A. Schedule: Only major areas are scheduled. Treat miscellaneous and similar items and areas within room or space with similar system.

B. Number of Coats: Where number of coats are specified, it is only as a minimum requirement. Apply additional coats, at no additional cost to Owner, if necessary to completely hide base material, produce uniform color, and provide satisfactory finish result.

C. Thickness of Coats: For each paint system product, provide the manufacturer's recommended mil-thickness for each applied coat.

D. Systems Specifications: These specifications are a guide and are meant to establish procedure and quality. Confer with Architect to determine exact finish desired.

E. Acceptance of Final Colors: Do not apply final coats of paint for either exterior and interior systems until colors have been reviewed and accepted by the Architect.

3.6 INTERIOR PAINT SYSTEMS (Systems are based on products by S-W; other manufacturers listed in Part Two may be used)

A. Interior Gypsum Board – Flat:

1. General: Provide as follows unless otherwise scheduled on Drawings or noted as follows in this Section.
2. Flat Finish — Low Odor Zero VOC System
3. Primer: ProMar 200 Zero VOC Interior Latex Primer, B28W2600, 0 g/L VOC
4. 1st coat: ProMar 200 Zero VOC Flat, B30-2600 series, 0 g/L VOC
5. 2nd coat: ProMar 200 Zero VOC Flat, B30-2600 series, 0 g/L VOC

B. Interior Gypsum Board – Eggshell/Satin:

1. General: Provide as follows unless otherwise scheduled on Drawings or noted as follows in this Section.
2. Primer: ProMar 200 Zero VOC Interior Latex Primer, B28W2600 0 g/L VOC
3. 1st coat: ProMar 200 Zero VOC Eg-Shel B26-2600 series, 0 g/L VOC
4. 2nd coat: ProMar 200 Zero VOC Eg-Shel B26-2600 series, 0 g/L VOC

C. Interior Gypsum Board – Semi-gloss:

1. General: Provide at stairs, service areas and where scheduled.
2. Primer: ProMar 200 Zero VOC Interior Latex Primer, B28W2600, 0 g/L VOC
3. 1st coat: ProMar 200 Zero VOC Semi-Gloss B31-2600 series, 0 g/L VOC
4. 2nd coat: ProMar 200 Zero VOC Semi-Gloss B31-2600 series, 0 g/L VOC

D. Interior Gypsum Board – Epoxy Coatings:

1. General: Provide at Restroom and other gypsum surfaces as scheduled on Drawings and required by the the governing Health Codes:
2. Eg-Shel Finish
    a. Primer: ProMar 200 Zero VOC Primer, B28W2600, 0 g/L VOC
    b. 1st coat: Pro Industrial Pre-Catalyzed Water-Based Epoxy Eg-Shel, K45 series, <150 g/L VOC
    c. 2nd coat: Pro Industrial Pre-Catalyzed Water-Based Epoxy Eg-Shel, K45 series, <150 g/L VOC
3. Semi-Gloss Finish (typical, unless noted otherwise)
    a. Primer: ProMar 200 Zero VOC Primer, B28W2600, 0 g/L VOC
    b. 1st coat: Pro Industrial Pre-Catalyzed Water-Based Epoxy Semi-Gloss, K46 series, <150 g/L VOC
    c. 2nd coat: Pro Industrial Pre-Catalyzed Water-Based Epoxy Semi-Gloss, K46 series, <150 g/L VOC
4. Gloss Finish
    a. Primer: ProMar 200 Zero VOC Primer, B28W2600, 0 g/L VOC
    b. 1st coat: Pro Industrial Zero VOC Water-Based Epoxy Gloss, B73-300 series, 0 g/L VOC
    c. 2nd coat: Pro Industrial Zero VOC Water-Based Epoxy Gloss, B73-300 series, 0 g/L VOC

E. Interior Ferrous Metal:

1. General: Shop and field-applied paint finishes for the Work of Section 050500 – Metal Fabrications, is included in the Scope of Work for those Sections.

2. For other exposed-to-view ferrous metal items, including items specified in DIVISION 23 – Mechanical; and DIVISION 26 – Electrical, provide the finishes as follow:

3. Bare Metal Items; High Performance Coating System: Mechanical and Electrical Piping, Conduits, Ductwork, Supports, Hangers, Machinery and Similar Items:
    a. Eg-Shel or Gloss Finish (Verify with Architect for each room / area prior to painting)
    b. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 series, <100 g/L VOC
    c. 1st coat: Pro Industrial Zero VOC Water-Based Epoxy Eg-Shel, B73-360 series or Gloss, B73-300 series, 0 g/L VOC
    d. 2nd coat: Pro Industrial Zero VOC Water-Based Epoxy Eg-Shel, B73-360 series or Gloss, B73-300 series, 0 g/L VOC

4. Shop Primed or painted (by others) Items; Semi-Gloss finish:
    a. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 series, <100 g/L VOC

b. 1st coat: Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650 series, 0 g/L VOC
c. 2nd coat: Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650 series, 0 g/L VOC

5. Shop Galvanized Items:

a. Galvanizing repair provided in Section 050500 – Metal Fabrications.
b. Galvanized Metal Decking & Ferrous Decking — Including Bar Joists
   i. Flat, Eg-Shel, or Semi-Gloss Finish
   ii. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 series, <100 g/L VOC
   iii. 1st coat: Low VOC Waterborne Acrylic Dryfall, Flat B42W81, Eg-Shel B42W82, Semi-Gloss, B42W83, All sheens <50 g/L VOC
   iv. 2nd coat: Low VOC Waterborne Acrylic Dryfall, Flat B42W81, Eg-Shel B42W82, Semi-Gloss, B42W83, All sheens <50 g/L VOC
c. Galvanized Metal Decking & Ferrous Decking — Including Bar Joists – High Performance System
   i. Primer: Pro Industrial Pro-Cryl Universal Primer, B66-310 series, <100 g/L VOC
   ii. 1st coat: Pro Industrial Multi-Surface Acrylic Eg-Shel, B66-560 series, <150 g/L VOC
   iii. 2nd coat: Pro Industrial Multi-Surface Acrylic Eg-Shel, B66-560 series, <150 g/L VOC

F. Interior Aluminum and Copper:

1. Refer to Section 076200 – Flashing and Sheet Metal for shop and field-applied paint finishes specified in those Sections.

