industry practices to ensure that products comply with requirements and serve intended functions.

B. Telecommunications Grounding: Use only high compression irreversible connections. Use two-hole lugs for bolted lug connectors.

C. The equipment grounding conductor shall be connected directly to the equipment grounding screw provided on receptacles.

D. At switch outlets, where self-grounding type switches are installed in metal boxes, the equipment grounding conductor shall be connected directly to the metal box.

E. Where switches installed in non-metallic boxes have metallic cover plates or screws, provide switches with green hexagonal equipment ground screw and connect to the equipment grounding conductor.

F. Coordinate with other electrical work as necessary to interface installation of electrical grounding system with other work.

G. Weld grounding conductors to underground grounding rods or electrodes. Welds that are puffed up or that show convex surfaces indicating improper cleaning are not acceptable. Irreversible high compression connections are also acceptable.

H. Install bonding jumpers with ground clamps on water meter piping to electrically bypass water meters.

I. Install clamp-on connectors only on thoroughly cleaned metal contact surfaces, to ensure electrical conductivity and circuit integrity.

3.3 FIELD QUALITY CONTROL

A. Upon completion of installation of electrical grounding systems, test ground resistance with ground resistance tester. Where tests show resistance to ground is over 5 ohms, take appropriate action to reduce resistance to 5 ohms or less, by driving added ground rods; then retest to demonstrate compliance. Report results to Engineer in writing.

END OF SECTION 260526

SECTION 260529 - SUPPORTING DEVICES

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 secure support from the building structure for electrical items by means of hangers, supports, anchors, sleeves, inserts, seals and associated fastenings.

1. Refer to other Division 26 Sections for additional specific support requirements that may be applicable to specific items.

1.3 SPECIAL REQUIREMENTS AT FINISHED EXPOSED STRUCTURE

A. At areas of finished exposed structure, supporting devices shall be concealed from view. Where unavoidable, types of supporting devices shall be selected by the Architect to suit the aesthetics of the space.

B. Obtain prior approval for visible supporting devices in areas of finished exposed structure.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Slotted Metal Angle and U-Channel Systems:

a. Allied Tube & Conduit.
b. American Electric.
c. B-Line Systems, Inc.
d. Cinch Clamp Co., Inc.
e. GS Metals Corp.
f. Haydon Corp.
g. Kin-Line, Inc.
h. Unistrut Diversified Products.

2. Conduit Sealing Bushings:

a. Bridgeport Fittings, Inc.
b. Cooper Industries, Inc.
c. Elliott Electric Mfg. Corp.
d. GS Metals Corp.
e. Killark Electric Mfg. Co.

f. Madison Equipment Co.
g. L.E. Mason Co.
h. O-Z/Gedney.
i. Producto Electric Corp.
j. Raco, Inc.
k. Red Seal Electric Corp.
l. Spring City Electrical Mfg. Co.
m. Thomas & Betts Corp.

2.2 COATINGS

A. Coating: Supports, support hardware, and fasteners shall be hot-dip galvanized or stainless steel. Products for use outdoors or wet indoor locations shall be stainless steel.

2.3 MANUFACTURED SUPPORTING DEVICES

A. Raceway Supports: Metal. Clevis hangers, riser clamps, conduit straps, threaded C-clamps with retainers, ceiling trapeze hangers, and wall brackets. Wire is not an acceptable raceway support.

B. Fasteners: Types, materials and construction features as follows:

1. Expansion Anchors: Carbon steel wedge or sleeve type. Plastic expansion anchors (for conduit 1-inch and smaller only).
2. Toggle Bolts: All steel springhead type.

C. Conduit Sealing Bushings: Factory-fabricated watertight conduit sealing bushing assemblies suitable for sealing around conduit or tubing passing through concrete floors and walls. Construct seals with steel sleeve, malleable iron body, neoprene sealing grommets or rings, metal pressure rings, pressure clamps and cap screws.

D. U-Channel Systems: 16-gage steel channels, with 9/16-inch diameter holes, at a minimum of 8-inches on center, in top surface. Provide fittings and accessories that mate and match the U-channel and are of the same manufacturer.

2.4 FABRICATED SUPPORTING DEVICES

A. General: Shop- or field-fabricated supports or manufactured supports assembled from U-channel components.

B. Steel Brackets: Fabricated of angles, channels and other standard structural shapes. Connect with welds and machine bolts to form rigid supports.

C. Pipe Sleeves: Provide pipe sleeves of one (1) of the following:

1. Sheet Metal: Fabricate from galvanized sheet metal; round tube closed with snaplock joint, welded spiral seams or welded longitudinal joint. Fabricate sleeves from the following gage metal for sleeve diameter noted:

a. 3-inches and smaller: 20-gage.
b. 4-inch to 6-inches: 16-gage.
c. Over 6-inches: 14-gage.

2. Steel Pipe: Fabricate from Schedule 40 galvanized steel pipe.
3. Plastic Pipe: Fabricate from Schedule 80 PVC plastic pipe.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install supporting devices to fasten electrical components securely and permanently in accordance with NEC requirements.

B. Coordinate with the building structural system and with other electrical installation.

C. Raceway Supports: Comply with the NEC and the following requirements:

1. Conform to manufacturer's recommendations for selection and installation of supports.
2. Strength of each support shall be adequate to carry present and future load multiplied by a safety factor of at least four (4). Where this determination results in a safety allowance of less than 200 lbs, provide additional strength until there is a minimum of 200 lbs safety allowance in the strength of each support.
3. Install individual and multiple (trapeze) raceway hangers and riser clamps as necessary to support raceways. Provide U-bolts, clamps, attachments, and other hardware necessary for hanger assembly and for securing hanger rods and conduits.
4. Support parallel runs of horizontal raceways together on trapeze-type hangers.
5. Attach raceways directly to building structure (structural concrete, structural wood, or steel red iron), or to unistrut trapeze supported directly from building structure with 3/8-inch minimum threaded rods. Wire type supports and click-type hangers shall not be allowed. Do not fasten to roof decking.
6. Support exposed and concealed raceway within 1-foot of an unsupported box and access fittings. In horizontal runs, support at the box and access fittings may be omitted where box or access fittings are independently supported and raceway terminals are not made with chase nipples or threadless box connectors.
7. In vertical runs, arrange support so that load produced by the weight of the raceway and the enclosed conductors is carried entirely by the conduit supports with no weight load on raceway terminals.

D. Miscellaneous Supports: Support miscellaneous electrical components as required to produce the same structural safety factors as specified for raceway supports. Install metal channel racks for mounting cabinets, panelboards, disconnects, control enclosures, pull boxes, junction boxes, transformers and other devices.

E. Support sheet metal boxes directly from the building structure or by bar hangers.

F. Sleeves: Install in concrete slabs and walls and all other firerated floors and walls for raceways and cable installations. For sleeves through fire rated-wall or floor construction, apply UL Listed firestopping sealant in gaps between sleeves and enclosed conduits and cables.

G. Conduit Seals: Install seals for conduit penetrations of slabs on grade and exterior walls below grade and where indicated. Tighten sleeve seal screws until sealing grommets have expanded to form watertight seal.

H. Fastening: Unless otherwise indicated, fasten electrical items and their supporting hardware securely to the building structure, including but not limited to conduits, raceways, cables, cabinets, boxes, disconnect switches and control components in accordance with the following:

1. Fasten by means of wood screws or screw-type nails on wood, toggle bolts on hollow masonry units, concrete inserts or expansion bolts on concrete or solid masonry, and machine screws, welded threaded studs, or spring-tension clamps on steel. Do not weld conduit, pipe straps or items other than threaded studs to steel structures. In partitions of light steel construction, use sheet metal screws.
2. Holes cut to depth of more than 1-1/2-inch in reinforced concrete beams or to depth of more than 3/4-inch in concrete shall not cut the main reinforcing bars. Fill holes that are not used.
3. Ensure that the load applied to any fastener does not exceed 25% of the proof test load. Use vibration- and shock-resistant fasteners for attachments to concrete slabs.

END OF SECTION 260529

SECTION 260533 - RACEWAYS

PART 1 - GENERAL

1.1 SUMMARY

A. All wiring, including low voltage wiring, shall be installed in continuous raceways as specified herein.

B. Types of raceway products in this section include the following:

1. Electrical metallic tubing (EMT).
2. Flexible metal conduit (FMC).
3. Liquid-tight flexible metal conduit (LFMC).
4. Rigid heavy-wall threaded metal conduit (RMC).
5. Rigid nonmetallic conduit (PVC40 or PVC80).
6. Surface metal raceways.
7. Blank duct plugs.

PART 2 - PRODUCTS

2.1 METAL CONDUIT AND TUBING

A. General: Provide metal conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for each service indicated. Where types and grades are not indicated, provide proper selection determined by Installer to fulfill wiring requirements and comply with applicable portions of NEC for raceways.

B. Rigid Heavy-Wall Threaded Metal Conduit (RMC): Provide rigid steel, zinc-coated, threaded type conforming to ANSI C80.1 and UL 6. Provide zinc coating fused to inside and outside walls.

1. Rigid Metal Conduit Fittings: Rigid metal conduits shall have threaded couplings, fittings, and accessories.
2. PVC Externally Coated Rigid Heavy-Wall Threaded Metal Conduit: Provide rigid steel zinc-coated with additional external coating of PVC conforming to ANSI C80.1 and NEMA RN 1.

C. Flexible Metal Conduit (FMC): Provide flexible metal conduit conforming to UL 1, formed from continuous length of spirally wound, interlocked zinc-coated strip steel.

1. Flexible Metal Conduit Fittings: Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type.

a. Straight Terminal Connectors: One-piece body, female end with clamp and deep slotted machine screw for securing conduit and male threaded end provided with locknut.
b. 45° or 90° Terminal Angle Connectors: Two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit and male threaded end provided with locknut.

D. Liquid-Tight Flexible Metal Conduit (LFMC): Provide liquid-tight flexible metal conduit conforming to UL 360; construct of single strip, flexible, continuous, interlocked and double-wrapped steel; galvanized inside and outside; coat with liquid-tight jacket of flexible polyvinyl chloride (PVC).

1. Liquid-Tight Flexible Metal Conduit Fittings: Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated throat.

E. Electrical Metallic Tubing (EMT): Provide electrical metallic tubing conforming to ANSI C80.3 and UL 797.

1. EMT Fittings: Fittings for EMT shall be steel and may be of the screw or compression type except that in poured concrete the screw type is not acceptable. All EMT connectors shall be of the insulated throat type. Cast or indenter fittings are not acceptable. EMT connectors shall be fastened to box or enclosure with locknuts. Snap-in fittings are not acceptable.
2. Steel EMT connectors with male threads on the locknut and female threads on the connector equal to Cooper Crouse-Hinds Space-Saver connectors may be used in lieu of insulated throat type connectors.
3. Steel EMT connectors in wet locations shall be compression type.

F. Conduit Bodies: Provide galvanized cast-metal conduit bodies of types, shapes and sizes as required to fulfill job requirements and NEC requirements. Construct conduit bodies with threaded-conduit-entrance ends, removable covers, either cast or of galvanized steel and corrosion-resistant screws.

2.2 RIGID NONMETALLIC CONDUIT (PVC)

A. General: Provide nonmetallic conduit and fittings of types, sizes and weights as specified.

B. Rigid Nonmetallic Conduit:

1. Heavy Wall Conduit: Watertight, Schedule 40, 90 C, UL Rated, construct of polyvinyl chloride and conforming to NEMA TC-2, for direct burial, or normal above ground use, UL Listed.
2. Extra Heavy Wall Conduit: Watertight, Schedule 80, UL Rated, construct of polyvinyl chloride compound C-200 PVC and UL Listed for direct burial or above ground use.

C. Conduit and Tubing Accessories: Provide conduit and tubing duct accessories of types, sizes, and materials, complying with manufacturers published product information, which mate and match conduit and tubing.

2.3 WIREWAYS

A. General: Provide electrical wireways of types, grades, sizes, and number of channels for each type of service as indicated. Provide complete assembly of raceway including, but not limited to, couplings, offsets, elbows, expansion joints, adapters, holddown straps, end caps and other components and accessories as required for complete system.

B. Lay-in Wireways: Construct lay-in wireways with hinged covers, in accordance with UL 870 and with components UL Listed, including lengths, connectors and fittings. Select units to allow fastening hinged cover closed without use of parts other than standard lengths, fittings and connectors. Construct units to be capable of sealing cover in closed position with sealing wire. Provide wireways with knockouts.

1. Connectors: Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached that removal is not necessary to utilize the lay-in feature.
2. Finish: Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Plate finish hardware to prevent corrosion. Protect screws installed toward inside of wireway with spring nuts to prevent wire insulation damage.

2.4 SURFACE METAL RACEWAYS

A. Boxes for Surface Raceways: Metal. Designed, manufactured and supplied by raceway manufacturer for use with specified raceway. Finish as selected by Architect.

B. Manufacturers: Subject to compliance with requirements, provide surface metal raceways of the following:

1. Wiremold Company.
2. Hubbell Wiring Systems.

2.5 BLANK DUCT PLUGS

A. Removable and reusable blank duct plug forms a watertight and dirt-tight seal on end of conduit duct.

B. Corrosion proof for long-term sealing.

C. Integral rope-tie mechanism secures pull string and excess slack pull string within the conduit system for future use.

D. Raychem RBDP-BLA series or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION OF RACEWAYS

A. General: Install raceways as indicated; in accordance with manufacturer's written installation instructions, and in compliance with NEC and NECA's "Standards of Installation". Install units plumb and level and maintain manufacturer's recommended clearances.

B. Coordinate with other work including wires/cables, boxes and panel work, as necessary to interface installation of electrical raceways and components with other work.

3.2 INSTALLATION OF CONDUITS

A. General: All conduits shall be concealed unless noted otherwise. Install concealed conduits either in walls, under slabs or above hung ceilings. Where conduits cannot be concealed in finished areas, surface metal raceways shall be used (conduit or Wiremold at Architect’s discretion). Obtain written permission prior to using surface metal raceways.

1. Mechanically fasten together metal conduits, enclosures, and raceways for conductors to form continuous electrical conductor. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly.
2. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat surfaces with corrosion inhibiting compound before assembling.
3. Install miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that have been specifically designed and manufactured for their particular application. Install expansion fittings in raceways every 200-feet linear run or wherever structural expansion joints are crossed.

4. Use roughing-in dimensions of electrically operated unit furnished by supplier. Set conduit and boxes for connection to units only after receiving review of dimensions and after checking location with other trades.

B. Conduit Installation:

1. Use rigid steel heavy-wall threaded zinc-coated conduit (RMC) in spaces where exposed below 4-feet-0-inch height in Mechanical Equipment Rooms, Electrical Equipment Rooms, Janitor Rooms, and in service/utility areas.
2. Use rigid steel heavy-wall threaded zinc-coated conduit (RMC) where subject to mechanical injury, or indoor wet locations.
3. Where acceptable to all authorities having jurisdiction, intermediate metal conduit (IMC) may be used in lieu of rigid steel conduit (RMC) in non-hazardous locations when in compliance with NEC.
4. Use PVC coated rigid steel conduit and fittings where installed in corrosive atmosphere or where exposed outdoors. Patch all nicks and scrapes in PVC coating after installing conduit.
5. Use steel zinc-coated EMT for raceway systems except as specifically specified previously, where not allowed by NEC or noted on drawings. Additionally EMT shall not be acceptable below grade, in or under slabs on grade, or in wet locations.
6. Use flexible conduit (FMC) in movable partitions and from outlet boxes to recessed lighting fixtures or devices in accessible ceilings, and final 24-inches of connection to motors, or control items subject to movement or vibration. The maximum length for flexible conduit shall not exceed 6-feet.
7. Use liquid-tight flexible conduit (LFMC) where FMC would be subjected to one (1) or more of the following conditions:

    a. Exterior location.
    b. Moist or humid atmosphere where condensate can be expected to accumulate.
    c. Pump motors.
    d. Corrosive atmosphere.
    e. Subjected to water spray or dripping oil, water or grease.

8. Conduit shall not be installed in concrete slabs on grade, or in concrete structural floors without written permission of the Engineer. Engineer approved means and methods shall be followed, if permission is granted.
9. Rigid Non-Metallic Conduits:

    a. Rigid non-metallic conduits may be used below grade or below concrete slabs-on-grade only.
    b. Rigid non-metallic conduits shall not be used for exposed stub-ups above floor. Where acceptable to authority having jurisdiction, rigid non-metallic conduits may be stubbed-up 6-inches above floor where concealed within walls. In masonry walls, non-metallic conduits may be extended to a maximum of 48-inches above floor.
    c. Make solvent cemented joints watertight in accordance with recommendations of manufacturer.
    d. Install rigid non-metallic conduits in compliance with NEC, local utility practices, and all other authorities having jurisdiction.
    e. Heavy wall schedule 80 conduit shall be used where subject to damage or where routed through or under building footings and foundations.