2. Mechanical and Electrical Items:
   a. Pretreatment: Metal Pretreatment.
   b. 1st Coat: Aluminum Primer. Provide additional general purpose sealer coat when recommended by paint manufacturer.
   c. 2nd Coat: Acrylic Paint, Semi-Gloss.
   d. 3rd Coat: Acrylic Paint, Semi-Gloss.

G. Interior Wood:

1. General: Transparant Finishes are specified and provided in Section 064123 Interior Architectural Woodwork
2. Semi-Gloss Finish — Low Odor Zero VOC System

3. Primer: ProMar 200 Zero VOC Primer, B28W2600, 0 g/L VOC
4. 1st coat: Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650 series, 0 g/L VOC
5. 2nd coat: Pro Industrial Zero VOC Acrylic Semi-Gloss, B66-650 series, 0 g/L VOC

H. Interior Mechanical Insulation; Finish Varies:

1. Provide finish materials recommended in writing by the mechanical insulation manufacturer for their products in exterior locations. Adapt the following as required.

   a. 1st Coat: General Purpose PVA Sealer, or as recommended by the insulation manufacturer.

   b. 2nd Coat: Match adjacent finish system.

I. Miscellaneous Interior Painting Systems:

1. Ductwork at Grilles and Diffusers:

   a. Apply interior surfaces of ductwork partially visible through grilles and diffusers.

   b. 1st Coat: Galvanized Metal Primer.

   c. 2nd Coat: Acrylic Paint, Matte Black.

   d. 3rd Coat: Acrylic Paint, Matte Black.

2. Exposed Insulated Pipes and Ductwork:

   a. 1st Coat: 1 coat General Purpose PVA sealer. Omit sealer where glass fabric jackets are used.

   b. 2nd Coat: Acrylic Paint, match adjacent finish.

   c. 3rd Coat: Acrylic Paint, match adjacent finish.

3. Exposed Non-Insulated Pipes and Ductwork: Including conduit.

   a. Cast-Iron Pipe:

      1) Pre-treatment: Conform with the requirements of Section 050500 – Metal Fabrications.

      2) 1st Coat: Ferrous Metal Primer.

      3) 2nd Coat: Acrylic Paint, match adjacent finish.

4) 3rd Coat: Acrylic Paint, match adjacent finish.

b. Other Pipes, Conduit, and Ductwork:

1) Pre-treatment: Conform with the requirements of Section 050500 – Metal Fabrications.

2) 1st Coat: As specified for ferrous and non-ferrous metals as applicable.

3) 2nd Coat: Acrylic Paint, match adjacent finish.

4) 3rd Coat: Acrylic Paint, match adjacent finish.

J. Miscellaneous Interior Painting Systems:

1. Factory Finished Equipment: Satisfactorily refinish surfaces damaged before, during, or after installation as directed; use 128 semi-gloss enamel.

2. Plywood Equipment Backing:

a. General: Telephone, Data and Electric Closets.

b. 1st Coat: Latex Enamel Undercoater.

c. 2nd Coat: Acrylic Paint; match adjacent finish.

d. 3rd Coat: Acrylic Paint; match adjacent finish.

K. Pipe Identification:

1. General: Per ANSI A13.1; buried pipe, electrical conduit, and pipe in concealed spaces such as furred spaces and shafts not included.

2. Color Scheme: ANSI Z53.1 in combination with legend and flow markers; continuous total length coverage. Safety colors as specified under applicable Mechanical Section.

3. Legend: Stencil letters of colors, type, and sizes per ANSI A13.1. Tags for identification of pipes less than 3/4-inch overall outside diameter, including valves and fittings; provided under applicable mechanical Section.

4. Flow Markers: Provide each type with appropriate size arrows to indicate flow direction in pipe; same color as legend.

5. Visibility: Locate legend and flowmarkers for easy visibility from operating floor; space not over 20 feet with at least one per room.

3.8 CLEANING:

A. Comply with provisions of Section 017900 – Cleaning.

B. Remove paint spots, oil, and stains from adjacent surfaces upon completion of Work; leave Work clean.

END OF SECTION

SECTION 10 28 00– TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Work included: Provide and install toilet accessories as shown on Drawings and as specified, including:

1. Toilet & Bath accessories.

B. Work Specified Elsewhere:

1. Section 088000 –Glazing.

2. Section 092216 – Non-Structural Metal Framing.

3. Division 23 – Mechanical (Pipe Protection under Lavatories).

1.2 SUBMITTALS

A. Comply with provisions of Section 013300 – Submittal Procedures

B. Manufacturer's literature describing products.

C. Shop Drawings: Show methods of backing, installation, and fastening.

1.3 QUALITY ASSURANCE

A. Installed grab bars shall withstand 300 pounds downward pull.

B. Design, quality, capacity, function, and finish shall conform with manufacturer's descriptions corresponding to catalog numbers cited unless otherwise noted.

C. Provide the same keying for all locks of all accessory units specified.

1.4 DELIVERY, STORAGE AND HANDLING

A. Comply with requirements of Section 016000 – Product Requirements.

B. Deliver materials and products in original containers with seals unbroken and labels intact until time of use. Label shall identify accessory, catalog number and finish.

C. Store delivered products in clean, safe, dry area.

1.5 PROJECT CONDITIONS

A. Comply with requirements of Section 013100 – Project Management and Coordination.

B. Coordinate as required with work of other sections to ensure proper backing.

C. Sequencing, Scheduling: Do not install accessories until after completion of finish painting.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

General: Accessory items specified by Bobrick catalog numbers (Basis of Design).

A. Manufacturers: Subject to compliance with requirements, provide accessories by one of the following:
   1. Toilet and Bath Accessories:
      a. A & J Washroom Accessories, Inc.
      b. American Specialties, Inc.
      c. Bobrick Washroom Equipment, Inc.
      d. Bradley Corporation.
      e. Gamco.
      f. McKinney/Parker Washroom Accessories Corp.

2.2 PRODUCTS:

A. Grab Bars:

Provide heavy duty 18-guage, type 304 stainless steel grab bars complying with the following:

2. Products: Bobrick; B-5806, 18", 24", 36" & 42" grab bars as indicated on drawings.
3. Mounting: Concealed with manufacturer's standard flanges and anchors.
4. Gripping Surfaces: Smooth, satin finish.
5. Outside Diameter: 1-1/4 inches for heavy-duty applications.

B. Mirror Unit:

Provide mirror unit complying with the following:

1. Products: Bobrick; B-165, 24" x 36" without shelf.
2. Stainless-Steel, Channel-Framed Mirror: Fabricate frame from stainless-steel channels in manufacturer's standard satin or bright finish with square corners mitered to hairline joints and mechanically interlocked.

C. Robe Hooks:

1. Model B-6717; single robe hook; surface-mounted; Type 304, stainless steel with satin finish.

D. Toilet Paper Dispenser:

1. Model B-4288 Contura Series multi-roll dispenser; satin stainless steel finish.

E. Toilet Seat Cover Dispenser:

1. Model B-221 Surface-Mounted Toilet Seat Cover Dispenser; dispenses 250 single or half-fold seat covers; Type 304 stainless steel satin finish; fill from bottom through concealed opening.

F. Sanitary Napkin Disposal:

1. Model B-270; Contura series, surface mounted sanitary napkin dispenser with full-length piano hinge and hinged bottom with tumbler lock; type 304 stainless steel with satin finish.

G. Mop and Broom Holder:

1. Model B-223x36; anti-slip mop holders with spring-loaded rubber cam on steel retainers; surface-mounted; Type 304 satin finish stainless steel; 36 inches long.

H. Stainless Steel Shelf:

1. Model B-295 x16; 16" long X 5" wide, 18-gauge, type 304 stainless steel, satin finish, ¾" return edge; front edge hemmed for safety. Brackets 16-gauge

J. Baby Changing Station:

1. Koala Model KB200-01SS GREY Surface-Mounted Baby Quick Change; Polypropylene cabinet and bed with stainless steel veneer, 35 3/16 inches wide by 22 1/4 inches high by 4 inches deep.

K. Soap Dispenser:

1. Model B-2111 Surface-Mounted Vertical Soap Dispenser; holds 40 ounces of liquid soap; Type 304 stainless steel satin finish.

L. Paper Towel Dispenser:

1. Model B-262 Surface-Mounted Paper Towel Dispenser; Dispenses 400 C-fold or 525 multifold towels; Type 304 stainless steel satin finish.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine area to receive toilet or bath accessories and certify that:

1. Backing not included in work of this section is correct.

2. Surfaces are dry, clean, free from foreign matter, and otherwise proper for installation.

3. Toilet compartments or dressing rooms, to receive accessories have been properly installed and correctly prepared.

B. Do not begin work until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

A. Install accessories in accordance with approved manufacturer's recommendations.

B. Attach accessories securely to substantial backing, with concealed fastenings unless otherwise noted; insure true alignment.

C. Adjust as required for correct operation.

3.3 CLEANING AND ADJUSTMENTS

A. Comply with requirements of Section 017900 – Cleaning.

B. Adjust units as necessary to assure smooth, quiet operation without catching, binding or malfunctioning.

END OF SECTION

SECTION 10 42 50 - SIGNS

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 types of signs:
   1. Panel signs.
      a. Interior room identification signs.
      b. Handicap accessibility signage.
      c. Parking signs (handicapped).
      d. Handicap entry signs.
      e. Maximum occupancy load signs
   2. Dimensional letters and numbers.
   3. Building address.

1.3 SUBMITTALS

A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.

B. Product data for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

C. Shop drawings showing fabrication and erection of signs. Include plans, elevations, and large-scale sections of typical members and other components. Show anchors, grounds, layout, reinforcement, accessories, and installation details.
   1. Provide message list for each sign required, including large-scale details of wording and lettering layout.
   2. For signs supported by or anchored to permanent construction, provide setting drawings, templates, and directions for installation of anchor bolts and other anchors to be installed as a unit of Work in other Sections.
   3. Templates: Furnish full-size spacing templates for individually mounted dimensional letters and numbers.

D. Samples: Provide the following samples of each sign component for initial selection of color, pattern and surface texture as required and for verification of compliance with requirements indicated.
   1. Samples for initial selection of color, pattern, and texture:
      a. Cast Acrylic Sheet and Plastic Laminate: Manufacturer's color charts consisting of actual sections of material including the full range of colors available for each material required.

b. Aluminum: Samples of each finish type and color, on 6-inch-long sections of extrusions and not less than 4-inch squares of sheet or plate, showing the full range of colors available.

c. Cast Acrylic Sheet and Plastic Laminate: Provide a sample panel not less than 8-1/2 inches by 11 inches for each material, color, texture, and pattern required. On each panel include a representative sample of the graphic image process required, showing graphic style, and colors and finishes of letters, numbers, and other graphic devices.

1.4 QUALITY ASSURANCE

A. Sign Fabricator Qualifications: Firm experienced in producing signs similar to those indicated for this Project, with a record of successful in-service performance, and sufficient production capacity to produce sign units required without causing delay in the Work.

B. Single-Source Responsibility: For each separate sign type required, obtain signs from one source of a single manufacturer.