C. Stub-up Connections: Extend conduits through concrete floor for connection to freestanding equipment with an adjustable top or coupling thread inside the plugs and set flush with the finished floor. Extend conductors to equipment with rigid steel conduit; flexible metal conduit (FMC or LFMC) may be used 6-inches above the floor. Where equipment connections are not made under this Contract, install screwdriver-operated threaded flush plugs flush with floor.

D. Protect stub-ups from damage where conduits rise from floor slabs. Arrange so curved portion of bends is not visible above the finished slab.

E. Install pull wires in all empty raceways and sleeves. Use No. 14 AWG zinc-coated steel or monofilament plastic line having not less than 200 lb tensile strength. Leave not less than 12-inches of slack at each end of the pull wire.

F. Provide blank duct plug on each end of all empty raceways and sleeves for permanent removable seal against dirt and water entry.

G. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean. Use temporary closures to prevent foreign matter and water from entering raceways. Remove water and foreign debris from all raceways prior to use.

H. Field-bend conduit with benders designed for purpose so as not to distort nor vary internal diameter.

I. Size conduits to meet NEC requirements and as shown on drawings or specified herein. All conduits shall be 1/2-inch minimum trade size. In any case, comply with NEC wire fill requirements.

J. Fasten rigid conduit terminations in sheet metal enclosures with locknuts inside and outside enclosure or with threadless rigid box connectors and terminate with bushing.

K. Conduit terminations in wet locations shall be of the threaded hub type or other sealing type fittings UL Listed for use in wet locations.

L. Conduits are not to cross vertical or horizontal openings such as pipe shafts, elevator shafts, ventilating duct openings, etc.

M. Keep conduits a minimum distance of 6-inches from parallel runs of flues, hot water pipes or other sources of heat. Wherever possible, install horizontal raceway runs above water and steam piping.

N. Conduit shall be properly supported as specified herein and as required by NEC.

O. Use of running threads at conduit joints and terminations is prohibited. Where required, use 3-piece union or split coupling.

P. Complete installation of electrical raceways before starting installation of cables/wires within raceways.

Q. Install raceway sealing fittings in accordance with the manufacturer's written instructions. Locate fittings at suitable, approved, accessible locations and fill them with UL Listed sealing compound. For concealed raceways, install each fitting in a flush steel box with a blank cover plate having a finish similar to that of adjacent plates or surfaces. Install raceway sealing fittings at the following points and elsewhere as indicated:

1. Where conduits enter or leave hazardous locations.
2. Where conduits pass from warm locations to cold locations, such as the boundaries of refrigerated spaces or air-conditioned spaces.
3. Where required by the NEC.

R. Openings around electrical penetrations through fire-resistant-rated walls, partitions, floors or ceilings shall be firestopped using approved methods to maintain the fire resistance rating.

S. Provide sleeves for conduits passing through foundation or other load bearing walls.

T. Conduits installed underground which extend through the foundation walls shall be sealed to prevent the entrance of moisture through the foundation walls. All conduits extending through the exterior walls of a building in areas below grade shall be provided with a hydrostatic seal such as Link Seal or equal.

U. Concealed Conduits:

1. Conduits in finished areas shall be installed concealed.
2. Metallic raceways shall not be installed underground or in concrete floors.

V. Conduits in Concrete Slabs:

1. Conduits shall not be installed in concrete slabs without prior approval/direction from the Structural Engineer regarding maximum conduit sizes, minimum cover, locations, etc.

W. Install conduits as not to damage or run through structural members. Avoid horizontal or cross runs in building partitions or side walls. Penetrate composite wood bearing members according to manufacturer's published written direction on permissible zones of penetration.

X. Exposed Conduits:

1. In unfinished areas such as Janitor Closets, Storage, Mechanical Equipment Rooms, etc., conduit may be run exposed. Prior permission shall be first obtained from the Architect. All exposed conduit shall be installed in a neat manner following the building lines. Horizontal runs shall be close to the ceiling and shall be installed above mechanical piping as much as possible. Multiple hung conduits shall be strapped to channel to hold it in place.
2. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with or at right angles to walls of building.
3. Install exposed conduit work as not to interfere with ceiling inserts, lights or ventilation ducts or outlets.
4. Support exposed conduits by use of hangers or clamps. Attach raceways directly to building structure (structural wood, structural concrete, or steel red iron), or to unistrut trapeze supported directly from building structure with 3/8-inch minimum threaded rods. Wire type supports and click-type hangers shall not be allowed. Do not attach to roof decking. Support conduits on each side of bends and on spacing not to exceed following: Up to 1-inch: 6-feet-0-inch; 1-1/4-inch and over: 8-feet-0-inch.
5. Run conduits for outlets on waterproof walls exposed. Set anchors for supporting conduit on waterproof wall in waterproof cement.
6. Above requirements for exposed conduits also apply to conduits installed in space above hung ceilings, except that spacing of supports for conduits up to 1-inch shall not exceed 8-feet-0-inch.

Y. Conduit Fittings:

1. Construct locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening.
2. Plastic insulating bushings for terminating rigid conduits smaller than 1-1/4-inch are to have ribbed sides, with smooth upper edges to prevent injury to cable insulation.
3. Install metallic insulated type bushings for terminating rigid conduits 1-1/4-inch and larger. Bushings are to have flared bottom and ribbed sides. Upper edge to have phenolic insulating ring molded into bushing.
4. Miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings and plugs to be specifically designed for their particular application.

3.3 INSTALLATION OF SURFACE RACEWAYS AND WIREWAYS

A. General: Mechanically assemble metal enclosures, and raceways for conductors to form continuous electrical conductor, and connect to electrical boxes, fittings and cabinets as to provide effective electrical continuity and rigid mechanical assembly.

1. Avoid use of dissimilar metals throughout system to eliminate possibility of electrolysis. Where dissimilar metals are in contact, coat all surfaces with corrosion inhibiting compound before assembling.
2. Install expansion fittings in all raceways wherever structural expansion joints are crossed.
3. Make changes in direction of raceway run with proper fittings, supplied by raceway manufacturer. No field bends of two-piece type raceway sections will be permitted.
4. Field bends of single piece raceway shall be permitted for small offsets only where the use of fittings supplied by the manufacturer is not possible. Field-bend raceway with benders designed for purpose so as not to distort nor vary internal diameter of raceway. Raceway shall be installed so as to avoid field bends wherever possible.
5. Properly support and anchor raceways for their entire length by structural materials. Raceways are not to span any space unsupported.
6. Use boxes as supplied by raceway manufacturer wherever junction, pull or device boxes are required. Standard electrical "handy" boxes, etc. shall not be permitted for use with surface raceway installations.

END OF SECTION 260533

SECTION 260534 - ELECTRICAL BOXES

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of electrical box work is indicated by drawings.

B. Types of electrical boxes and accessories in this section include the following:

1. Outlet boxes.
2. Junction boxes.
3. Pull boxes.
4. Bushings.
5. Locknuts.
6. Knockout closures.
7. Floor boxes.

C. See Section 260533 Raceways for conduit fittings, surface metal (Wiremold) raceways and boxes.

PART 2 - PRODUCTS

2.1 FABRICATED MATERIALS

A. Outlet Boxes: Conform to UL 514A, "Metallic Outlet Boxes, Electrical," and UL 514B, "Fittings for Conduit and Outlet Boxes." Boxes shall be of type, shape, size and depth to suit each location and application.

1. Conform to NEMA OS 1, "Sheet Steel Outlet Boxes, Device Boxes, Covers and Box Supports." Boxes shall be sheet steel with stamped knockouts, threaded screw holes and accessories suitable for each location including mounting brackets and straps, cable clamps, exterior rings and fixture studs.

B. Raintight Outlet Boxes: Provide corrosion-resistant cast-metal raintight outlet wiring boxes, of types, shapes and sizes required, including depth of boxes, with threaded conduit holes for fastening electrical conduit, cast-metal face plates with face plate gaskets and corrosion-resistant plugs and fasteners.

C. Junction and Pull Boxes: Provide galvanized code-gage sheet steel junction and pull boxes, with screw-on covers; of types, shapes and sizes, to suit each respective location and installation; with welded seams and equipped with steel nuts, bolts, screws and washers.

D. Bushings, Knockout Closures and Locknuts: Provide corrosion-resistant box knockout closures, conduit locknuts and conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

PART 3 - EXECUTION

3.1 INSTALLATION OF ELECTRICAL BOXES AND FITTINGS

A. General: Install electrical boxes and fittings as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation" and in accordance with recognized industry practices to fulfill project requirements.

B. Surface-mounted device boxes in unfinished areas shall be a minimum of 4-inch square knockout type. Surface-mounted boxes in finished and exterior areas, shall be cast metal, threaded hub similar to CrouseHinds "FS" or "FD" condulet box.

C. Coordinate installation of electrical boxes and fittings with wire/cable, wiring devices and raceway installation work.

D. Provide weathertight outlets for interior and exterior locations exposed to weather or moisture.

E. Provide knockout closures to cap unused knockout holes where blanks have been removed.

F. Install electrical boxes in those locations, which ensure ready accessibility to enclosed electrical wiring. Junction boxes shall not be installed above non-accessible ceilings.

G. Do not install boxes back-to-back in walls. Provide not less than 24-inch separation and insulate to prevent sound transmission.

H. Avoid installing aluminum products in concrete.

I. Position recessed outlet boxes accurately to allow for surface finish thickness.

J. Avoid using round boxes where conduit must enter box through side of box, which would result in difficult and insecure connections when fastened with locknut or bushing on rounded surfaces.

K. Fasten electrical boxes firmly and rigidly to substrates or structural surfaces to which attached or solidly embed electrical boxes in concrete or masonry. Box support shall be independent of conduit.

L. Provide electrical connections for installed boxes.

M. Subsequent to installation of boxes, protect boxes from construction debris and damage.

3.2 POSITION OF OUTLETS

A. The Electrical Contractor shall consult with Mechanical and General Contractor prior to rough-in of outlets and shall set boxes to avoid interference with equipment installation in walls or ceilings.

B. Outlets shall be centered with respect to paneling, trim, furring, etc. Outlets improperly located shall be corrected at Contractor's expense. Outlets shall be set plumb, secured firmly in place with face of box or plaster ring extending to finished surface or wall, ceiling or floor as the case may be.

C. Washers or bushings shall be installed between recessed box and device strap to make a flush rigid installation of the device installed.

D. The following mounting height schedule is included to assist the Contractor in estimating. All device locations shall be coordinated with Architectural details and elevations. Exact heights shall be obtained from the Project Superintendent at the time of installation or taken from drawings as shown thereon. Heights of device outlets are noted in inches from the centerline of the outlet box to the finished floor.

Switches	46 inches
Receptacles and Low Voltage Outlets	
Weatherproof (Exterior)	23 inches and horizontal mount
Others	18 inches
At Counters	6-inches above backsplash
(Unless Otherwise Indicated)	
Thermostats	50 inches

3.3 GROUNDING

A. Upon completion of installation work, ground electrical boxes as required by NEC and other Division 26 Sections.

END OF SECTION 260534

SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SUMMARY

A. Types of electrical identification specified in this section include the following:

1. Raceways
2. Buried cable warnings and tracer wires
3. Warning labels and signs
4. Electrical power, control, and communication conductors
5. Operational instructions and warnings
6. Equipment/system identification signs

PART 2 - PRODUCTS

2.1 RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600V or Less:

1. Black letters on a white field
2. Legend: Indicate voltage and served load

C. Colors for Raceways Carrying Fiber Optic Telecommunications Cabling:

1. Black letters on an orange field
2. Legend: “Fiber Optic”

D. Vinyl Labels for Raceways: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating extending 360 degrees around raceways. Permanently attach label with matching wraparound clear adhesive plastic tape at each end of label, adhesive lap joint of label, or pretensioned snap on label. Provide 8-inch minimum length for 2-inch and smaller conduit, 12-inch length for larger conduit.

2.2 ELECTRICAL IDENTIFICATION MATERIALS

A. General: Except as otherwise indicated, provide manufacturer's standard products of categories and types required for each application. Where more than one (1) single type is specified for an application, selection is Installer's option, but provide single selection for each application.

B. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tape not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

C. Cable/Conductor Identification Tags: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

D. Underground-Type Plastic Line Marker:

1. General: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape, intended for direct-burial service; not less than 6-inch wide x 8 MILS thick. Provide tape with printing which most accurately indicates type of service or buried cable.

   a. Inscription for Red-Colored Tapes: ELECTRIC LINE.
   b. Inscription for Orange-Colored Tapes: FIBER OPTIC.

2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.
4. Include integral tracer wire to ease future locates. A separate independent tracer wire designed for the purpose is also acceptable.

E. Warning Signs:

1. Adhesive Film Label with Clear Protective Overlay: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 1-inch in an orange field. Overlay shall provide a weatherproof and UV-resistant seal for label. Legend “Danger High Voltage”.

F. Engraved Plastic-Laminate Signs:

1. General: Provide engraving stock melamine plastic laminate, complying with FS L-P-387, in sizes and thicknesses indicated, engraved with engraver's standard letter style of sizes and wording indicated, black face and white core (letter color) except as otherwise indicated, punched for mechanical fastening except where adhesive mounting is necessary because of substrate.

   a. Thickness: 1/16-inch, for units up to 20 sq. in. or 8-inch length; 1/8-inch for larger units.
   b. Fasteners: Self-tapping stainless steel screws, except contact-type permanent adhesive where screws cannot or should not penetrate substrate.

2.3 LETTERING AND GRAPHICS

A. General: Coordinate names, abbreviations and other designations used in electrical identification work, with corresponding designations shown, specified or scheduled. Provide numbers, lettering and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of electrical systems and equipment. Comply with ANSI A13.1 pertaining to minimum sizes for letters and numbers.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION

A. General Installation Requirements:

1. Install electrical identification products as indicated, in accordance with manufacturer's written instructions and requirements of NEC.
2. Coordination: Where identification is to be applied to surfaces, which require finish, install identification after completion of painting.

3. Regulations: Comply with governing regulations and requests of governing authorities for identification of electrical work.

B. Operational Identification and Warnings:

1. General: Wherever reasonably required to ensure safe and efficient operation and maintenance of electrical systems, and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install self-adhesive plastic signs or similar equivalent identification, instruction or warnings on substations, panelboards, switches, contactors, outlets and other controls, devices and covers of electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for intended purposes.

C. Equipment/System Identification:

1. General: Install engraved plastic-laminate sign on each major unit of electrical equipment in building; including central or master unit of each electrical system including communication/control/signal systems. Except as otherwise indicated, provide single line of text, 1/2-inch high lettering on 1-1/2-inch high sign (2-inch high where two (2) lines are required), white lettering in black field. Provide text matching terminology and numbering of the Contract Documents and shop drawings. Provide signs for each unit of the following categories of electrical work.

    a. Electrical cabinets and enclosures.
    b. Access panel/doors to electrical facilities.
    c. Circuit disconnects.
    d. Panelboards.
    e. Distribution panelboards and each device in distribution panelboards.
    f. Transformers
    g. Medium voltage transformers
    h. Telecommunications cabinets.

2. Include description of upstream power source “FED FROM” on each sign.
3. Install signs at locations indicated or, where not otherwise indicated, at location for best convenience of viewing without interference with operation and maintenance of equipment. Secure to substrate with fasteners, except use adhesive where fasteners should not or cannot penetrate substrate.

D. Underground Cable Identification:

1. General: During back-filling/top-soiling of each exterior underground electrical, signal or communication cable, install continuous underground-type plastic line marker, located directly over buried line at 6-inch to 8-inch below finished grade. Where multiple small lines are buried in a common trench and do not exceed an overall width of 16-inch, install a single line marker.
2. Install line marker for every buried cable, regardless of whether direct buried or protected in conduit.
3. Install tracer wire over each buried line to ease future locates. Independent tracer wires or tracer wires integral with plastic line marker are acceptable.

E. Cable/Conductor Identification:

1. General: Apply cable/conductor identification tags in each box/enclosure/cabinet. Match identification with marking system used in panelboards, shop drawings, contract documents, and similar previously established identification for project electrical work.

F. Raceway Identification:

1. Raceways Carrying Fiber Optic Telecommunications Circuits: Apply labels no further apart than 40’ and at each change of direction. Locate for ease of viewing from floor.
2. Raceways Carrying Circuits at 600V or Less: Install labels on raceways carrying circuits rated 100A and above. Apply labels no further apart than 40’ and at each change of direction. Locate for ease of viewing from floor.

END OF SECTION 260553

SECTION 260923 - OCCUPANCY SENSORS

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. Indoor occupancy sensors.

B. Related Requirements:

1. Division 26 Section "Wiring Devices" for manual light switches.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For each type of occupancy sensor to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

2.1 INDOOR OCCUPANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbell Building Automation occupancy sensors by catalog number below; or comparable product by one of the following:

1. Hubbell Building Automation, Inc.
2. Lithonia Lighting; Acuity Lighting Group, Inc.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors. Stand-alone sensors with separate power pack.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at

120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

5. Mounting:

   a. Sensor: Suitable for mounting in any position on a standard outlet box.
   b. Power Pack and Relay: Externally mounted in a standard electrical junction box with typed label identification on cover.
   c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Bypass Switch: Override the "on" function in case of sensor failure.

C. Dual-Technology Type: Ceiling mounted, white finish; detect occupants in coverage area using PIR (or acoustic) and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.

1. Sensitivity Adjustment: Self-adjusting. Learns switching patterns unique to the space controlled.
2. Detection Coverage: Detect 360-degrees occupancy anywhere within a circular area of 2,000 sq. ft.
3. Exposed Structure Areas: Provide Wiremold-type surface mount box, match finish of occupancy sensor. Sensor canopy shall fit completely on the backbox with no overhang; size Wiremold surface mount box to match and mate with sensor canopy.
4. Hubbell Building Automation OMNI DT 2000 RP or approved equivalent.

2.2 WALLBOX OCCUPANCY SENSORS

A. Basis-of-Design Product: Subject to compliance with requirements, provide Hubbell Building Automation occupancy sensors by catalog number below; or comparable product by one of the following:

1. Hubbell Building Automation, Inc.
2. Lithonia Lighting; Acuity Lighting Group, Inc.

B. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Finish and wallplate material to match wiring devices specified in Division 26 Section “Wiring Devices”.
3. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F.
4. Switch Rating: Not less than 1000-VA fluorescent at 120 V and 800-W incandescent.

C. Wall-Switch Sensor:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 1000 sq. ft.
2. Sensing Technology: Dual technology - PIR (or acoustic) and ultrasonic.
3. Switch Type: single pole, field selectable automatic "on," or manual "on" automatic "off."
4. Voltage: Dual voltage, 120 and 277 V.
5. Concealed, field-adjustable, "off" time-delay selector at up to 15 minutes.
6. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.
7. Hubbell Building Automation LHMTS1 or approved equivalent.

2.3 CONDUCTORS AND CABLES

A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Wire Conductors."

B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Cable types as recommended by manufacturer.

C. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Cable types as recommended by manufacturer.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

A. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.

B. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions. Provide additional sensors as necessary to cover controlled spaces indicated on Drawings.

C. Coordinate connection of occupancy sensor auxiliary relays for HVAC control with HVAC and Controls Installer.

3.2 WIRING INSTALLATION

A. Wiring Method: Comply with Division 26 Section "Wire Conductors." Route all conductors in conduit.

B. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.

C. Size conductors according to manufacturer's written instructions unless otherwise indicated.

D. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

3.3 IDENTIFICATION

A. Identify components and power and control wiring according to Division 26 Section "Electrical Identification."

1. Identify circuits or luminaires controlled by occupancy sensors at each sensor.

3.4 FIELD QUALITY CONTROL

A. Perform the following tests and inspections with the assistance of a factory-authorized service representative:

1. Operational Test: After installing sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.

2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

B. Occupancy sensors will be considered defective if they do not pass tests and inspections.

C. Prepare test and inspection reports.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

1. Verify operation at outer limits of sensor range. Set time delay to suit Owner's operations.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain occupancy sensors.

END OF SECTION 260923

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Extent of panelboard and enclosure work, including cabinets and cutout boxes is indicated by drawings and schedules.

B. Types of panelboards and enclosures in this section include the following:

1. Power-distribution panelboards.
2. Lighting and appliance panelboards.

C. Refer to other Division 26 Sections for wire conductors, connectors and electrical raceway work required in conjunction with panelboards and enclosures; not work of this section.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of panelboard, switching and overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.

1.4 INFORMATIONAL SUBMITTALS

A. Panelboard Schedules: For installation in panelboards. Submit final versions after load balancing.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For panelboards and components to include in emergency, operation, and maintenance manuals. Include the following:

1. Manufacturer's written instructions for testing and adjusting overcurrent protective devices.
2. Time-current curves, including selectable ranges for each type of overcurrent protective device that allows adjustments.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide panelboard products of one (1) of the following:

1. General Electric Company.
2. Square D Company.
3. Siemens.
4. Cutler Hammer.

2.2 PANELBOARDS

A. General: Except as otherwise indicated, provide panelboards, enclosures and auxiliary components, of types, sizes and ratings indicated, which comply with manufacturer's standard materials; design and construction in accordance with published product information; equip with proper number of unit panelboard devices as required for complete installation. Where types, sizes or ratings are not indicated, comply with NEC, UL and established industry standards for those applications indicated.

B. Door-in-door Hinged Front Cover: Entire panelboard front shall hinge open for ease of maintenance. Provide door-in-door hinged front cover for:

1. Power-distribution panelboards.
2. Lighting and appliance panelboards.

C. Enclosures: Flush and surface mounted, dead-front cabinets.

1. Rated for environmental conditions at installed location.

a. Indoor Dry and Clean Locations: NEMA 250, Type 1.
b. Outdoor Locations: NEMA 250, Type 3R.

D. Power Distribution Panelboards: Provide circuit breaker type dead-front safety constructed power distribution panelboards as indicated, with panelboard switching and protective devices in quantities, ratings, types and with arrangement shown; with anti-turn (solderless pressure) type main lug connectors approved for copper or aluminum conductors. Equip with hard-drawn copper bus bars with not less than 98% conductivity and with full-sized neutral bus; provide suitable lugs on neutral bus for outgoing feeders requiring neutral connections. Provide molded-case circuit-breakers for each feeder circuit indicated, with toggle handles that indicate when tripped. Where multipole breakers are indicated, provide with common trip so overload on one-pole will trip all poles simultaneously. Provide panelboards with bare copper uninsulated grounding bars suitable for bolting to enclosures. Panelboard enclosures shall be not less than 8-inches deep – lighting panel construction shall not be acceptable.

1. Vertical Bussing: Full 90-inch high units, extend vertical bussing full length of unit for maximum mounting space of circuit breakers and future circuit breakers.
2. Solid State Trip Units: Provide main circuit breakers with solid state trip units:

a. Long time, short time, and instantaneous settings.

3. Circuit breakers in distribution panelboards shall be fully rated with an interrupting capacity indicated on the Drawings. Series ratings are not acceptable.

4. TVSS: IEEE C62.41, UL 1449 Third Edition Listed, Type 2, plug-in style, solid-state, parallel-connected, sine-wave tracking suppression and filtering modules with front panel status display.

   a. Minimum single-impulse current rating, all protection modes: 240 kA per phase.
   b. All protection modes: Line to line, line to neutral, line to ground, neutral to ground.
   c. UL 1449 Listed Voltage Protection Rating for 277/480V applications: 1800V line-line at 320V MCOV; or better.
   d. EMI/RFI Noise Attenuation: Integral RF noise filter, 55 dB at 100 kHz.
   e. Auxiliary Contacts: One normally open, one normally closed, for remote monitoring of system operation.
   f. Audible Alarm: Activated on failure of any surge diversion module.
   g. Integral Mount: TVSS unit integral and factory assembled within panelboard, factory assembled disconnect removes TVSS from service. Front panel display mounts through front of distribution panelboard interior.

5. Multifunction digital meter: Microprocessor based unit suitable for 3- or 4-wire systems and have as a minimum the following features:

   a. Switch-selectable digital display of the following:

      (1) Phase Currents, Each Phase: Plus or minus 1%.
      (2) Phase-to-Phase Voltages, 3-Phase: Plus or minus 1%.
      (3) Phase-to-Neutral Voltages, 3-Phase: Plus or minus 1%.
      (4) Three-Phase Real Power: Plus or minus 2%.
      (5) Three-Phase Reactive Power: Plus or minus 2%.
      (6) Power Factor: Plus or minus 2%.
      (7) Frequency: Plus or minus 0.5%.
      (8) Integrated Demand, (KWD or KVAD) with Demand Interval Selectable from 5 to 60 Minutes: Plus or minus 2%, user resettable.
      (9) Accumulated energy, in megawatt hours (joules), plus or minus 2%; stored values unaffected by power outage for up to 72 hours.
      (10) Pulse Output: Monitored by building Energy Management System (EMS).
      (11) Communications: RS485 port for interface to building Energy Management System (EMS).
      (12) Communications: ModBus port for interface to building Energy Management System (EMS).
      (13) Mounting: Display and control unit flush or semi-flush mounted in distribution panelboard.
      (14) G.E. EPM 6000 series with pulse output, RS485, and ModBus communications or approved equivalent.

6. Distribution Panelboards shall be equivalent to (include specified accessories):

General Electric	Spectra Series
Siemens	S4, S5
Square D	I-LINE
Cutler-Hammer	Pow-R-Line 4B

E. Lighting and Appliance Panelboards: Provide dead-front safety type lighting and appliance panelboards as indicated, with switching and protective devices in quantities, ratings, types and arrangements shown; with anti-turn solderless pressure type lug connectors approved for copper or aluminum conductors; equip with hard-drawn copper bus bars with not less than 98% conductivity, full-sized neutral bar, with bolt-on type heavy-duty, quick-make, quick-break, single-pole or multi-pole circuit breakers, as indicated, with toggle handles that indicate when tripped. Provide multi-pole breakers with a common trip. Provide suitable lugs on neutral bus for each outgoing feeder required; provide bare uninsulated copper grounding bars suitable for bolting to enclosures. Breakers shall be HACR rated.

1. Lighting and Appliance Panelboards shall be type:

	240V Bolt-on	480V Bolt-on
General Electric	AQ	AD,AE
Square D	NQOD	NF
Siemens	S1	S2
Cutler-Hammer	PRL1, PRL2	PRL2, PRL3

2. Breakers in panelboards may be fully rated or series rated with an interrupting capacity not less than indicated on the Drawings.

F. Lighting and Appliance Panelboard Enclosures: Provide galvanized sheet steel cabinet type enclosures, minimum 20-inches wide and 5-3/4-inches deep, code-gage, minimum 16-gage thickness. Construct with multiple knockouts and wiring gutters. Provide fronts with adjustable trim clamps, and doors with flush metal locks and keys, all panelboard enclosures keyed alike. Equip with interior circuit-directory frame, and card with clear plastic covering. Provide baked gray enamel finish over a rust inhibitor coating. Design enclosures for recessed or surface-mounting as indicated. Provide enclosures which are fabricated by same manufacturer as panelboards, which mate properly with panelboards to be enclosed and are NEMA rated to suit the atmospheric conditions of the equipment surroundings.

1. Furnish six (6) spare keys for each type of panelboard cabinet lock.

G. Panelboard Accessories: Provide panelboard accessories and devices including, but not necessarily limited to, circuit-breakers, trip units, ground-fault protection units, shunt trip units, etc., as recommended by manufacturer for ratings and applications indicated.

PART 3 - EXECUTION

3.1 INSPECTION

A. Installer must examine areas and conditions under which panelboards and enclosures are to be installed and notify Architect/Engineer in writing of conditions detrimental to proper completion of work. Do not proceed with work until unsatisfactory conditions have been corrected in a manner acceptable to Installer.

3.2 INSTALLATION OF PANELBOARDS

A. General: Install panelboards and enclosures as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC Standards and NECA's "Standard of Installation", and in compliance with recognized industry practices to ensure that products fulfill requirements.

B. Coordinate installation of panelboards and enclosures with cable and raceway installation work.

C. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B or manufacturer's torque requirements when more stringent.

D. At each flush mount panelboard, provide four (4) empty 3/4-inch conduit from panelboard stubbed up above accessible ceiling for future branch circuits. Cap and label.

E. Anchor enclosures firmly to walls and structural surfaces, ensuring that they are permanently and mechanically secure.

F. Provide properly wired electrical connections within enclosures.

G. Provide factory panelboard circuit directory cards in lighting and appliance panelboards upon completion of installation work. Circuit directory cards shall be arranged with even numbered circuits separated by group or card from odd numbered circuits. All circuits, including spares and spaces, shall be labeled. All identification shall be at a minimum typewritten. Hand lettering is not acceptable. Use room numbers assigned by the Owner in circuit descriptions; do not use Architectural room numbers indicated on Drawings.

H. Provide engraved nameplate for each panelboard. In addition, at distribution panelboards, provide engraved nameplate for each branch circuit breaker, including spares.

I. All wiring within panelboards shall be arranged in a neat and organized manner.

3.3 GROUNDING

A. Provide equipment grounding connections for panelboards as required by NEC and other Division 26 Sections. Tighten connections to comply with tightening torques specified in UL Standards 486A and B to assure permanent and effective grounds.

3.4 FIELD QUALITY CONTROL

A. Prior to energization of circuitry, check all accessible connections to manufacturer's tightening torque specifications.

B. Prior to energization of panelboards, check with ground resistance tester phase-to-phase and phase-to-ground insulation resistance levels to ensure requirements are fulfilled.

C. Prior to energization, check panelboards for electrical continuity of circuits and for short-circuits.

D. Subsequent to wire and cable hook-ups, energize panelboards and demonstrate functioning in accordance with requirements. Where necessary, correct malfunctioning units and then retest to demonstrate compliance.

E. After occupancy, measure panelboard loads. Re-connect circuits and balance loads equally across all phases. Record and submit written reports of amp draw on each panelboard phase.

END OF SECTION 262416

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 SUMMARY

A. The extent of wiring device work is indicated by drawings and schedules. Wiring devices are defined as single discrete units of electrical distribution systems, which are intended to carry but not utilize electric energy.

B. Types of electrical wiring devices in this section include the following:

1. Receptacles.
2. Ground-fault circuit interrupters.
3. Switches.
4. Wallplates.
5. Plugs and connectors.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide wiring devices of one (1) of the following (for each type and rating of wiring device):

1. Arrow Hart
2. Bryant Electric Co.
3. Hubbell Inc.
4. Pass and Seymour Inc.

2.2 FABRICATED WIRING DEVICES

A. General: Provide factory-fabricated wiring devices, in types, colors and electrical ratings for applications indicated and which comply with NEMA Standards Pub/No. WD 1. All devices shall be extra heavy duty specification grade.

1. Gray color devices except as otherwise indicated.

B. Verify color selection with Architect prior to ordering.

C. Receptacles:

1. Heavy-Duty Duplex: Provide extra heavy-duty self-grounding type duplex receptacles, 2-pole, 3-wire, 20-amperes, 125-volts, triple-wipe contacts, with green hexagonal equipment ground screw, metal plaster ears, design for side and back wiring with spring loaded, screw activated pressure plate, with NEMA configuration 5-20R unless otherwise indicated.

a. P & S Plug Tail receptacles with connector built into back of device and separate polycarbonate connector housing with connector leads are acceptable.

2. Ground-Fault Interrupters: Provide "feed-thru" type ground-fault circuit interrupters, with extra heavy-duty duplex receptacles, capable of protecting connected downstream receptacles on single circuit, and of being installed in a 2-3/4-inch deep outlet box without adapter, grounding type UL Rated Class A, Group 1, rated 20-amperes, 120-volts, 60 Hz, triple-wipe contacts, side- and back-wired; with solid-state ground-fault sensing and signaling; with 5-milliamperes ground-fault trip level; equip with NEMA configuration 5-20R. Provide ground-fault circuit interrupter at each device indicated on the Drawings, “feed-thru” protection shall not be substituted for a ground fault device.

D. Plugs and Connectors:

1. Provide required amperage ratings, voltage ratings, and NEMA configurations which are designed to suit the atmospheric conditions of the equipment surroundings. All plugs and connectors shall be manufactured by Daniel Woodhead Company or approved equivalent by one (1) of the following manufacturers:

a. Hubbell Inc.
b. Pass and Seymour Inc.

E. Switches:

1. General: Switches shall be provided as specified in this section. Additional features such as key operator, rocker, and lighted toggle shall be provided where indicated on the drawings.
2. Single-Pole: Provide extra heavy-duty flush single-pole AC quiet, self-grounding type switches, 20-amperes, 120/277-volts, with mounting yoke insulated from mechanism, equip with plaster ears, toggle switch handle, and designed for side and back wiring with spring loaded, screw activated pressure plate.
3. Three-Way: Provide extra heavy-duty flush 3-way AC quiet, self-grounding type switches, 20-amperes, 120/277-volts, with mounting yoke insulated from mechanism, equip with plaster ears, toggle switch handles, and designed for side and back wiring with spring loaded, screw activated pressure plate.
4. Four-Way: Provide extra heavy-duty flush 4-way AC quiet, self-grounding type switches, 20-amperes, 120/277-volts, with mounting yoke insulated from mechanism, equip with plaster ears, toggle switch handles, and designed for side and back wiring with spring loaded, screw activated pressure plate.

2.3 WIRING DEVICE ACCESSORIES

A. Wallplates: Provide wallplates for single and combination wiring devices, of types, sizes and with ganging and cutouts as indicated. Select plates which mate and match wiring devices to which attached. Construct with metal screws for securing plates to devices; screw heads colored to match finish of plates; wallplates colored to match wiring devices except as noted below. Provide plates possessing the following additional construction features:

1. Finished Areas:

Material and Finish:	0.04-inch thick, type 302 satin finished stainless steel

2. Unfinished Areas:
   Material and Finish: Steel plate, galvanized.
3. Surface-mounted boxes in unfinished areas shall be furnished with 4-inch square raised covers, with openings to fit device or devices to be installed.

B. Furnish cast metal weatherproof covers for receptacles installed outdoors, in wet locations or shown as weatherproof. Provide in-use weatherproof cast metal covers where required per NEC. Cast metal covers and in-use cast metal covers shall be by Intermatic or approved equivalent.