C. Handicapped Accessibility: Provide signs which are in conformance with the requirements of ANSI A117.1-1992 and the Americans with Disability Act of 1990 (ADA).

1.5 PROJECT CONDITIONS

A. Field Measurements: Take field measurements prior to preparation of shop drawings and fabrication to ensure proper fitting. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include, but are not limited to, the following:
   1. Manufacturers of Panel Signs:
      a. ABC Architectural Signing System.
      b. ASI Sign Systems, Inc.
      c. Best Manufacturing Company.
      d. Spanjer Brothers, Inc.
      e. Vomar Products, Inc.
   2. Manufacturers of Dimensional Letters:
      a. ASI Sign Systems, Inc.
      b. Metal Arts.
      c. Metallic Arts, Inc.
      d. Spanjer Brothers, Inc.
      e. Vomar Products, Inc.

2.2 MATERIALS

A. Cast Acrylic Sheet: Provide cast (not extruded or continuous cast) methyl methacrylate monomer plastic sheet, in sizes and thicknesses indicated, with a minimum flexural strength of 16,000 psi when tested according to ASTM D 790, with a minimum allowable continuous service temperature of 176 deg F and of the following general types:
   1. Opaque Sheet: Where sheet material is indicated as "opaque," provide colored opaque acrylic sheet in colors and finishes as selected from the manufacturer's standards.

B. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by the sign manufacturer for the casting process used and for the use and finish indicated.

C. Fasteners: Use concealed fasteners fabricated from metals that are not corrosive to the sign material and mounting surface.

D. Anchors and Inserts: Use nonferrous metal or hot-dipped galvanized anchors and inserts for exterior installations and elsewhere as required for corrosion resistance. Use toothed steel or lead expansion bolt devices for drilled-in-place anchors. Furnish inserts, as required, to be set into concrete or masonry work.

2.3 PANEL SIGNS

A. Panel Signs: Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes, and details of construction.
   1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally.

B. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished to conform with the following requirements:
   1. Edge Condition: Square cut.
   2. Corner Condition: Corners rounded.

C. Brackets: Fabricate brackets and fittings for bracket-mounted signs from extruded aluminum to suit sign panel construction and mounting conditions. Factory-paint brackets in a color matching the background color of the sign panel.

D. Raised Copy: Machine-cut copy characters from matte-finished opaque acrylic sheet and chemically weld onto the acrylic sheet forming sign panel face. Produce precisely formed characters with square cut edges free from burrs and cut marks.
   1. Panel Material: Matte-finished opaque acrylic sheet.
   2. Raised Copy Thickness: Not less than 1/32 inch.

E. Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers and other graphic devices.
   1. Provide signage indicating handicap entry at each set of entry doors into facility.
   2. Provide one wall mounted sign per door or set of doors throughout building.
      a. Provide signs with cutouts and removable inserts (maximum of two (2) per sign) with permanent ADA text.
   3. Provide maximum occupancy load signs in assembly rooms as required by code.

4. Building Address: Provide panel with letters and/or numbers as required. Attach to location as directed by Architect.

2.4 DIMENSIONAL LETTERS AND NUMBERS

A. Cast Letters and Numbers: Form individual letters and numbers by casting. Produce characters with smooth, flat faces, sharp corners, and precisely formed lines and profiles, free from pits, scale, sand holes, or other defects. Cast lugs into the back of characters and tap to receive threaded mounting studs. Comply with requirements indicated for finish, style, and size.
   1. Metal: Aluminum.
   2. Provide letters of size and style as indicated attached to front and back of building as directed by Architect.

B. Aluminum Castings: Provide aluminum castings of alloy and temper recommended by sign manufacturer for casting process used and for type of use and finish indicated.

C. Aluminum Finishes - Clear Anodic Finish: Manufacturer's standard clear anodic coating, 0.018 mm or thicker, over a satin (directionally textured mechanical finish).

2.5 EXTERIOR DIRECTIONAL AND PARKING SIGNS

A. Panel Signs: Comply with requirements indicated for materials, thickness, finishes, colors, designs, shapes, sizes, and details and construction.
   1. Produce smooth, even, level sign panel surfaces, constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally.

B. Steel Posts: 0.120-inch, galvanized, seamless, square steel posts in length adequate for mounting method specified. Include post caps, fillers, spacers, junction boxes, access panels, and related accessories required for a complete installation. Comply with the following requirements for post shape, finish, and mounting method indicated.
   1. Post Size: 2 by 2 inches square.
   2. Post Mounting Method: Provide sign posts of length required for permanent installation by direct-burial mounting method.

C. Sign Panels: Provide smooth, even, level sign panel surfaces constructed to remain flat under installed conditions within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.
   1. Unframed Single-Sheet Panels: Provide unframed single-sheet sign panels with edges mechanically and smoothly finished to conform to the following:
      a. Panel Material: 0.125 inch thick fiberglass sheet.
         1. Panel Finish: Manufacturer's standard semigloss finish with UV inhibitors.
      b. Edge Condition: Square cut.
      c. Corner Condition: Square corners.

D. Graphic Content and Style: Provide sign copy that complies with the requirements indicated for size, style, spacing, content, position, material, finishes, and colors of letters, numbers, and other graphic devices.

1. Copy Embedded in Fiberglass Panels: Apply computer-generated adhesive graphics to panel as a masking material. Apply acrylic polyurethane background-color flood coats, 0.015-inch minimum thickness. Include UV inhibitors. Remove masking materials.
   a. Provide signage indicating handicap parking at all handicap parking spaces.
   b. Provide directional signage on site for bus, automobile, and pedestrian access.