C. Engrave finish plates for switches controlling equipment (e.g. “EXH FAN”) in 1/4-inch high black filled letters.

PART 3 - EXECUTION

3.1 INSTALLATION OF WIRING DEVICES

A. Install wiring devices as indicated, in accordance with manufacturer's written instructions, applicable requirements of NEC and NECA's "Standard of Installation" and in accordance with recognized industry practices to fulfill project requirements.

B. Coordinate with other work, including painting, electrical boxes and wiring work, as necessary to interface installation of wiring devices with other work.

C. Install wiring devices only in electrical boxes, which are clean; free from excess building materials, dirt and debris.

D. Install wallplates after painting work is completed.

E. The continuity of branch circuit conductors shall not depend on device connections such as lampholders, receptacles, etc. where the removal of the device would interrupt the continuity. Branch circuit conductors shall be spliced with jumpers to connect the device.

F. Connections of wire to devices shall be screw tightened except devices with built-in connector/leads. Connections using only spring pressure are not acceptable.

G. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for wiring devices. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standards 486A and B. Use properly scaled torque indicating hand tool.

H. All switches and receptacles with exposed terminals shall be wrapped with insulating tape equal to Scotch No. 33 such that no live parts are left exposed.

3.2 PROTECTION OF WALLPLATES AND RECEPTACLES

A. Upon installation of wallplates and receptacles, advise Contractor regarding proper and cautious use of convenience outlets. At time of Substantial Completion, replace those items which have been damaged, including those burned and scored by faulty plugs and those which are not clean and free from paint, dirt and debris.

3.3 GROUNDING

A. Provide equipment grounding connections for wiring devices, unless otherwise indicated. Tighten connections to comply with tightening torques specified in UL Standard 486A to assure permanent and effective grounds.

3.4 TESTING

A. Prior to energizing circuitry, test wiring for electrical continuity, and for short-circuits. Ensure proper polarity of connections is maintained. Subsequent to energization, test wiring devices to demonstrate compliance with requirements.

END OF SECTION 262726

SECTION 262813 - FUSES

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of fuse work is indicated by drawings and schedules.

B. Types of fuses specified in this section include the following:

1. Class RK1 time-delay.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide products of one (1) of the following:

1. Bussman Div; McGraw-Edison Co.
2. Littelfuse Co.
3. Gould Shawmut.

B. Fuse types listed below are for Bussman Co. Fuses by Littelfuse Co. or Gould Shawmut shall be equivalent to types indicated.

2.2 FUSES

A. General: Except as otherwise indicated, provide fuses of types, sizes, ratings, and average time/current and peak let-through current characteristics indicated, which comply with manufacturer's standard design, materials and construction in accordance with published product information, and with industry standards and configurations.

B. Class RK1 Time-Delay Fuses: Provide UL Class RK1 time-delay fuses rated 250V (Type LPN-RK) for voltages under 250V; and 600V (Type LPS-RK) for voltages 250-600V, 60 Hz, with 200,000 RMS symmetrical interrupting current rating.

PART 3 - EXECUTION

3.1 INSTALLATION OF FUSES

A. Install fuses as indicated, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA Standards for installation of fuses.

B. Coordinate with other work, including electrical wiring work, as necessary to interface installation of fuses with other work.

C. Install fuses in fused switches.

D. Short-circuit protection dual-element fuses installed in individual motor circuits with separate overload protection shall be sized at 175% of motor nameplate current rating or the next standard fuse size. Where excessive ambient temperature, high inertia motor loads or frequent "on-off" cycling requires larger fuses, consult the electrical engineer. Use fuse reducers where fuse gaps are larger than fuse dimension.

E. All fuse sizes shall be coordinated with manufacturer's requirements for each unit of equipment to be connected.

3.2 FIELD QUALITY CONTROL

A. Prior to energization of fusible devices, test devices for continuity of circuitry and for short-circuits. Correct malfunctioning units and then demonstrate compliance with requirements.

END OF SECTION 262813

SECTION 262816 - CIRCUIT AND MOTOR DISCONNECTS

PART 1 - GENERAL

1.1 SUMMARY

A. Extent of circuit and motor disconnect switch work is indicated on drawings and schedules.

B. Types of circuit and motor disconnect switches in this section include the following:

1. Equipment disconnects.
2. Motor-circuit disconnects.
3. Horsepower rated thermal-element toggle switches.
4. Horsepower rated toggle switches.

C. Wires/cables, raceways and electrical boxes and fittings required in connection with circuit and motor disconnect work are specified in other Division 26 Sections.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Manufacturer: Subject to compliance with requirements, provide circuit and motor disconnects of one (1) of the following:

1. General Electric Co.
2. Square D Company.
3. Cutler Hammer.
4. Siemens.

2.2 DISCONNECT SWITCHES

A. Heavy-Duty Disconnect Switches: Provide surface-mounted, heavy-duty type, sheet-steel enclosed switches, of types, sizes and electrical characteristics indicated; rated for system voltage 60 Hz, with required number of poles and solid neutral (where required) incorporating quick-make, quick-break type switches. Equip with operating handle which is integral part of enclosure base and whose position is easily recognizable, and is padlockable in OFF position; construct current carrying parts of high-conductivity copper, with silver-tungsten type switch contacts, and positive pressure type reinforced fuse clips where fusing is required. The enclosure shall be NEMA rated to suit the atmospheric conditions of the equipment surroundings and of the manufacturer's standard finish.

B. Motor-circuit disconnect switches must be HP rated.

C. Neutral Bar: Provide solid copper neutral bar internal to disconnect switch enclosure for circuits indicated with neutral connection.

D. Ground Bar: Provide solid copper equipment ground bar internal to disconnect switch enclosure.

E. Fuses: Provide fuses for disconnect switches where fusing is required, of classes, types and ratings needed to fulfill electrical requirements for service indicated.

F. Horsepower Rated Thermal-Element Toggle Switches (S_{TE}): Provide single-phase fractional HP manual motor starters, of sizes and ratings to match motor. Equip with manually operated quick-make, quick-break lockable toggle mechanism and with one-piece melting alloy resettable type thermal unit. Starter shall become inoperative when thermal unit is removed. Enclosure shall be NEMA rated to suit the atmospheric conditions of the equipment surroundings and of the manufacturer's standard finish.

G. Horsepower Rated Toggle Switches (S_H): Manually operated 30A, double-pole, quick-make, quick-break lockable toggle mechanism rated for connected motor horsepower. Enclosure shall be NEMA rated to suit the atmospheric conditions of the equipment surroundings and of the manufacturer's standard finish. Pass & Seymour 7812-P (NEMA 1), 7832 (NEMA 3R) or approved equivalent.

PART 3 - EXECUTION

3.1 INSTALLATION OF MOTOR AND CIRCUIT DISCONNECT SWITCHES

A. Install circuit and motor disconnect switches where indicated, complying with manufacturer's written instructions, applicable requirements of NEC, NEMA and NECA's "Standard of Installation" and in accordance with recognized industry practices.

B. Coordinate motor and circuit disconnect switch installation work with electrical raceway work, location of equipment and as necessary for proper interface. Provide U-channel supports from floor and/or structure where required to mount disconnects at free-standing equipment.

C. Install disconnect switches used with motors and controllers, and motor-driven appliances within sight of controller position for motors greater than 1/8 HP.

3.2 GROUNDING

A. Provide equipment grounding connections, sufficiently tight to assure a permanent and effective ground as required by NEC and in Grounding Section of Division 26.

3.3 FIELD QUALITY CONTROL

A. Subsequent to completion of installation of electrical disconnect switches, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at Project Site, then retest to demonstrate compliance; otherwise remove and replace with new units and retest.

END OF SECTION 262816

SECTION 265113 - LUMINAIRES

PART 1 - GENERAL

1.1 SUMMARY

A. Materials covered in this section include the following:

1. Luminaires.
2. Emergency lighting units.
3. Exit signs with battery backup.
4. Ballasts.
5. Lamps.

1.2 SUBMITTALS

A. For each luminaire type, submit the following information for review:

1. A cut sheet for each luminaire with type designation listed at the top of the cut sheet. Clearly identify full luminaire part number and all included options. Cut sheet shall contain photometrics and list luminaire efficiency.
2. Ballast cut sheet from an acceptable manufacturer with specific model number identified. Indicate on the ballast cut sheet each luminaire type utilizing the ballast.
3. Lamp cut sheet from an acceptable manufacturer with specific model number identified. Indicate on the lamp cut sheet each luminaire type utilizing the lamp.
4. Include warranty information that meets or exceeds requirements indicated.

1.3 WARRANTY

A. Provide material manufacturer’s written warranties, as follows:

1. Standard Luminaires: One (1) year.
2. LED Luminaires: Five (5) years.
3. Fluorescent/compact fluorescent ballasts: Five (5) years and include replacement labor allowance.
4. Emergency lighting units: Five (5) years.
5. Exit signs with battery backup: Five (5) years.
6. Lamps: Manufacturer’s standard warranty based on lamp and ballast types.

PART 2 - PRODUCTS

2.1 LUMINAIRES - GENERAL

A. Provide recessed luminaires with rubber or fiberglass gaskets or equivalent material to prevent light leaks around flush trim. Provide integral thermal protection suitable for surrounding environment. Provide exterior luminaires with weatherproof, neoprene gaskets suitable for outdoor wet location.

B. All acrylic lenses shall be prismatic and not less than 0.125-inches thick nominal. Lensed luminaires installed in kitchens and other areas indicated on the drawings shall have prisms inverted to provide smooth cleaning surface.

C. No labels or identification on the luminaires shall be visible from a floor-standing position.

D. All components of all luminaires shall be UL listed. Finished assembly shall be UL listed.

~~E.~~ All luminaire finishes shall be factory applied.

F. Provide factory installed integral disconnecting means for fluorescent luminaires per 2011 NEC article 410.130 (G). Note that exception No. 4 and exception No. 5 will not be accepted.

G. All fluorescent luminaires shall be painted after fabrication. Housings for recessed fluorescent luminaires shall have a minimum depth of 4".

H. Downlights shall have matte Alzak finish self-trimming reflectors with hardware mounting for reflector, spring clips are not acceptable.

I. Contractor shall field verify voltage of all luminaires prior to ordering.

2.2 EMERGENCY LIGHTING UNITS

A. Description: Sealed emergency unit with maintenance-free batteries and lamp types indicated on the Luminaire Schedule plus appropriately sized battery charger and electronic control circuitry, UL 924 listed and NFPA 101 compliant. Luminaire housing shall be minimum 16-gauge cold rolled steel baseplate with UV-stabilized high impact clear wraparound polycarbonate lens and aiming lamps.

B. Provide with self-test and self-diagnostic feature. Unit shall automatically perform test for 30 seconds every month and a full discharge test of 90 minutes one time per year. Upon component failure, unit shall emit an audible alarm and provide a visual signal.

C. Size unit battery system for minimum 90 minutes continuous illumination of connected lamps upon loss of AC power.

D. The emergency lighting unit layout shall provide light levels that comply with NFPA 101 in the paths of egress. Provide additional emergency lighting units to comply with NFPA 101 egress lighting requirements, include the cost of any additional emergency lighting units in bid amount.

E. For cold environment applications, the emergency lighting unit shall be rated down to -22°F temperature using integral strip heater(s) or other proven method.

F. All exterior units and remote heads shall have minimum 16-gauge cold rolled steel baseplate with UV-stabilized high impact clear wraparound polycarbonate lens and aiming lamps, UL wet location listed.

G. Provide steel wire guard of suitable size and strength, white finish, for units subject to physical damage.

2.3 EXIT SIGNS WITH INTEGRAL BATTERY BACKUP

A. Description: Exit sign luminaires with integral maintenance-free batteries and integral LED light source plus appropriately sized battery charger and electronic control circuitry, UL 924 listed and NFPA 101 compliant. Luminaire housing shall be high impact polycarbonate construction with red 'EXIT' lettering and chevrons as indicated.

B. Provide with self-test and self-diagnostic feature. Unit shall automatically perform test for 30 seconds every month and a full discharge test of 90 minutes one time per year. Upon component failure, unit shall emit an audible alarm and provide a visual signal.

C. Size exit sign luminaire battery system for minimum 90 minutes continuous illumination of connected lamps upon loss of AC power.

D. For cold environment applications, the exit sign luminaire shall be rated down to -22°F temperature using integral strip heater(s) or other proven method.

E. Provide steel wire guard of suitable size and strength, white finish, for units subject to physical damage.

2.4 FLUORESCENT BALLASTS

A. Acceptable fluorescent ballasts:

1. GE Ultrastart series (T8, T5, T5HO lamps) or CFL ProLine (compact fluorescent lamps)
2. Philips Advance Optanium Series

B. Linear fluorescent ballasts for T8 lamps: Electronic programmed rapid start type, operating range of 120 – 277 volts +/- 10%, ballast factor of 0.85 or greater unless indicated otherwise, total harmonic distortion (THD) less than 10%, power factor greater than 0.95, Class 'A' sound rating.

C. Compact fluorescent ballasts: Electronic programmed rapid start, operating range of 120 – 277 volts +/- 10%, total harmonic distortion (THD) less than 10%, power factor greater than 0.95, Class 'A' sound rating, end-of-lamp-life shutdown circuitry.

D. Match ballast temperature and moisture ratings to the atmosphere in which they are to be installed. Luminaires installed in low ambient temperature areas shall have ballasts specifically designed for low temperature starting.

2.5 LAMPS (NOT INCLUDING LED)

A. Acceptable lamp manufacturers:

1. General Electric
2. Osram-Sylvania
3. Philips

B. All linear fluorescent and compact fluorescent lamps shall have a Correlated Color Temperature (CCT) of 4100K and Color Rendering Index (CRI) of at least 80.

C. Provide lamps for all luminaires. Lamps shall be new at the time of building acceptance by the Owner. Replace lamps used for construction lighting prior to acceptance.

D. Burn-in fluorescent lamps per manufacturer's recommendations.

E. All linear fluorescent and compact fluorescent lamps shall be low-mercury TCLP compliant.

F. All compact fluorescent lamps shall be plug-in type; screw-in lamp versions are not acceptable.

G. Compact fluorescent lamps shall utilize Amalgam lamp technology for stable lumen performance over a wider range of ambient temperatures.

2.6 LIGHT EMITTING DIODES (LED) SYSTEMS

A. Each LED-containing luminaire shall be tested as a complete lighting system under the requirements of IESNA LM-79, LM-80 and utilize absolute photometry.

B. Provide each luminaire with an LED driver tested and approved for use with the actual LED array in the luminaire. Luminaires installed in low ambient temperature areas shall have LED drivers specifically designed for low temperature starting. Luminaires installed in high ambient temperature areas shall have LED drivers specifically designed for high temperature starting.

C. Correlated Color Temperature (CCT) and minimum Color Rendering Index (CRI) of the LED array shall be as indicated on the Luminaire Schedule.

PART 3 - EXECUTION

3.1 INSPECTION

A. Examine areas and conditions under which luminaires are to be installed and substrate which will support luminaires. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to Installer.

3.2 INSTALLATION OF LUMINAIRES

A. Install luminaires at locations and heights as indicated, in accordance with luminaire manufacturer's written instructions, applicable requirements of NEC, NECA's "Standard of Installation", NEMA Standards, and with recognized industry practices to ensure that luminaires fulfill requirements.

B. Coordinate with other trades to properly interface installation of luminaires with other work.

C. Coordinate luminaire trim flange and construction to properly mate with actual mounting surface.

D. Where recessed luminaires are specified, furnish plaster frames or other framing devices during the construction of the mounting surface prior to the installation of the luminaires.

E. Independently support each lay-in luminaire installed in an acoustical ceiling using minimum 2-#12 steel wires connected to opposite ends of the luminaire housing and anchored to structure (floor deck, metal truss, etc.) above. All other luminaires installed in a ceiling grid shall be supported by minimum 1-#12 steel wire connected to luminaire housing and anchored to structure (floor deck, metal truss, etc.) above. In no case shall any luminaire be hung from plaster, plasterboard, acoustic, or insulating materials or supported solely by an acoustical ceiling grid.

F. Where recessed luminaires are installed in fire-rated ceilings or walls, provide an enclosure approved by authorities having jurisdiction surrounding each luminaire and maintain the fire rating of the ceiling or wall. Provide adequate clearance between luminaire and enclosure in accordance with luminaire manufacturer’s recommendations.

3.3 ADJUSTING AND CLEANING

A. Clean luminaires of dirt and debris upon completion of installation.

B. Protect installed luminaires from damage during construction period.

C. Aim adjustable luminaires per Engineer’s instructions.

3.4 FIELD QUALITY CONTROL

A. Upon completion of installation of luminaires, and after building circuitry has been energized, apply electrical energy to demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

B. Burn-in fluorescent and compact fluorescent lamps per lamp manufacturer's recommendations.

C. Simulate power outage and test battery systems integral with emergency luminaires. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

3.5 GROUNDING

A. Provide equipment grounding connections for luminaires as required by NEC and other Division 26 Sections. Tighten connections to comply with tightening torques specified in UL Standard 486A for permanent and effective grounds.