E. Fabrication:
1. General: Provide manufacturer's standard single-post, single-panel-type post and panel sign. The completed sign assembly shall consist of a message panel supported on 1 post. Comply with requirements indicated for materials, thicknesses, finishes, colors, designs, shapes, sizes and details of construction.
   a. Allow for thermal movement resulting from a maximum ambient temperature change (range) of 100 deg F. Design, fabricate, and install post and panel sign assemblies to prevent buckling, opening up of joints, and overstressing of welds and fasteners.
      1. Base design on actual surface temperatures of metals due to both solar heat gain and nighttime-sky heat loss.
   b. Welded Connections: Comply with AWS standards for recommended practices in shop welding. Provide welds behind finished surfaces without distortion or discoloration of exposed side. Clean exposed welded surfaces of welding flux and dress on exposed and contact surfaces.
   c. Mill joints to a tight, hairline fit. Form joints exposed to the weather to exclude water penetration.
   d. Preassemble signs in the shop to the greatest extent possible to minimize field assembly. Disassembly sign only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation, in a location not exposed to view after final assembly.
   e. Conceal fasteners if possibly; otherwise, locate fasteners where they will be inconspicuous.

2. Posts: Fabricate posts to lengths required for mounting method indicated.
   a. Direct Burial: For permanent sign installation, provide post 36 inches longer than height of sign to permit direct embedment in concrete foundations.

3. Panels: Form panels to required size and shape. Comply with requirements indicated for design, dimensions, finish, color and details of construction.
   a. Coordinate dimensions and attachment methods to produce message panels with closely fitting joints. Align edges and surfaces with one another in the relationship indicated.
   b. Increase metal thickness or reinforce with concealed stiffeners or backing materials as required to produce surfaces without distortion, buckles, warp, or other surface deformations.
   c. Continuously weld joints and seams, unless other methods are indicated; grind, fill and dress welds to produce smooth, flush, exposed surfaces with welds invisible after final finishing.

2.6 FINISHES

A. Colors and Surface Textures: For exposed sign material that requires selection of materials with integral or applied colors, surface textures or other characteristics related to appearance, provide color matches indicated, or if not indicated, as selected by the Architect from the manufacturer's standards.

B. Metal Finishes: Comply with NAAMM "Metal Finishes Manual" for finish designations and applications recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Locate sign units and accessories where indicated, using mounting methods of the type described and in compliance with the manufacturer's instructions.
   1. Install signs level, plumb, and at the height indicated, with sign surfaces free from distortion or other defects in appearance.

B. Wall-Mounted Panel Signs: Attach panel signs to wall surfaces using the methods indicated below:
   1. Shim Plate Mounting: Provide 1/8-inch-thick concealed aluminum shim plates with predrilled and countersunk holes, at locations indicated, and where other mounting methods are not practicable. Attach the plate with fasteners and anchors suitable for secure attachment to the substrate. Attach panel sign units to the plate using the method specified above.

C. Dimensional Letters and Numbers: Mount letters and numbers using standard fastening methods recommended by the manufacturer for letter form, type of mounting, wall construction, and condition of exposure indicated. Provide heavy paper template to establish letter spacing and to locate holes for fasteners.
   1. Projected Mounting: Mount letters at the projection distance from the wall surface indicated.

3.2 CLEANING AND PROTECTION

A. After installation, clean soiled sign surfaces according to the manufacturer's instructions. Protect units from damage until acceptance by the Owner.

END OF SECTION

SECTION 10 44 13 – FIRE PROTECTION CABINETS AND FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 SUMMARY

A. Work Included: Provide and install fire extinguishers and cabinets and accessories as shown on Drawings and as specified, including:

1. Fire extinguishers.

2. Fire extinguisher cabinets and accessories.

B. Work Specified Elsewhere:

1. Section 092216 – Non-Structural Metal Framing.

2. Section 092900 – Gypsum Board.

3. Section 099123 – Interior Painting.

1.2 SUBMITTALS

A. Comply with provisions of Section 013300 – Submittal Procedures.

B. Submit manufacturer's literature describing products.

C. Shop Drawings: Submit showing locations, sizes, methods of attachment, and rough-in dimensions.

D. Certification: Installer shall submit written certification that the fire extinguishers installed comply with the contract documents and are fully and correctly charged.

1.3 QUALITY ASSURANCE

A. Single-Source Responsibility: Obtain extinguishers and cabinets from one source from a single manufacturer.

B. Provide only fire extinguishers which comply with NFPA 10.

C. UL Listed Products: Fire extinguishers shall be UL Listed with UL Listing mark for type, rating, and classification of extinguisher.

D. Conform to NFPA 10, International Building Code (IBC) with 2003 Utah Amendments, and local Fire Marshall requirements, including:

1. Location: Provide portable fire extinguishers within 75 feet maximum travel distance to any occupied interior portion of the building.

2. Provide additional high hazard portable fire extinguishers in hazardous locations as local governing codes.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with provisions of Section 016000 – Product Requirements.

B. Deliver and store packaged products in original containers with seals unbroken and labels intact until time of use.

C. Provide proper facilities for handling and storage of products to prevent damage. Where necessary, stack products off ground on level platform, fully protected from weather.

1.5 PROJECT CONDITIONS

A. Sequencing: Schedule installation of items to occur after application of exposed finishes wherever installation will not damage exposed finish surfaces and completion of finishes will not impede installation.

B. Do not deliver or install extinguishers until just before substantial completion.

C. Do not use permanent fire extinguishers for construction period fire protection.

PART 2 – PRODUCTS

2.1 FIRE EXTINGUISHERS

A. Manufacturer: Provide products manufactured by Potter Roemer; Div. of Smith Industries, Inc; Amerex Corporation; JL Industries, Inc; Larsen's Manufacturing Company; or equal.

1. Basis-of-Design: Products manufactured by JL Industries are the Basis-of-Design for sizes as shown on Drawings.

B. Fire Extinguisher Types:

1. Typical:

a. UL Rating: 4A-80BC; 10-pound capacity, or greater.

b. Type: ABC multi-purpose dry chemical; stored pressure type.

c. Model: JL Industries, Cosmic 10E

d. Cabinet mounted (typical).

e. Provide bracket mount where cabinets are not shown on Drawings.