END OF SECTION 265113

SECTION 268080 - TELECOMMUNICATIONS 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. This Section includes cables, racks, patch panels, wire management, connecting devices, installation, testing, and warranty for wiring systems to be used as signal pathways for high-speed data transmission. Unless otherwise indicated, copper systems shall be Systimax Category 6, certified and warrantied.

1. Provide exterior cabling infrastructure consisting of Systimax outside plant fiber cables for data and VoIP phone backbone.
2. Provide Systimax copper data cables from each workstation outlet indicated, homerun to serving telecommunications node.

1.3 OTHER ACCEPTABLE SYSTEMS

A. Warrantied and certified systems from manufacturers listed below shall also be acceptable. Systimax part numbers are referenced to establish minimum features and quality levels. Components from other manufacturers shall meet or exceed the Systimax components specified. Submit technical documentation and compare products to Systimax products specified, definitively show submitted products meet or exceed Systimax products specified. Warranty shall be 20-year application warranty.

1. Systimax
2. Panduit
3. Uniprise

1.4 WARRANTY

A. General Warranty: Special warranty specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.

B. Special Warranty: 20 year for data systems, product application warranty.

1.5 DEFINITIONS

A. EMI: Electromagnetic interference.

B. IDC: Insulation displacement connector.

C. LAN: Local area network.

D. PVC: Polyvinyl chloride.

E. STP: Shielded twisted pair.

F. UTP: Unshielded twisted pair.

G. EMT: Electrical Metallic Tubing

H. FMC: Flexible Metal Conduit

I. MM: Multimode fiber optic

J. SM: Singlemode fiber optic

1.6 SUBMITTALS

A. Maintenance Data: For products to include in maintenance manuals specified in Division 1.

B. Special Warranty: Certificate signed by manufacturer activating 20-year warranty for telecommunications systems.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: A minimum of one (1) registered communication distribution technician shall be at the job site when telecommunications work is performed and supervise installation of all telecommunications work.

B. Installer Qualifications: Installers proposed for use on job must show a minimum of 5-years experience installing systems of similar bandwidth and scope. Installers shall be factory certified on the system product.

C. Comply with NFPA 70.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

E. Comply with all applicable EIA/TIA Standards for telecommunications cabling, pathways, performance testing, grounding, and administrative standards.

F. Testing Equipment: Specifically suited and designed for link testing of the cabling and connecting hardware specified:

1. Copper Channels: Fluke DTX1800 or approved equivalent
2. Fiber Channels: Fluke DTX-MFM and DTX-GFM multimode fiber test assemblies
3. Fiber Channels: Fluke singlemode fiber test assembly

1.8 COORDINATION

A. Coordinate Work of this Section with Owner's LAN and telephone switch active equipment suppliers.

1. Meet jointly with representatives of above organizations and Owner's representatives to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute record to other participants.

3. Adjust arrangements and locations of distribution frames, patch panels, and cross connects in equipment rooms and wiring closets to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.

PART 2 - PRODUCTS

2.1 SYSTEM REQUIREMENTS

A. General: Coordinate the features of materials and equipment so they form an integrated system. Match components and interconnections for optimum future performance.

2.2 PATHWAYS

A. Interior concealed telecommunications pathways: EMT and cable tray.

B. Interior exposed telecommunications pathways: EMT. All pathways shall be concealed, interior exposed pathways shall be allowed only at areas of finished exposed structure. Telecommunications pathways at areas of exposed finished structure shall be routed as high as possible and painted to match surrounding finishes. Telecommunications cables must be concealed in EMT at areas of exposed finished structure, visible data cable at areas of exposed finished structure shall not be allowed.

2.3 HORIZONTAL DATA CABLES (STATION CABLES)

A. Systimax Gigaspeed XL 2071E

1. Category 6 channel specifications to 550 MHz, 100-ohm, 4-pair UTP
2. Plenum rated
3. Type: Unshielded Twisted Pair (UTP), UL Listed
4. Blue Jacket

2.4 OUTLETS

A. Faceplates:

1. Size: Single gang, unless otherwise indicated
2. Outlet positions: Four (4) jack openings.
3. Fillers: Gray, as required for unused jack openings
4. Material: Stainless Steel
5. Systimax modular faceplate series suitable for M Series connectors

B. Data Jacks:

1. Systimax Gigaspeed XL MGS400 Series
2. Mounting: In modular face plate
3. Color: Blue
4. Category 6, eight-position modular receptacle, 568 B pin-out configuration
5. Jack insert identification
6. Verify jack type and configuration with Owner’s equipment

2.5 PATCH PANELS FOR HORIZONTAL DATA CABLES

A. Systimax Patchmax GS3 Gigaspeed XL

1. Front connections: modular jacks
2. Rear connections: 110 IDC style, rotatable to allow front access
3. Ports: 24 or 48
4. Quantity: As required for termination of each cable plus 100% spare capacity
5. Mounting: Rack mount. Match patch panel width to rack width.
6. Black finish

2.6 PATCH CORDS

A. Fiber patch cords (multi-mode)

1. Dual zip-cord type 62.5 micron multi-mode fiber cables, 3.0 mm cordage, machine polished, factory terminated and tested.
2. Maximum attenuation of 3.0 dB/km at 850 nm and 1.0 dB/km at 1300 nm.
3. Terminations: LC type, one connector on each end of each fiber in cord. Coordinate connector types with Owner's active equipment prior to ordering. Obtain written approval from Owner on termination types.
4. Quantity: Number of fibers of patch cords shall be 50 percent of backbone fiber terminations.
5. Lengths: 20% of fiber patch cords shall be 4ft, 80% shall be 7ft.
6. Systimax FDMSTST duplex fiber patch cords, plenum rated orange jacket.

B. Data patch cords for telecommunications nodes

1. Systimax Gigaspeed XL patch cords, 7' length, Category 6, blue color.
2. Plenum rated jacket.
3. Quantity: Equal to 110% of the horizontal cables.

C. Station cords for workstation areas

1. Systimax Gigaspeed XL patch cords, 10' length, Category 6, gray color.
2. Plenum rated jacket.
3. Quantity: Equal to 110% of the horizontal cables.

2.7 MOUNTING ELEMENTS

A. Vertical Cable Management

1. Double sided, mounted both sides of vertical rack frames.
2. Hinged removable front and rear covers.
3. Provide two (2) wire retainers for each 12 inches of duct

B. Horizontal Cable Management

1. Horizontal distribution channels on both front and rear
2. Slotted wall wiring duct with removable cover approximately 3 inches wide by 3 inches deep in front and 2 inches wide and 4 inches deep in rear
3. Provide one horizontal cable management organizer on top and bottom of each patch panel and top and bottom of each Owner provided network electronics unit.
4. Panduit WMP1E or approved equivalent

C. Distribution Rings

1. Wall mounted 6" D rings suitable for Category 6 cables.

D. Telecommunications Cable Loop Hangers

1. Plenum rated plastic loop with support wire to structure
2. Size as required for supported cables, minimum 2" diameter
3. Arlington Industries TL series or approved equivalent

E. Cable Bundling Hardware

1. Reusable Velcro cable ties

2.8 IDENTIFICATION PRODUCTS

A. Comply with EIA/TIA Standards.

1. Cable Labels: Self-adhesive vinyl or vinyl-cloth wraparound tape markers, machine printed with alphanumeric cable designations.
2. Wall Fields, Racks, and Patch Panels: Engraved black with white letter laminate plastic with identifying description of frames and wall fields served. Lettering shall be minimum 3/4 inch high.
3. Workstation Labels: Machine printed labels with maximum font size to allow two (2) rows of printing to completely fill the label window height. Coordinate text color and tape background color with Owner. High strength adhesive backing fastens securely to faceplate to discourage tampering. Brother P-Touch Extra Strength Tape or approved equivalent.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine pathway elements intended for cable. Check raceways, cable trays, and other elements for compliance with space allocations, installation tolerances, hazards to cable installation, and other conditions affecting installation. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Wiring Method:

1. Install all wiring in conduit. Conceal conduit within structure. Wiring above lay-in type ceilings shall be permitted to be installed in cable tray in lieu of conduit.
2. Exposed cabling at areas of finished exposed structure shall not be allowed. Route cabling in conduit, extend conduit into nearest accessible ceiling area and conceal with lay-in ceiling; or extend to serving telecommunications node.

B. Supports: Attached independent supports directly to building concrete structure or to unistrut frame supported directly from building concrete structure. Do not attach supports to roof decking or ceiling systems.

C. Line Power: Connect telecommunications components to 120V line power.

D. Utilize sweep elbows for all telephone and signal system raceways.

E. Install cable using techniques, practices, and methods that are consistent with Category 6 rating of components and that ensure Category 6 performance for data outlets.

F. Install cable without damaging conductors, shield, or jacket and without splices.

G. Do not bend cable in handling or in installing to smaller radii than minimums recommended by manufacturer.

H. Pull cables without exceeding cable manufacturer's recommended pulling tensions.

1. Pull cables simultaneously if more than one is being installed in the same raceway.
2. Use pulling compound or lubricant if necessary. Use compounds that will not damage conductor or insulation.
3. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage media or raceway.

I. Install cable parallel and perpendicular to building surfaces and structural members.

J. Secure and support cable not more than 6 inches from cabinets, boxes, fittings, outlets, frames, and terminals. Provide necessary J-hooks and D-rings.

K. Wiring within Enclosures: Provide adequate length of conductors. Train conductors to terminal points with no excess. Use lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.

L. Separation of Wires: Comply with EIA/TIA-569 rules for separating unshielded copper communication and data-processing equipment cables from potential EMI sources, including electrical power lines and equipment.

M. Make splices, taps, and terminations only at indicated outlets, terminals, and cross-connect and patch panels. All cables shall homerun from workstation outlet to serving telecommunications closet.

N. Use splice and tap connectors compatible with media types.

3.3 GROUNDING

A. Ground cable shields, drain conductors, and equipment to eliminate shock hazard and to minimize ground loops, common-mode returns, noise pickup, cross talk, and other impairments.

B. Ground cable trays, telecommunications utilities, and racks. Homerun a #6 ground conductor from each rack to local telecommunications ground bar.

C. Ground Lugs: Two hole copper lugs sized for ground conductor used and terminated on two hole connections. Use conductive anti-oxidation compound at mechanical connections.

3.4 JACK INSTALLATION

A. Install filler plug for each unused faceplate opening.

B. Terminate wire in 568B pin configuration.

3.5 CABLE INSTALLATION

A. Install cables in and through pathways furnished as specified in EIA/TIA – 569.

B. Physically isolate telecommunications wiring from other communication, speaker-microphone, line-level, speaker-level, and power wiring.

C. Comply with TIA/EIA-569-A rules for separating Category 6 telecommunications cabling from potential EMI sources. In no cases shall separation be less than 6 inches.

D. Run cables parallel to building structure. Do not install within roof decking pan.

E. Provide D ring, J-hook, and cable loop supports no farther apart than 4'-0" on center.

F. Provide service loop at each outlet. Service loop shall be concealed, 10" nominal diameter with Velcro type fastener, 60" slack minimum.

G. Provide service loops for each horizontal and backbone cable at telecommunication nodes. Include 10 feet for copper systems minimum and 25 feet for fiber systems minimum, provide cable management for service loop before dropping to rack or wall field. Train conductors to terminal points with no excess. Install cable tray waterfall drop-out fittings and lacing bars to restrain cables, to prevent straining connections, and to prevent bending cable to smaller radius than minimum recommended by manufacturer.

3.6 IDENTIFICATION

A. Identify system components complying with applicable requirements of EIA/TIA.

B. Label cables within outlet boxes.

C. Label each jack at workstation faceplate. Align labels over jack served. Labels shall be typed, handwritten label shall not be allowed.

D. Cables, General: Label each cable within 4 inches of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.

E. All labeling nomenclature shall comply with Owner standards, coordinate with Owner. Submit proposed labeling scheme for approval prior to installation.

F. Distribution Racks and Frames: Label each unit and field within that unit with engraved plaque.

G. Connector Fields: Label each connector and each discrete unit of cable-terminating and connecting hardware.

H. Cable Administration Drawings: Show building floor plans with cable administration point labeling. Identify labeling convention and show labels for telecommunications closets, horizontal cables, terminal hardware and positions, work areas and workstation terminal positions. Furnish electronic record of all drawings, in software and format selected by the Owner. Drawings shall be electronically generated, no hand-written documentation shall be acceptable. Protect with finished rigid frame and clear plastic cover and mount in each telecommunications closet.

I. Cable Plant Drawings: Show incoming utilities, backbone cables and their designations, origins, and destinations. For each cable, list the manufacturer, part number, conductor size, pair count, type, and cable rating. Show telecommunications closets, entrance pathways, and spare conduit. Furnish electronic record of all drawings, in software and format selected by the Owner. Drawings shall be electronically

generated, no hand-written documentation shall be acceptable. Protect with finished rigid frame and clear plastic cover and mount in each telecommunications node.

J. Permanently label all underground duct and raceway entrances with location served.

3.7 FIELD QUALITY CONTROL

A. Testing: On installation of cable and connectors, demonstrate product capability and compliance with requirements. Test each signal path for end-to-end performance from each end of all pairs installed. Remove temporary connections when tests have been satisfactorily completed.

1. Certify all cable performance in accordance with industry standards. Provide a report that indicates all cable lengths, attenuations, and near end cross talks.
2. Prepare test reports in both electronic (original tester software format) and printed format. Arrange results by telecommunications room.

B. Copper Cable Procedures:

1. Utilize Category 6 tester calibrated within the past 6 months and properly configured for the cable tested. Test all cables.
2. Perform alien crosstalk measurements on each patch panel bundle of 24 cables per recommended procedure of tester manufacturer. Test the three (3) longest and the three (3) shortest cables in each bundle.

C. Fiber Optic Cable Procedures:

1. Test all cables, both ends. Total optical loss shall not exceed connector loss plus attenuation loss of cable calculated from cable specification and installed length. Test fiber using the 10GBASE-S test limit for the maximum model bandwidth capability of the fiber installed.
2. Test optical performance with specified tester at both 850nm and 1300nm with LED source.
3. Test optical performance with specified tester at both 850nm and 1300nm with VCSEL source.
4. Provide fiber end-face image.

D. Correct malfunctioning units at Project site, where possible, and retest to demonstrate compliance; otherwise, remove and replace with new units and retest.

E. Provide warranty certificate, manufacturer’s 20 year for voice data system.

F. Provide electronic copy of all test information and as built drawings.

3.8 CLEANING

A. After completing system installation, including outlet fittings and devices, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION 268080

SECTION 311000 - SITE CLEARING

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 DEFINITIONS

A. Subsoil: All soil beneath the topsoil layer of the soil profile, and typified by the lack of organic matter and soil organisms.

B. Surface Soil: Soil that is present at the top layer of the existing soil profile at the Project site. In undisturbed areas, the surface soil is typically topsoil; but in disturbed areas such as urban environments, the surface soil can be subsoil.

C. Topsoil: Top layer of the soil profile consisting of existing native surface topsoil or existing in-place surface soil and is the zone where plant roots grow. Its appearance is generally friable, pervious, and black or a darker shade of brown than the underlying subsoil; reasonably free of subsoil, clay lumps, gravel, and other objects more than 2 inches in diameter; and free of subsoil and weeds, roots, rocks, toxic materials, or other non-soil materials.

D. Plant-Protection Zone: Area surrounding individual trees, groups of trees, shrubs, or other vegetation to be protected during construction, and indicated on Drawings.

E. Tree-Protection Zone: Area surrounding individual trees or groups of trees to be protected during construction, and defined by a circle concentric with each tree with a radius 1.5 times the diameter of the drip line unless otherwise indicated.

F. Vegetation: Trees, shrubs, groundcovers, grass, and other plants.

1.3 MATERIAL OWNERSHIP

A. Except for stripped topsoil and other materials indicated to be stockpiled or otherwise remain Owner's property, cleared materials shall become Contractor's property and shall be removed from Project site.

1.4 SUBMITTALS

A. Existing Conditions: Documentation of existing trees and plantings, adjoining construction, and site improvements that establishes preconstruction conditions that might be misconstrued as damage caused by site clearing.

1. Use sufficiently detailed photographs or videotape.

a. Photograph all existing structures near the vicinity of new construction.
b. Photograph any existing cracks or structural deficiencies of existing structures.

2. Include plans and notations to indicate specific wounds and damage conditions of each tree or other plants designated to remain.

B. Record Drawings: Identifying and accurately showing locations of capped utilities and other subsurface structural, electrical, and mechanical conditions.

C. Contractor's Certification form for the SDDENR Permit for Stormwater Discharges Associated with Construction Activities and related SWPPP.

D. Product Data and Manufacturer's installation instructions for erosion control blanket, and all erosion control products.

1.5 QUALITY ASSURANCE

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

1.6 PROJECT CONDITIONS

A. Traffic: Minimize interference with adjoining roads, streets, walks, and other adjacent occupied or used facilities during site-clearing operations.

1. Do not close or obstruct streets, walks, or other adjacent occupied or used facilities without permission from Owner and authorities having jurisdiction.
2. Provide alternate routes around closed or obstructed traffic ways if required by Owner or authorities having jurisdiction.

B. Salvable Improvements: Carefully remove items indicated to be salvaged and store on Owner's premises at location directed by Owner.

C. Utility Locator Service: Notify South Dakota One Call for area where Project is located before site clearing.

D. Do not commence site clearing operations until temporary erosion- and sedimentation-control and tree and plant-protection measures are in place.

E. The following practices are prohibited within tree protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

F. Do not direct vehicle or equipment exhaust towards protection zones.

G. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

H. Soil Stripping, Handling, and Stockpiling: Perform only when the topsoil is dry or slightly moist.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Satisfactory Soil Material

1. Obtain approved borrow soil material off-site when satisfactory soil material is not available on-site.

B. Erosion Control Blanket

1. Wood fiber, dyed green, double netting.

a. Curlex II by American Excelsior or equal.

C. Turf Reinforcement Mat

1. 100% Recycled Post Consumer Polyester Fiber, Polypropylene Netting, Polyrophylene stitching thread.

a. Recyclex TRM by American Excelsior or equal.

D. Stabilization Mat

1. Semi-rigid polymer mat

a. Scourstop by Landmark Earth Solutions, Inc. or equal.

E. Temporary Seed Mix: Annual Rye Grass.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect and maintain benchmarks and survey control points from disturbance during construction.

B. Locate and clearly identify trees, shrubs, and other vegetation to remain.

C. Protect existing site improvements to remain from damage during construction.

1. Restore damaged improvements to their original condition, as acceptable to Owner.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Owner has applied for and obtained coverage under the SDDENR General Permit for Stormwater Discharge Associated with Construction Activities.

1. Contractor shall adhere to the requirements of the permit until project closeout.

B. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to requirements of authorities having jurisdiction.

C. Install all erosion control products according to manufacturer’s instructions.

D. Verify that flows of water redirected from construction areas or generated by construction activity do not enter or cross protection zones.

E. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until

permanent vegetation has been established.

1. SDDENR requires the site to be inspected every week and within 24 hrs after a rain event.
2. Maintain records of inspection.

F. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

G. Clean all storm sewer pipe that receives runoff from site free of any silt, dirt or debris at the end of project.

H. Erosion control requirements in addition to the Stormwater Permit requirements.

1. Provide 4’ wide erosion control blanket along perimeter of all pavements, walks, and buildings.

a. Do not install in areas where plantings or landscaping is indicated.

2. Provide erosion control blanket on all slopes that are 6H:1V or steeper.
3. Provide inlet protection for all Stormwater inlets that receive runoff from site.

a. Provide 8’ x 8’ erosion control blanket around each inlet.

4. Seed disturbed areas that will remain idle for 2 weeks or longer with temporary seed mixture.
5. Provide erosion control measures before erosion occurs.

3.3 TREE PROTECTION

A. General: Protect trees and plants indicated to remain on-site.

B. Repair or replace trees, shrubs, and other vegetation indicated to remain or be relocated that are damaged by construction operations, in a manner approved by Architect.

3.4 EXISTING UTILITIES

A. Locate, identify, and disconnect utilities indicated to be remove or abandoned in place.

1. Seal or cap utility at removal limits.

B. Interrupting Existing Utilities: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility services according to requirements indicated:

1. Notify Architect and Owner not less than 72 hours in advance of proposed utility interruptions.
2. Do not proceed with utility interruptions without Owner's written permission.

C. Excavate for and remove underground utilities indicated to be removed.

3.5 CLEARING AND GRUBBING

A. Remove obstructions, trees, shrubs, and other vegetation to permit installation of new construction.

1. Do not remove trees, shrubs, and other vegetation indicated to remain or to be relocated.
2. Completely remove stumps and roots.

B. Fill depressions caused by clearing and grubbing operations with satisfactory soil material unless further excavation or earthwork is indicated.

1. Place fill material in horizontal layers not exceeding a loose depth of 8 inches, and compact each layer to a density equal to adjacent original ground.

3.6 TOPSOIL STRIPPING

A. Remove sod and grass before stripping topsoil.

B. Strip topsoil to minimum depth of 6 inches (150 mm) in a manner to prevent intermingling with underlying subsoil or other waste materials.

1. Remove subsoil and nonsoil materials from topsoil, including clay lumps, gravel, and other objects more than 2 inches in diameter; trash, debris, weeds, roots, and other waste materials.

C. Stockpile topsoil away from edge of excavations without intermixing with subsoil. Grade and shape stockpiles to drain surface water. Prevent windblown dust and erosion by water.

1. Do not stockpile topsoil within protection zones.
2. Stockpile surplus topsoil to allow for respreading deeper topsoil.

3.7 SITE IMPROVEMENTS

A. Remove existing above- and below-grade structures and utilities as indicated and necessary to facilitate new construction.

B. Remove slabs, paving, curbs, gutters, and aggregate base as indicated.

1. Unless existing full-depth joints coincide with line of demolition, neatly saw-cut along line of existing pavement to remain before removing adjacent existing pavement. Saw-cut faces vertically.

3.8 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Remove surplus soil material, obstructions, demolished materials, and waste materials including trash and debris, and legally dispose of them off Owner's property.

1. All topsoil to remain property of the Owner.

2. Surplus topsoil shall be hauled and stockpiled on Owner’s property at 1996 N. University Street, Vermillion, SD.

B. Separate recyclable materials produced during site clearing from other nonrecyclable materials. Store or stockpile without intermixing with other materials and transport them to recycling facilities. Do not interfere with other Project work.

END OF SECTION 311000

SECTION 312000 - 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. Geotechnical Exploration report #12-927, prepared by GeoTek, December 6, 2012.

1. Owner is not responsible for interpretations or conclusions drawn from this data. Report is available for information purposes only.

1.2 SUMMARY

A. Section Includes:

1. Preparing subgrades for slabs-on-grade, walks, pavements, turf and grasses and plants.
2. Excavating and backfilling for buildings and structures.
3. Drainage course for concrete slabs-on-grade.
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.

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. Drainage Course: Aggregate layer supporting the slab-on-grade that also minimizes upward capillary flow of pore water.

F. 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 Geotechnical Engineer. 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 Geotechnical Engineer. Unauthorized excavation, as well as remedial work directed by Geotechnical Engineer, shall be without additional compensation.

G. Fill: Soil materials used to raise existing grades.

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 INFORMATIONAL SUBMITTALS

A. Results of Special Inspections:

1. Subgrade Inspection and proof roll observation results.
2. Fill material inspection.

B. Pre-excavation 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. Submit before earth moving begins.

1.5 QUALITY ASSURANCE

A. Geotechnical Testing Agency Qualifications: Qualified according to ASTM E 329 and ASTM D 3740 for testing indicated.

B. Pre-excavation Conference: Conduct conference at Project site.

1.6 PROJECT 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.

B. Utility Locator Service: Notify utility locator service for area where Project is located before beginning earth moving operations.

C. Do not commence earth moving operations until temporary erosion- and sedimentation-control measures, specified in Section 311000 "Site Clearing," are in place.

D. The following practices are prohibited within protection zones:

1. Storage of construction materials, debris, or excavated material.
2. Parking vehicles or equipment.
3. Foot traffic.
4. Erection of sheds or structures.
5. Impoundment of water.
6. Excavation or other digging unless otherwise indicated.
7. Attachment of signs to or wrapping materials around trees or plants unless otherwise indicated.

E. Do not direct vehicle or equipment exhaust towards protection zones.

F. Prohibit heat sources, flames, ignition sources, and smoking within or near protection zones.

PART 2 - PRODUCTS

2.1 SOIL MATERIALS

A. General: Provide borrow soil materials when sufficient satisfactory soil materials are not available from excavations.

B. Satisfactory Soils: Soil Classification Groups GC, SC, CL, GW, GP, GM, SW, SP, and SM according to ASTM D 2487 Groups A-1, A-2-4, A-2-5, and A-3 according to AASHTO M 145, or a combination of these groups; free of rock or gravel larger than 3 inches (75 mm) in any dimension, debris, waste, frozen materials, vegetation, and other deleterious matter.

1. Liquid Limit: 45 or less.

C. Unsatisfactory Soils: Soil Classification Groups ML, OL, CH, MH, OH, and PT according to ASTM D 2487 Groups A-2-6, A-2-7, A-4, A-5, A-6, and A-7 according to AASHTO M 145, or a combination of these groups.

1. Unsatisfactory soils also include satisfactory soils not maintained within 2 percent of optimum moisture content at time of compaction.

D. Clay Subbase Material: Imported non-organic lean clay having a liquid limit of 45 or less and a plasticity index between 16 and 28, and approved for use by the Geotechnical Engineer. Clay fill materials used for structural fill must be within +/- 2 percent of optimum moisture content at the time of placement.

E. Granular Base Course: Imported naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; complying with ASTM D 2940 and the requirements of Section 882 of the South Dakota Department of Transportation Standard Specifications for Roads and Bridges.

F. Gravel Cushion: Comply with Sections 260 and 882 in the SDDOT Standard Specifications (Current Edition) for material, quality and placement.

G. Granular Engineered Fill: Imported pit-run or processed sand or gravel having a maximum particle size of 3 inches and not more than 15 percent by weight passing a No. 200 (0.075-mm) sieve.

H. Clay Fill: Non-organic lean clay having a liquid limit of 45 or less and a plasticity index between 16 and 28, and approved for use by the Geotechnical Engineer. Clay fill materials used for structural fill must be within +/- 2 percent of optimum moisture content at the time of placement.

I. Drainage Rock: Crushed quartzite complying with the following gradation: 95-100% passing a 1-inch sieve; 25-60% passing a ½-inch sieve; 0-10% passing a #4 sieve; 0-5% passing a #8 sieve.

1. Application: Drainage rock should be placed directly beneath all footings in minimum thickness of 12 inches, as directed by the Geotechnical Company.

J. Drainage Course (Under Slabs): Imported fill material consisting of free-draining granular material with a maximum particle size of 1-inch and less than 10 percent by weight passing the No. 200 (0.075-mm) sieve.

1. Application: Drainage course should be placed directly beneath all floor slabs in minimum thickness of 12 inches, as directed by the Geotechnical Company.

K. Bedding Course: Naturally or artificially graded mixture of natural or crushed gravel, crushed stone, and natural or crushed sand; ASTM D 2940; except with 100 percent passing a 1-inch (25-mm) sieve and not more than 8 percent passing a No. 200 (0.075-mm) sieve.

L. Filter Material: Narrowly graded mixture of natural or crushed gravel, or crushed stone and natural sand; ASTM D 448; coarse-aggregate grading Size 67; with 100 percent passing a 1-inch (25-mm) sieve and 0 to 5 percent passing a No. 4 (4.75-mm) sieve.

M. Sand: ASTM C 33; fine aggregate.

N. Impervious Fill: Clayey gravel and sand mixture capable of compacting to a dense state.

PART 3 - EXECUTION

3.1 PREPARATION

A. Protect structures, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, undermining, washout, and other hazards created by earth moving operations.

B. Protect and maintain erosion and sedimentation controls during earth moving operations.

C. Protect subgrades and foundation soils from freezing temperatures and frost. Remove temporary protection before placing subsequent materials.

3.2 TEMPORARY EROSION AND SEDIMENTATION CONTROL

A. Provide temporary erosion- and sedimentation-control measures to prevent soil erosion and discharge of soil-bearing water runoff or airborne dust to adjacent properties and walkways, according to erosion- and sedimentation-control Drawings and requirements of authorities having jurisdiction.

B. Inspect, maintain, and repair erosion- and sedimentation-control measures during construction until permanent vegetation has been established.

C. Remove erosion and sedimentation controls and restore and stabilize areas disturbed during removal.

3.3 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.

3.4 EXPLOSIVES

A. Explosives: Do not use explosives.

3.5 EXCAVATION, GENERAL

A. Unclassified Excavation: Excavate to subgrade elevations regardless of the character of surface and subsurface conditions encountered. Unclassified excavated materials may include rock, soil materials,

and obstructions. No changes in the Contract Sum or the Contract Time will be authorized for rock excavation or removal of obstructions.

1. If excavated materials intended for fill and backfill include unsatisfactory soil materials and rock, replace with satisfactory soil materials.
2. Remove rock to lines and grades indicated to permit installation of permanent construction without exceeding the following dimensions:

    a. 24 inches (600 mm) outside of concrete forms other than at footings.
    b. 12 inches (300 mm) outside of concrete forms at footings.
    c. 6 inches (150 mm) outside of minimum required dimensions of concrete cast against grade.
    d. Outside dimensions of concrete walls indicated to be cast against rock without forms or exterior waterproofing treatments.
    e. 6 inches (150 mm) beneath bottom of concrete slabs-on-grade.
    f. 6 inches (150 mm) beneath pipe in trenches, and the greater of 24 inches (600 mm) wider than pipe or 42 inches (1065 mm) wide.

3.6 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.

B. Excavation under Building Slabs: Reference requirements described in soil reports GeoTek #12-927, dated December 6, 2012, as prepared by GeoTek Engineering & Testing Services, Inc. - attached to the end of this Section; comply with requirements specified within Section 312000. Soil reports are included for Contractor reference only.

C. Backfill: Backfill around exterior perimeter of foundations with approved clean, non-organic and non- expansive lean clay materials. Compact exterior backfill in non-structural areas (such as lawn and landscaping) within 15 feet of the structure to a density of at least 95 percent of Standard Proctor (ASTM D698); non-structural areas greater than 15 feet from the structure should be compacted to 92 percent of Standard Proctor (ASTM D698). Compact backfill in areas of pavement or sidewalks to at least 97 percent of Standard Proctor. Slope finished grades away from the perimeter of the structure to provide positive drainage. Drying/conditioning of on-site fill materials may be necessary in order to achieve specified compaction levels; backfill shall be placed at a moisture content between +/-2%, as determined by Standard Proctor.

D. Excavations at Edges of Tree- and Plant-Protection Zones:

1. Excavate by hand to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.

3.7 EXCAVATION FOR WALKS AND PAVEMENTS

A. Excavate surfaces under walks and pavements to indicated lines, cross sections, elevations, and subgrades.

B. Unless indicated otherwise, excavate surfaces under walks and equipment pads to a minimum depth of 6 inches below existing grade. Scarify exposed subgrades to a minimum depth of 8 inches and re-compact to not less than 97 percent of Standard Proctor; provide a minimum of 6 inches of base course material under slabs, unless indicated otherwise on Drawings.

1. Where necessary, raise subgrades to design elevations with non-organic lean clay having a liquid limit less than 45; fill soils should be within +/- 2 percent of optimum water content. Compact fill materials to not less than 97 percent of Standard Proctor.

3.8 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: 12 inches (300 mm) each side of pipe or conduit.

C. 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.

D. Trenches in Tree- and Plant-Protection Zones:

1. Hand-excavate to indicated lines, cross sections, elevations, and subgrades. Use narrow-tine spading forks to comb soil and expose roots. Do not break, tear, or chop exposed roots. Do not use mechanical equipment that rips, tears, or pulls roots.
2. Do not cut main lateral roots or taproots; cut only smaller roots that interfere with installation of utilities.

3.9 SUBGRADE INSPECTION

A. Notify Geotechnical Engineer when excavations have reached required subgrade.

B. If Geotechnical Engineer 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, repeating proof-rolling in direction perpendicular to first 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 Geotechnical Engineer, 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 Geotechnical Engineer, without additional compensation.

3.10 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 Geotechnical Engineer.

1. Fill unauthorized excavations under other construction, pipe, or conduit as directed by Geotechnical Engineer.

3.11 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.

3.12 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 and 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.

C. Backfill shall not be placed against structures until at least 7 days after placing concrete and then only after tests have established that concrete has attained sufficient strengths to withstand pressures induced from backfill.

D. Backfill for exterior foundation for the frost-depth footings of slab-on-grade structures:

1. Backfill exterior foundations with satisfactory soils or non-organic clay soils having a liquid limit less than 45.

2. If granular soils are used, cap with 1 to 2 feet of Impervious Fill in areas that will not be hard surfaced.
3. Place backfill evenly on both sides of foundation wall.

E. Backfill for below-grade walls:

1. Backfill below-grade walls with Sand Backfill.
2. Cap with 1 to 2 feet of Impervious Fill in areas that will not be hard surfaced.
3. Sand Backfill zone to extend a minimum of 2 feet outside the bottom of the wall and extend upward and outward to a slope no steeper than 1:1.
4. Brace walls to prevent damage to the walls.

3.13 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 and within 18 inches of bottom of footings with satisfactory soil; fill with concrete to elevation of bottom of footings. Concrete is specified in Division 03 Section "Cast-in-Place Concrete".

D. Backfill voids with satisfactory soil while removing shoring and bracing.

E. Place and compact initial backfill of subbase material, 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.

1. 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.