2.2 CABINETS AND CABINET ACCESSORIES

A. Semi-Recessed style with duo vertical panel with pull handle. (Field verify to match with TOSH MOB building standard).

1. Construction of cold rolled steel formed, mitered, welded and ground smooth; 20 gauge tubular door and 18 gauge frame; rolled radius edge treatment.

2. Cabinet door and trim shall be finished with white power coat finish.

3. Interior shall be finished in white baked enamel.

4. Basis of Design: JL Industries, 1015 V/W vertical Duo with flat trim and 1-1/2" return trim.

C. Hinges: Provide hinges for each door; concealed or continuous type; allow full 180 degree opening of door.

1. Exposed hinges: Finish to match door.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine construction to support, adjoin, or otherwise contact and verify that:

1. Dimensions are correct.

2. Load-bearing studs or backing are available where required by weight of items.

3. Setting conditions are dry, clean, and otherwise proper for installation.

B. Do not install items until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Coordinate details with other work supporting, adjoining, or otherwise contacting items as required to insure proper installation.

3.3 INSTALLATION

A. Perform installation in accordance with the manufacturer's printed instructions except where more stringent requirements are shown or specified.

1. Comply with Contract Documents where project conditions require extra precautions or provisions to ensure satisfactory performance of the work.

B. Install extinguishers and cabinets at locations indicated in accordance with approved shop drawings.

1. Typical Fastenings: Use machine screws or bolts to metal backing. Toggle bolts will not be permitted.

2. Drill and tap mounting surfaces for mounting hardware as required.

C. Install so that top of cabinet is 54 inches above finish floor.

END OF SECTION

SECTION 21 13 13 - FIRE SPRINKLER AND PIPING

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 piping and equipment for the following building systems:
1. Automatic wet-type fire protection system for this facility.
2. A dry compressed air type system for the drive thru canopy.
3. Automatic wet-type, Class II for sprinklers.
4. Wet-pipe sprinklers, including piping, valves, specialties.
5. Manual –Dry Type-Class I, fire-suppression standpipes.

B. Related Sections include the following:
1. Division 22 05 29 Hangers and Supports.
2. Division 23 21 16 Piping Specialties

1.3 DEFINITIONS

A. Working Plans: Documents, including drawings, calculations, and material specifications prepared according to NFPA 13 and NFPA 14 for obtaining approval from authorities having jurisdiction.

B. Authority having Jurisdiction: The building official and Engineer.

1.4 SYSTEM DESIGN AND PERFORMANCE REQUIREMENTS

A. Design standpipes and sprinklers and obtain approval from authorities having jurisdiction. FPC contractor is to review current fire flow test data (within 6 months) and evaluate the fire line size from the street to the building; if a fire booster pump is necessary; number of zones; main fire lines sizes throughout the building; and a dry sprinkler system in the attic.

B. Design & install fire protection system for canopies, drive-through's, etc. requiring dry loops for freeze protection areas. Coordinate with G.C. and mechanical engineer for locations of loops drops and air compressor locations for maintenance. Under no circumstance shall glycol be used in any part of the fire protection system. Only water or air shall be used.

C. FPC contractor is to provide & install appropriate number of fire circuits/zones per code. Sprinkler heads shall be centered as close as possible on ceiling tiles in all finished areas with lay-in ceilings. Use flex head connectors or swing joints to allow for 1" of ceiling motion in all directions as required by IBC 1621 and ASCE 7. Areas with hard ceilings are to have sprinkler heads located symmetrically in the room.

D. Occupancy hazard classifications shall be determined in accordance with NFPA 13 unless higher hazard classifications are indicated on the drawings or required by insurance underwriter or AHJ.

E. The system shall be designed to account for seasonal changes and for future degradation of the water supply system by using a static pressure reduction of 15% below the pressure indicated on the flow test.

F. Design standpipes and obtain approval from authorities having jurisdiction. Include minimum residual pressures at hydraulically remote outlets according to the following.
1. NPS 1-1/2 Hose Connections: 65 psig.

G. Design sprinkler piping according to the following and obtain approval from authorities having jurisdiction.
1. Office and Public Areas: Light Hazard.
2. Restaurant Seating Areas: Light Hazard.
3. Kitchen: Ordinary Hazard, Group 1.
4. Mechanical Equipment Rooms: Ordinary Hazard, Group 1.
5. Building Service Areas: Ordinary Hazard, Group 1.
6. Electrical Equipment Rooms: Ordinary Hazard, Group 1.

D. Design fire protection system and alarms using FM (Factory Mutual) Approved equipment, and design in accordance with FM (Factory Mutual) Property Loss Prevention Data.

1.5 SUBMITTALS

A. Product Data: For the following:
1. Pipe and fitting materials and methods of joining for sprinkler and standpipe piping.
2. Valves, including specialty valves, accessories, and devices.
3. Alarm devices. Include electrical data.
4. Hose connections. Include size, type and finish.
5. Sprinklers, escutcheons, and guards. Include sprinkler flow characteristics, mounting, finish and other pertinent data.

B. Fire-Hydrant Flow Test Report:

C. Approved Sprinkler Piping Drawings: Working plans, prepared according to NFPA 13, that have been approved by authorities having jurisdiction. Include hydraulic calculations, unless noted otherwise.

D. Field Test Reports and Certificates: Indicate and interpret test results for compliance with performance requirements and as described in NFPA 13 and NFPA 14. Include "Contractor's Materials and Test Certificate for Aboveground Piping" and "Contractor's Material and Test Certificate for Underground Piping."

E. Maintenance Data: For each type of standpipe and sprinkler specialty to include in maintenance manuals specified in Division 1.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has designed and installed sprinkler piping similar to that indicated for this Project and obtained design approval and inspection approval from authorities having jurisdiction.

B. Engineering Responsibility: Preparation of working plans, calculations, and field test reports by a qualified professional engineer or Engineering Technician NICET Level III. Base calculations on results of fire-hydrant flow test or the Engineer's water analysis.

C. Manufacturer Qualifications: Firms whose equipment, specialties, and accessories are listed by product name and manufacturer in UL's "Fire Protection Equipment Directory" and FM's "Figure Protection Approval Guide" and that comply with other requirements indicated.

D. Standpipe and Sprinkler Components: Listing/approval stamp, label or other marking by a testing agency acceptable to authorities having jurisdiction.

E. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

F. NFPA Standards: Equipment, specialties, accessories, installation and testing complying with the following:
1. NFPA 13-96, "Installation of Sprinkler Systems."
2. NFPA 14-96, "Standpipe and Hose Systems."
3. NFPA 70-96, "National Electric Code."
4. NFPA 72-96, "National Fire Alarm Code."

G. International Conference of Building Code Officials codes and standards complying with the following:
1. 2018 International Building Code
2. 2018 International Fire Code
3. NFPA 13

1.7. 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. Sprinkler Cabinets: A supply of spare sprinklers (never less than 6) shall be supplied and located in a cabinet where the temperature does not exceed 100 F. These sprinklers shall correspond to the types and temperature rating of the sprinklers installed on the project. Special sprinkler head wrenches shall be included to correspond to the types of heads provided.

The stock of spare sprinklers shall include all types and ratings installed and shall be as follows:

a. For systems with not over 300 sprinklers, not less than 6 sprinklers.

b. For systems with 300 to 1000 sprinklers, not less than 12 sprinklers.
c. For systems with over 1000 sprinklers, not less than 24 sprinklers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide products by one of the followings:
1. Specialty Valves and Devices:
a. Central Sprinkler Corp.
b. Firematic Sprinkler Devices, Inc.
c. Globe Fire Sprinkler Corp.
d. Grinnell Corp.
e. Reliable Automatic Sprinkler Co., Inc.
f. Viking Corp.

2. Water-Flow Indicators and Supervisory Switches:
a. Grinnell Corp.
b. Potter Electric Signal Co.
c. Reliable Automatic Sprinkler Co., Inc.
d. Viking Corp.
e. Watts Industries, Inc.; Water Products Div.

3. Sprinkler Drain and Alarm Test Fittings:
a. Central Sprinkler Corp.
b. Grinnell Corp.
c. Victaulic Co. of America

4. Sprinkler, Branch-Line Test Fittings:
a. Smith Industries, Inc.; Potter-Roemer Div.

5. Sprinkler, Inspector's Test Fittings:
a. Grinnell Corp.
b. Central Sprinkler.

6. Sprinklers:
a. Central Sprinkler Corp., (except "Omega" type sprinklers).
b. Firematic Sprinkler Devices, Inc.
c. Globe Fire Sprinkler Corp.
d. Grinnell Corp.
e. Reliable Automatic Sprinkler Co., Inc.

7. Gate Valves:
a. American Cast Iron Pipe Co.; Waterous Co.
b. Grinnell Corp.
c. Nibco, Inc.
d. Stockham Valves & Fittings, Inc.

8. Indicator Valves:
a. Central Sprinkler, Inc.
b. Grinnell Corp.

c. Nibco, Inc.
d. Victaulic Co. of America.

9. Fire-Protection-Service Valves:
   a. Central Sprinkler Corp.
   b. Grinnell Corp.
   c. Nibco, Inc.
   d. Victaulic Co. of America

10. Keyed Couplings:
    a. Grinnell Corp.
    b. Victaulic Co. of America.
    c. Central Sprinkler Corp.

2.2 PIPE AND TUBES

A. Standard-Weight Steel Pipe: ASTM A 53, ASTM A 135, or ASTM A 795; Schedule 40 in NPS 6 and smaller, and Schedule 30 in NPS 8 and larger. Schedule 10 pipe for mains.

2.3 PIPE AND TUBE FITTINGS

A. Cast-Iron Threaded Flanges: ASME B16.1.

B. Cast-Iron Threaded Fittings: ASME B16.4.

C. Steel, Threaded Couplings: ASTM A 865.

D. Steel Welding Fittings: ASTM A 234/A 234M, ASME B16.9, or ASME B16.11.

E. Steel Flanges and Flanged Fittings: ASME B16.5.

F. Steel, Grooved-End Fittings: UL-listed and FM-approved, ASTM A 47, malleable iron or ASTM A 536, ductile iron; with dimensions matching steel pipe and ends factory grooved according to AWWA C606.

2.4 JOINING MATERIALS

A. Refer to Division 15 Section “Basic Mechanical Materials and Methods” for pipe-flange gasket materials and welding filler metals.

B. Steel, Keyed Couplings: UL 213 and AWWA C606, for steel-pipe dimensions. Include ASTM A 536, ductile-iron housing, rubber gaskets, and steel bolts and nuts. Include listing for dry-pipe service for coupling for dry piping.

2.5 GENERAL-DUTY VALVES

A. Refer to Division 15 Section “Valves” for gate, ball, butterfly, globe, and check valves not required to be UL listed and FM approved.

2.6 FIRE-PROTECTION-SERVICE VALVES

A. General: UL listed, and FM approved, with minimum 175-psig nonshock working-pressure rating. Valves for grooved-end piping may be furnished with grooved ends instead of type of ends specified.

B. Gate Valves, NPS 2 and Smaller: UL 262; cast-bronze, threaded ends, solid wedge; OS&Y; and rising stem.

C. Indicating Valves, NPS 2-1/2 and Smaller: UL 1091; butterfly or ball-type bronze body with threaded ends; and integral indicating device.
1. Indicator: Electrical prewired, supervisory switch. Coordinate voltage and number of circuits with Fire Alarm requirements.