F. Place and compact final backfill of satisfactory soil to final subgrade elevation.

3.14 SOIL FILL

A. Plow, scarify, bench, or break up sloped surfaces steeper than 1 vertical to 4 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 granular engineered fill or (approved) lean clay.
3. Under steps and ramps, use granular engineered fill.
4. Under building slabs, use granular engineered fill or (approved) lean clay.
5. Under footings and foundations, use granular engineered fill.

C. Place soil fill on subgrades free of mud, frost, snow, or ice.

3.15 SOIL MOISTURE CONTROL

A. Uniformly moisten or aerate subgrade and each subsequent fill or backfill soil layer before compaction to within 2 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 2 percent and is too wet to compact to specified dry unit weight.

3.16 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 structures, building slabs, steps, and pavements, scarify and recompact top 8 inches of existing subgrade and each layer of backfill or fill soil material at 97 percent, unless indicated otherwise.
2. Compact each layer of fill below footings to not less than 100 percent.
3. Compact each layer of fill below floor slabs to not less than 95 percent.
4. Under walkways, scarify and recompact top 8 inches below subgrade and compact each layer of backfill or fill soil material at 97 percent.
5. Under turf or unpaved areas, scarify and recompact top 8 inches below subgrade and compact each layer of backfill or fill soil material at 95 / 92 percent, as indicated.
6. For utility trenches, compact each layer of initial and final backfill soil material at 92 percent.

3.17 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 required elevations within the following tolerances:

1. Turf or Unpaved Areas: Plus or minus 1 inch (25 mm).
2. Walks: Plus or minus 1 inch (25 mm).
3. 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.

3.18 SUBSURFACE DRAINAGE

A. Drainage Backfill: Place and compact filter material over subsurface drain, in width indicated, to within 12 inches (300 mm) of final subgrade, in compacted layers 6 inches (150 mm) thick. Overlay drainage backfill with one layer of subsurface drainage geotextile, overlapping sides and ends at least 6 inches (150 mm).

1. Compact each filter material layer to 85 percent of maximum dry unit weight according to ASTM D 698, with a minimum of two passes of a plate-type vibratory compactor.
2. Place and compact impervious fill over drainage backfill in 6-inch- (150-mm-) thick compacted layers to final subgrade.

3.19 SUBBASE AND BASE COURSES UNDER PAVEMENTS AND WALKS

A. Place subbase course and base course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place subbase course and base course under pavements and walks as follows:

1. Place base course material over subbase course under hot-mix asphalt pavement.
2. Shape subbase course and base course to required crown elevations and cross-slope grades.
3. Place subbase course and base course 6 inches (150 mm) or less in compacted thickness in a single layer.
4. Place subbase course and base course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
5. Compact subbase course and base course at optimum moisture content to required grades, lines, cross sections, and thickness to not less than 97 percent of maximum dry unit weight according to ASTM D 698.

3.20 DRAINAGE COURSE UNDER CONCRETE SLABS-ON-GRADE

A. Place drainage course on subgrades free of mud, frost, snow, or ice.

B. On prepared subgrade, place and compact drainage course under cast-in-place concrete slabs-on-grade as follows:

1. Place drainage course that exceeds 6 inches (150 mm) in compacted thickness in layers of equal thickness, with no compacted layer more than 6 inches (150 mm) thick or less than 3 inches (75 mm) thick.
2. Compact each layer of drainage course to required cross sections and thicknesses to not

less than 95 percent of maximum dry unit weight according to ASTM D 698.

3.21 FIELD QUALITY CONTROL

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

1. Determine prior to placement of fill that site has been prepared in compliance with requirements.
2. Determine that fill material and maximum lift thickness comply with requirements.
3. Determine, at the required frequency, that in-place density of compacted fill complies with requirements.

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

C. Allow testing agency to inspect and test subgrades and each fill or backfill layer. Proceed with subsequent earth moving only after test results for previously completed work comply with requirements.

D. 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 Geotechnical Engineer.

E. Testing agency will test compaction of soils in place according to ASTM D 1556, ASTM D 2167, ASTM D 6938, and ASTM D 2937, as applicable. Tests will be performed at the following locations and frequencies:

1. Paved and Building Slab Areas: At subgrade and at each compacted fill and backfill layer, at least one test for every 2000 sq. ft. (186 sq. m) or less of paved area or building slab, but in no case fewer than three tests.
2. Foundation Wall Backfill: At each compacted backfill layer, at least one test for every 100 feet (30 m) 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 (46 m) or less of trench length, but no fewer than two tests.

F. When testing agency reports that subgrades, fills, or backfills have not achieved degree of compaction specified, scarify and moisten or aerate, or remove and replace soil materials to depth required; recompact and retest until specified compaction is obtained.

3.22 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 Geotechnical Engineer; reshape and recompact.

C. Where settling occurs before Project correction period elapses, remove finished surfacing, backfill with additional soil material, compact, and reconstruct surfacing.

1. Restore appearance, quality, and condition of finished surfacing to match adjacent

work, and eliminate evidence of restoration to greatest extent possible.

3.23 DISPOSAL OF SURPLUS AND WASTE MATERIALS

A. Transport surplus satisfactory soil to designated storage areas on Owner's property.

1. Stockpile or spread soil as directed by Geotechnical Engineer.

2. Remove waste materials, including unsatisfactory soil, trash, and debris, and legally dispose of them off Owner's property.

END OF SECTION 312000

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 East 50th Street North
Sioux Falls, South Dakota 57104
605-335-5512 Fax 605-335-0773

December 6, 2012

Office of State Engineer
523 East Capitol
Pierre, SD 57501

Attn: Gordon Hollenbeck

Subj: Geotechnical Exploration
Proposed DakotaDome, Athletic Area
HPER/DakotaDome Renovation – Track Complex
University of South Dakota
Vermillion, SD
OSE #R0612-02X/TRACK
GeoTek #12-927

This correspondence presents our written report of the geotechnical exploration for the referenced project. The preliminary information is dated November 21, 2012. We are transmitting an electronic copy of our report along with a copy as noted below.

We thank you for the opportunity of providing our services on this project, and look forward to working with you in the future. Should you have any questions regarding the project or report, please feel free to contact our office.

Respectfully submitted,

Ralph E. Lindner

Ralph E. Lindner, PE
Project Engineer

cc: Architecture Inc., Attn: Mitch Aldinger

GEOTECHNICAL EXPLORATION
PROPOSED DAKOTADOME, ATHLETIC AREA
HPER/DAKOTADOME RENOVATION – TRACK COMPLEX
VERMILLION, SOUTH DAKOTA

GEOTEK #12-927

INTRODUCTION

This report presents the results of the recent geotechnical exploration program for the proposed DakotaDome, Athletic Area for the HPER/DakotaDome Renovation – Track Complex in Vermillion, SD.

The scope of work as presented in this report is limited to the following:

1. To put down twelve test borings to gather data on the subsurface conditions for the proposed site.
2. To conduct field and laboratory tests to determine the engineering properties of the foundation soils.
3. To provide a written report for earthwork recommendations for design and construction.

FIELD DATA

Site Conditions

The area for the planned construction is located on the east side of University Avenue and south of Highway 50 by-pass on the north side of the USD campus. The site is grass covered and slopes to the north with elevation 1225' to 1222'.

Boring locations and elevations were provided in the field by Sayre Associates. A copy of the boring locations is attached.

Subsurface Conditions

Twelve test borings were put down to gather data on the subsurface conditions for the planned construction. The attached boring logs illustrate the soil conditions encountered at the test locations.

A review of the boring logs indicates a soil profile that consists of 1' to 4' of clay fill underlain by silty clay (loess) followed by lean clay (glacial till).

The consistency of the silty clay layer varied from soft to firm and the consistency of the lean clay was firm to stiff. The consistency and density of the soils are indicated by the N values (penetration resistance) shown on the boring logs.

Groundwater

Groundwater measurements were made at the boring locations and data is recorded on the boring logs. No measurement of groundwater was noted or upon completion of the borings.

Groundwater measurements may or may not be an accurate indication of the absence of groundwater at the depth explored Also, seasonal and yearly fluctuations of the water table may occur.

ENGINEERING REVIEW

Project Information

The project will consist of a multilane all-weather track, bleachers, press box and buildings for concession, storage and restroom facilities. Grade elevations for the track and floor elevations of the various buildings were not available at this time. For purposes of discussion this report, we are assuming that the floor elevation at the track level will be between elevation 1225' and 1226'. Footings will rest at frost depth, about 5' below the floor. Footing loads are expected to be light to moderate.

The above information and/or assumptions are important factors in our review and recommendations. If there are any additions or corrections to the above mentioned data, it is

necessary that you contact us so that we may review our recommendations with regards to the revised plans.

Analysis-Track

The test borings indicate a subgrade that is reasonably stable for support of the pavement section. No major soil correction is anticipated for structural support. However, some subgrade improvements are recommended to minimize the stress the pavement experiences from frost heave.

This process is achieved by replacing a depth of the frost susceptible clay soils with a low frost susceptible granular subbase. Specifications for granular subbase material are listed in the South Dakota DOT (882.2). Otherwise, pit-run sand and gravel may be considered suitable material.

The thickness of the granular subbase is mostly proportional to the reduction in frost heave. Subbase thickness of 12" to 24" is recommended for consideration for the project.

The subbase material should be placed in a similar manner as other structural fill. The fill should be placed in lifts not exceed 12" and receive a compaction level of at least 95 percent of maximum as determined by Standard Proctor (ASTM: D698).

The other option to the subbase material would be to use an exaggerated thickness of base course, such as recycled concrete. The result would be 18" to 24" of base course and no granular subbase.

It is advisable to have a cross slope of the clay subgrade such that a drain tile could be installed for collection of subsurface water. Drain tile would be installed along the inside edge of the track in the grass area in a slightly depressed depth outside the footprint of the pavement. Placement of a geotextile fabric over the clay subgrade is also an option.

For a section that consists of subbase and base course, a minimum 6" layer of base course is recommended. A recycled concrete or other materials meeting South Dakota DOT for quality and gradation should be used. Compaction of the base course should be at least 98 percent of Standard Proctor.

A pavement thickness in the range of 3" to 4" is recommended. Asphalt should be placed in two lifts. An asphalt mix with a proven quality should be used for the project. Otherwise, a mix design should be established. The mix should have a stability of at least 1,500 pounds and be compacted to at least 92 percent of theoretical maximum density (Marshal mix design – 50 blows).

Footings and Floor Slabs (Borings 7, 9, 10, 11 and 12)

Footings for the bleachers are expected to rest at a depth of 4' to 5' below grade and footings for the building at a depth of 5' below the floor. We recommended that the excavation of the footings extend through the clay fill exposing the natural silty clay and lean clay. Footings should be sized for a maximum allowable soil bearing pressure of 2,000 psf.

On a portion of the site at footing elevation the natural silty clay soils may have excessive moisture such that some over excavation will be needed. We anticipate a minimum over excavation depth would be 1' with replacement with a 1" concrete rock.

If the buildings are heated, we recommend that a minimum layer of 12" of compacted granular fill be provided beneath the slab. The fill should have a maximum size of 1" and no more than 10 percent passing the #200 sieve. Compaction level should reach at least 95 percent of Standard Proctor.

If the buildings are unheated the floors slabs will be susceptible to frost heave. If it is desired to minimize the effects of the frost heave, an over excavation of the frost susceptible clay subgrade should be provided with the replacement of low frost susceptible granular fill. Over excavation depths of up to 4' should be considered. Backfill material should consist of a relatively clean pit-run sand and gravel with a maximum size of 1" and no more than 10

percent passing the #200 sieve. Compaction level of this granular fill should reach 95 percent of Standard Proctor.

Exterior Backfill and Drainage

The majority of the on-site soils can be used for exterior backfill around foundations. Debris, organic or over size material should not be used. Exterior backfill soils are located in nonstructural areas, such as lawn or landscaping, should be compacted to at least 90

percent of Standard Proctor. Other backfill areas that would support drives or sidewalks could be compacted to at least 95 percent.

Finished grades around the perimeter of the structure should be sloped such that positive drainage away from the building is provided. Also, a system to collect and channel roof run-off waters away from the building is suggested.

Construction Monitoring and Testing

At the time of excavation, the soil conditions between the boring locations should be observed. Competent soil should be noted at and below the excavation prior to placement of fill or foundations.

Where fill is used for structural support, such as fill in the footing or floor slab area, a system of field density tests should be taken during placement to document proper compaction for uniform support.

STANDARD OF CARE

The recommendations and opinions presented in this report are in accordance with current engineering practices for this time and area. Other than this, no express or implied warranty is intended.

Because the area of the borings is small in relation to the entire site, and for other reasons, GeoTek does not guarantee continuity or warrant conditions between the soil borings.

REMARKS

The collected soil samples will be retained in our office for a period of thirty days after the date of this report and will then be discarded unless we are notified otherwise.

We trust that this report provides you with the necessary information for the project. Should you have any comments or questions, please feel free to contact our office.

GeoTek Engineering & Testing Services, Inc.

Ralph E. Lindner, PE
Project Engineer

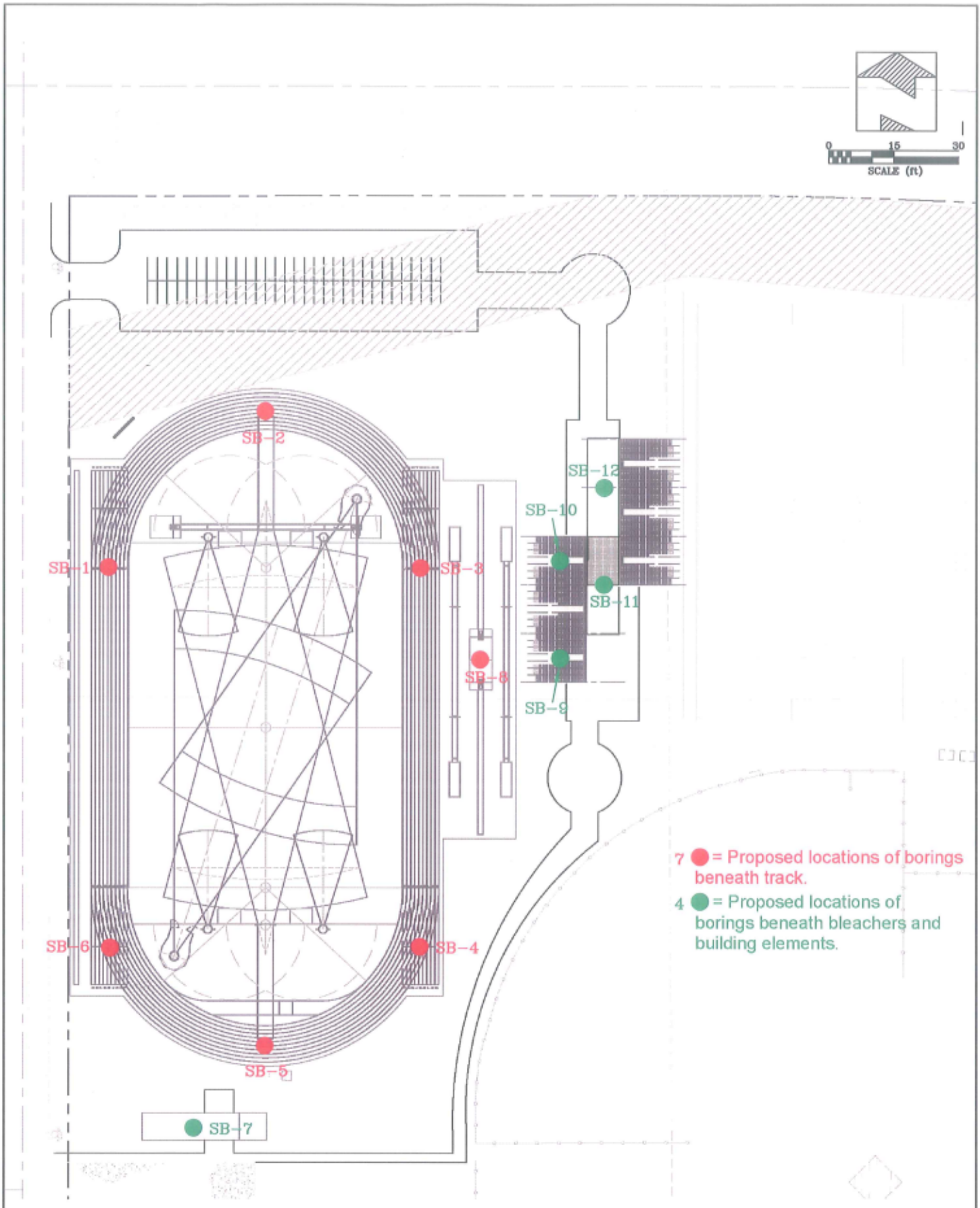


FIGURE 1
SOIL BORING LOCATION MAP
HPER/DAKOTADOME RENOVATION-TRACK COMPLEX, USD
VERMILLION, SD

ACAD\GEOTEK\RALPH\12-927

PROJECT#: 12-927

DRAWN BY:PAC CHECKED BY:

GEOTEK ENGINEERING & TESTING SERVICES, INC.

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th St. N.
Sioux Falls SD 57104
605-335-5512 Fax 605-335-0773
Slindner@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **12-927** BORING NO. **1 (1 of 1)**

PROJECT **DakotaDome, Athletic Area, HPER/DakotaDome Renovation-Track Complex, USD, OSE # R0612--02X/TRACK, Vermillion, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 1222.9 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
1	**FILL, MOSTLY LEAN CLAY**: dark brown, moist	FILL	12		1	SPT	17				
	SILTY CLAY: brown and gray mottled, moist, firm, (CL)	LOESS	6		2	SPT	22				
			6		3	SPT	26				
7	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm to stiff, (CL)	TILL	8		4	SPT					
			11		5	SPT					
11	Bottom of borehole at 11 feet.										

WATER LEVEL MEASUREMENTS

START 11-19-12 COMPLETE 11-19-12 4:00 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
11-19-12	4:00 pm	11	9.5	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 12-927.GPJ GEOTEKENG.GDT 12/7/12

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th St. N.
Sioux Falls SD 57104
605-335-5512 Fax 605-335-0773
Slindner@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **12-927** BORING NO. **2 (1 of 1)**

PROJECT **DakotaDome, Athletic Area, HPER/DakotaDome Renovation-Track Complex, USD, OSE # R0612--02X/TRACK, Vermillion, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 1223.8 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: very dark brown, moist	FILL	11		1	SPT	19				
2	**SILTY CLAY**: brown and gray mottled, moist, firm, (CL)	LOESS	6		2	SPT	19				
			7		3	SPT	26				
7	**SAND**: medium grained, brown, moist, medium dense, (SP)	COARSE ALLUVIUM	9		4	SPT					
9½	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	TILL	9		5	SPT					
11	Bottom of borehole at 11 feet.										

WATER LEVEL MEASUREMENTS

START 11-19-12 COMPLETE 11-19-12 3:38 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
11-19-12	3:38 pm	11	9.5	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 12-927.GPJ GEOTEKENG.GDT 12/7/12

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th St. N.
Sioux Falls SD 57104
605-335-5512 Fax 605-335-0773
Slindner@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **12-927** BORING NO. **3 (1 of 1)**

PROJECT **DakotaDome, Athletic Area, HPER/DakotaDome Renovation-Track Complex, USD, OSE # R0612--02X/TRACK, Vermillion, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 1223.8 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LAB WC	LAB D	LAB LL	LAB PL	LAB QU
	FILL, MOSTLY LEAN CLAY: a trace of sand, dark brown, moist	FILL	9		1	SPT	11				
			9		2	SPT	19				
4½	**SILTY CLAY**: brown and gray mottled, moist, firm to soft, (CL)	LOESS	5		3	SPT	28				
			3		4	SPT					
			3		5	SPT					
11	Bottom of borehole at 11 feet.										

WATER LEVEL MEASUREMENTS

START 11-19-12 COMPLETE 11-19-12 3:18 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
11-19-12	3:18 pm	11	9.5	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 12-927.GPJ GEOTEKENG.GDT 12/7/12

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th St. N.
Sioux Falls SD 57104
605-335-5512 Fax 605-335-0773
Slindner@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **12-927** BORING NO. **4 (1 of 1)**

PROJECT **DakotaDome, Athletic Area, HPER/DakotaDome Renovation-Track Complex, USD, OSE # R0612--02X/TRACK, Vermillion, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 1224.8 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: a trace of sand, dark brown, moist	FILL	12		1	SPT	12				
			10		2	SPT	19				
4½	**SILTY CLAY**: brown and gray mottled, moist, firm to soft, (CL)	LOESS	4		3	SPT	29				
			3		4	SPT					
			3		5	SPT					
11	Bottom of borehole at 11 feet.										

WATER LEVEL MEASUREMENTS

START 11-19-12 COMPLETE 11-19-12 5:46 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
11-19-12	5:56 pm	11	9.5	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 12-927.GPJ GEOTEKENG.GDT 12/7/12

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th St. N.
Sioux Falls SD 57104
605-335-5512 Fax 605-335-0773
Slindner@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **12-927** BORING NO. **5 (1 of 1)**

PROJECT **DakotaDome, Athletic Area, HPER/DakotaDome Renovation-Track Complex, USD, OSE # R0612--02X/TRACK, Vermillion, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 1225.3 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LAB WC	LAB D	LAB LL	LAB PL	LAB QU
	FILL, MOSTLY LEAN CLAY: a trace of sand, dark brown, moist	FILL	8		1	SPT	24				
			7		2	SPT	16				
3½	**SILTY CLAY**: brown and gray mottled, moist, firm to soft, (CL)	LOESS	5		3	SPT	28				
			2		4	SPT					
			3		5	SPT					
11	Bottom of borehole at 11 feet.										

WATER LEVEL MEASUREMENTS

START 11-19-12 COMPLETE 11-19-12 5:15 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
11-19-12	5:15 pm	11	9.5	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 12-927.GPJ GEOTEKENG.GDT 12/7/12

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th St. N.
Sioux Falls SD 57104
605-335-5512 Fax 605-335-0773
Slindner@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **12-927** BORING NO. **6 (1 of 1)**

PROJECT **DakotaDome, Athletic Area, HPER/DakotaDome Renovation-Track Complex, USD, OSE # R0612--02X/TRACK, Vermillion, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 1224.2 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	SILTY CLAY: brown and gray mottled, moist, firm, (CL)	LOESS	12		1	SPT	18				
			7		2	SPT	19				
			5		3	SPT	26				
7	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, firm, (CL)	TILL	5		4	SPT					
			8		5	SPT					
11	Bottom of borehole at 11 feet.										

WATER LEVEL MEASUREMENTS

START 11-19-12 COMPLETE 11-19-12 4:22 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
11-19-12	4:22 pm	11	9.5	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 12-927.GPJ GEOTEKENG.GDT 12/7/12

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th St. N.
Sioux Falls SD 57104
605-335-5512 Fax 605-335-0773
Slindner@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **12-927** BORING NO. **7 (1 of 1)**

PROJECT **DakotaDome, Athletic Area, HPER/DakotaDome Renovation-Track Complex, USD, OSE # R0612--02X/TRACK, Vermillion, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 1225.5 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LAB WC	LAB D	LAB LL	LAB PL	LAB QU
	FILL, MOSTLY LEAN CLAY: very dark brown, moist	FILL			1	HSA					
2	**SILTY CLAY**: a trace of gravel, brown and gray mottled, moist, firm, (CL)	LOESS	6		2	SPT	22				
			5		3	SPT	26				
7	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, firm to stiff, (CL)	TILL	7		4	SPT	25	99			2700
			9		5	SPT					
			10		6	SPT					
14½	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	TILL	14		7	SPT					
16	Bottom of borehole at 16 feet.										

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
11-19-12	4:52 pm	16	14.5	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

START 11-19-12 COMPLETE 11-19-12 4:52 pm

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 12-927.GPJ GEOTEKENG.GDT 12/7/12

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th St. N.
Sioux Falls SD 57104
605-335-5512 Fax 605-335-0773
Slindner@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **12-927** BORING NO. **8 (1 of 1)**

PROJECT **DakotaDome, Athletic Area, HPER/DakotaDome Renovation-Track Complex, USD, OSE # R0612--02X/TRACK, Vermillion, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 1223.8 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: a trace of sand, dark brown, moist	FILL	14		1	SPT	15				
2	**SILTY CLAY**: brown and gray mottled, moist, firm to soft, (CL)	LOESS	6		2	SPT	22				
			3		3	SPT	30				
			6		4	SPT	26				
9½	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	TILL	9		5	SPT					
11	Bottom of borehole at 11 feet.										

WATER LEVEL MEASUREMENTS

START 11-19-12 COMPLETE 11-19-12 2:52 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
11-19-12	2:52 pm	11	9.5	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 12-927.GPJ GEOTEKENG.GDT 12/7/12

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th St. N.
Sioux Falls SD 57104
605-335-5512 Fax 605-335-0773
Slindner@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **12-927** BORING NO. **9 (1 of 1)**

PROJECT **DakotaDome, Athletic Area, HPER/DakotaDome Renovation-Track Complex, USD, OSE # R0612--02X/TRACK, Vermillion, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 1224.2 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: a trace of sand, dark brown, moist	FILL			1	HSA					
2	**SILTY CLAY**: brown, moist, firm, (CL)	LOESS	5		2	SPT					
3½	**SILTY CLAY**: brown and gray mottled, moist, firm, (CL)	LOESS	5		3	SPT	28				
7	**LEAN CLAY**: a trace of gravel, brown and gray mottled, moist, firm, (CL)	TILL	6		4	SPT	25				
			6		5	SPT					
12	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm, (CL)	TILL	7		6	SPT					
			7		7	SPT					
16	Bottom of borehole at 16 feet.										

WATER LEVEL MEASUREMENTS

START 11-19-12 COMPLETE 11-19-12 11:14 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
11-19-12	5:56 pm	16	14.5	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 12-927.GPJ GEOTEKENG.GDT 12/7/12

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th St. N.
Sioux Falls SD 57104
605-335-5512 Fax 605-335-0773
Slindner@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **12-927** BORING NO. **10 (1 of 1)**

PROJECT **DakotaDome, Athletic Area, HPER/DakotaDome Renovation-Track Complex, USD, OSE # R0612--02X/TRACK, Vermillion, SD**

SURFACE ELEVATION 1224.1 ft

DEPTH in FEET	DESCRIPTION OF MATERIAL	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: a trace of sand, dark brown, moist	FILL			1	HSA					
2	**SILTY CLAY**: brown and gray mottled, moist, firm, (CL)	LOESS	6		2	SPT	24				
			5		3	SPT	29				
			5		4	SPT	27				
9½	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm to very stiff, (CL)	LOESS	5		5	SPT					
			11		6	SPT					
			18		7	SPT					
16	Bottom of borehole at 16 feet.										

WATER LEVEL MEASUREMENTS

START 11-19-12 COMPLETE 11-19-12 11:51 am

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
11-19-12	5:57 pm	16	14.5	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 12-927.GPJ GEOTEKENG.GDT 12/7/12

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th St. N.
Sioux Falls SD 57104
605-335-5512 Fax 605-335-0773
Slindner@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **12-927** BORING NO. **11 (1 of 1)**

PROJECT **DakotaDome, Athletic Area, HPER/DakotaDome Renovation-Track Complex, USD, OSE # R0612--02X/TRACK, Vermillion, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 1224.2 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: a trace of sand, dark brown, moist	FILL			1	HSA					
2	**SILTY CLAY**: brown and gray mottled, moist, firm to soft, (CL)	LOESS	5		2	SPT	19				
			4		3	SPT	30				
7	**LEAN CLAY WITH SAND**: a little gravel, mottled brown and gray, moist, firm, (CL)	TILL	7		4	SPT					
			7		5	SPT					
12	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	TILL	8		6	SPT					
			14		7	SPT					
16	Bottom of borehole at 16 feet.										

WATER LEVEL MEASUREMENTS

START 11-19-12 COMPLETE 11-19-12 12:38 pm

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
11-19-12	2:26 pm	16	14.5	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 12-927.GPJ GEOTEKENG.GDT 12/7/12

GEOTEK ENGINEERING
& TESTING SERVICES, INC.
909 E. 50th St. N.
Sioux Falls SD 57104
605-335-5512 Fax 605-335-0773
Slindner@geotekeng.com

GEOTECHNICAL TEST BORING LOG

GEOTEK # **12-927** BORING NO. **12 (1 of 1)**

PROJECT **DakotaDome, Athletic Area, HPER/DakotaDome Renovation-Track Complex, USD, OSE # R0612--02X/TRACK, Vermillion, SD**

DEPTH in FEET	DESCRIPTION OF MATERIAL (SURFACE ELEVATION 1224.3 ft)	GEOLOGIC ORIGIN	N	WL	SAMPLE NO.	SAMPLE TYPE	LABORATORY TESTS WC	D	LL	PL	QU
	FILL, MOSTLY LEAN CLAY: very dark brown, moist	FILL			1	HSA					
2	**SILTY CLAY**: brown and gray mottled, moist, firm, (CL)	LOESS	7		2	SPT	18				
4	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, firm, (CL)	TILL	7		3	SPT	23				
7	**LEAN CLAY WITH SAND**: a little gravel, brown, moist, stiff, (CL)	TILL	10		4	SPT					
			9		5	SPT					
			12		6	SPT					
			14		7	SPT					
16	Bottom of borehole at 16 feet.										

WATER LEVEL MEASUREMENTS

START 11-19-12 COMPLETE 11-19-12 2:14 pm

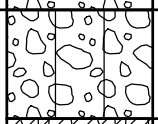
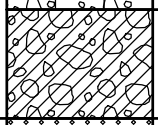
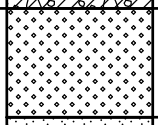
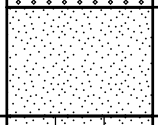
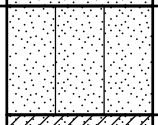
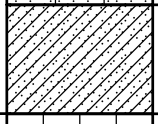
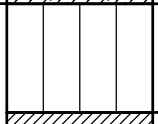
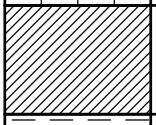
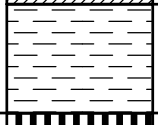
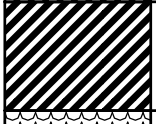
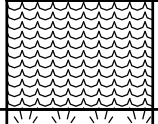
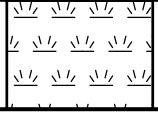
DATE	TIME	SAMPLED DEPTH	CASING DEPTH	CAVE-IN DEPTH	WATER LEVEL
11-19-12	2:27 pm	16	14.5	--	none
--	--	--	--	--	--
--	--	--	--	--	--
--	--	--	--	--	--

METHOD
3.25" ID Hollow Stem Auger

CREW CHIEF Mike Wagner

GEOTECHNICAL TEST BORING 12-927.GPJ GEOTEKENG.GDT 12/7/12

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			SYMBOLS		TYPICAL DESCRIPTIONS
			GRAPH	LETTER	
COARSE GRAINED SOILS MORE THAN 50% OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL - SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL - SAND - SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL - SAND - CLAY MIXTURES
	SAND AND SANDY SOILS MORE THAN 50% OF COARSE FRACTION PASSING ON NO. 4 SIEVE	CLEAN SANDS (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SAND, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND - SILT MIXTURES
				SC	CLAYEY SANDS, SAND - CLAY MIXTURES
FINE GRAINED SOILS MORE THAN 50% OF MATERIAL IS SMALLER THAN NO. 200 SIEVE SIZE	SILTS AND CLAYS	LIQUID LIMIT LESS THAN 50		ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS	LIQUID LIMIT GREATER THAN 50		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

NOTE: DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE SOIL CLASSIFICATIONS

BORING LOG SYMBOLS AND DESCRIPTIVE TERMINOLOGY

SYMBOLS FOR DRILLING AND SAMPLING

Symbol	Definition
Bag	Bag sample
CS	Continuous split-spoon sampling
DM	Drilling mud
FA	Flight auger; number indicates outside diameter in inches
HA	Hand auger; number indicates outside diameter in inches
HSA	Hollow stem auger; number indicates inside diameter in inches
LS	Liner sample; number indicates outside diameter of liner sample
N	Standard penetration resistance (N-value) in blows per foot
NMR	No water level measurement recorded, primarily due to presence of drilling fluid
NSR	No sample retrieved; classification is based on action of drilling equipment and/or material noted in drilling fluid or on sampling bit
SH	Shelby tube sample; 3-inch outside diameter
SPT	Standard penetration test (N-value) using standard split-spoon sampler
SS	Split-spoon sample; 2-inch outside diameter unless otherwise noted
WL	Water level directly measured in boring
▼	Water level symbol

SYMBOLS FOR LABORATORY TESTS

Symbol	Definition
WC	Water content, percent of dry weight; ASTM:D2216
D	Dry density, pounds per cubic foot
LL	Liquid limit; ASTM:D4318
PL	Plastic limit; ASTM:D4318
QU	Unconfined compressive strength, pounds per square foot; ASTM:D2166

DENSITY/CONSISTENCY TERMINOLOGY

Density Term	N-Value	Consistency Term
Very Loose	0-4	Soft
Loose	5-8	Firm
Medium Dense	9-15	Stiff
Dense	16-30	Very Stiff
Very Dense	Over 30	Hard

PARTICLE SIZES

Term	Particle Size
Boulder	Over 12”
Cobble	3” – 12”
Gravel	#4 – 3”
Coarse Sand	#10 – #4
Medium Sand	#40 – #10
Fine Sand	#200 – #40
Silt and Clay	passes #200 sieve

DESCRIPTIVE TERMINOLOGY

Term	Definition
Dry	Absence of moisture, powdery
Frozen	Frozen soil
Moist	Damp, below saturation
Waterbearing	Pervious soil below water
Wet	Saturated, above liquid limit
Lamination	Up to ½” thick stratum
Layer	½” to 6” thick stratum
Lens	½” to 6” discontinuous stratum

GRAVEL PERCENTAGES

Term	Range
A trace of gravel	2-4%
A little gravel	5-15%
With gravel	16-50%