D. Gate Valves, NPS 2-1/2 and Larger: UL 262, iron body, bronze mounted, taper wedge, OS&Y, and rising stem. Include replaceable, bronze, wedge facing ranges and flanged ends.

E. Swing Check Valves, NPS 2 and Smaller: UL 312 or MSS SP-80, Class 150; bronze body with bronze disc and threaded ends.

F. Swing Check Valves, NPS 2-1/2 and Larger: UL 312, cast-iron body and bolted cap, with bronze disc or cast-iron disc with bronze-disc ring and flanged ends.

2.7 SPECIALTY VALVES

A. Alarm Check Valves: UL 193, 175-psig working pressure; designed for horizontal or vertical installation, with cast-iron flanged inlet and outlet, bronze grooved seat with O-ring seals, and single-hinge pin and latch design. Include trim sets for bypass, drain, electric sprinkler alarm switch, pressure gages, retarding chamber, and fill-line attachment with strainer.
1. Option: Grooved-end connections for use with keyed couplings.
2. Drip Cup Assembly: Pipe drain without valves and separate from main drain piping.

2.8 SPRINKLERS

A. Automatic Sprinkler: With heat-responsive element complying with the following:
1. NFPA 13, Current Edition

B. Sprinkler Type and Categories: "Ordinary" temperature classification rating, unless otherwise indicated or required by application. Areas of light hazard occupancy shall be of the quick response type.
1. Orifice: ½ inch with discharge coefficient K between 5.3 and 5.8.
2. Orifice: 17/32 inch with discharge coefficient K between 7.4 and 8.2.
3. Orifice: Extra large orifice allowed in Exhibition Hall.

C. Sprinkler heads shall be U.L. listed and of the type required to properly protect the intended space. Heads shall be of ordinary-temperature classification except as required by ceiling temperature, location, or service as allowed or required by code. Provide quick-response heads in all light hazard occupancies and resident sleeping rooms.

LOCATION	ORIENTATION	HEAD FINISH	COVER OR ESCUTCHEON
Office	Recessed	White	White
Resident Rooms	Recessed	White	White
Lobbies	Recessed	White	White
Entry Lobby	Recessed	White	White
Storage w/ Ceiling	Recessed	White	White
Corridors	Recessed	White	White
Open Areas	Upright / Pendant	Brass	-
Equipment Rooms, Truss Space	Upright / Pendant	Brass	-

D. Sprinkler Finishes: Chrome-plated black anodized, bronze, and painted.

E. Special Coatings: Wax, lead, and corrosion-resistant paint.

F. Sprinkler Guards: Wire-cage type, including fastening device for attaching to sprinkler.

2.9 ALARM DEVICES

A. General: Types matching piping and equipment connections.

B. Water-Motor-Operated Alarms: UL 753, mechanical-operation type with pelton-wheel operator with shaft length, bearings and sleeve to suit wall construction and 10-inch- diameter, cast-aluminum alarm gong with red-enamel factory finish. Include NPS ¾ inlet and NPS 1 drain connections.

C. Water-Flow Indicators: UL 346; electrical-supervision, vane-type water-flow detector, with 250-psig pressure rating; and designed for horizontal or vertical installation. Include two single-pole, double-throw, circuit switches for isolated alarm and auxiliary contacts, 7 A, 125-V ac and 0.25 A, 24-V dc; complete with factory-set, field adjustable retard element to prevent false signals and tamperproof cover that sends signal if removed. For wet system only.

D. Pressure Switches: UL 753; electrical-supervision-type, water-flow switch with retard feature. Include single-pole, double-throw, normally closed contacts and design that operates on rising pressure and signals water flow. For dry system only.

E. Valve Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled valve is in other than fully open position.

F. Indicator-Post Supervisory Switches: UL 753; electrical; single-pole, double throw; with normally closed contacts. Include design that signals controlled indicator-post valve is in other than fully open position.

2.10 PRESSURE GAGES

A. Pressure Gages: UL 393, 3-1/2- to 4-1/2-inch- diameter dial with dial range of 0 to 250 psig.

2.11 COORDINATION

A. All work of this contractor will be coordinated with other trades to insure minimal changes to the sprinkler system from the designs. Careful coordination of mechanical and electrical ducts, pipe and conduit shall be required.

B. The ceiling plenum must be carefully reviewed and coordinated with all trades. In the event of conflict, the installation of the mechanical equipment and piping shall be in the following order: plumbing waste, rainwater, and soil lines; supply, return, and exhaust ductwork, water piping, fire protection piping.

C. All piping shall be run concealed where possible. All lines will be run as high as possible so as to not interfere with future changes to ceiling heights or other mechanical equipment. This contractor will be responsible for all sleeves, core drills, and sealing of penetrations in walls, floors and structural members to facilitate the installation of the system.

D. All areas above the ceiling is to be a dry type sprinkler system. All areas below the ceiling are to be a wet system. FP Contractor is to provide / install all devices necessary for this work.

2.12 VALVE APPLICATIONS

A. Indicate valve types to be used. The following requirements apply:
   1. Fire-Protection-Service Valves: UL listed, and FM approved for applications where required by NFPA 13 and NPFA 14.
      a. Shutoff Duty: Use gate valves at building entry. Use butterfly valves at other locations.

   2. General-Duty Valves: For applications where UL-listed and FM-approved valves are not required by NFPA 13 and NFPA 14.
      a. Shutoff Duty: Use gate, ball, or butterfly valves.

2.13 JOINT CONSTRUCTION

A. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for basic piping joint construction.

B. Steel-Piping, Grooved Joints: Use Schedule 40 steel pipe with cut or roll-grooved ends and Schedule 30 or thinner steel pipe with roll-grooved ends; steel, grooved-end fittings; and steel, keyed couplings. Assemble joints with couplings, gaskets, lubricant, and bolts according to coupling manufacturer's written instructions. Use gaskets listed for dry-pipe service for dry piping.

C. Dissimilar-Piping-Material Joints: Construct joints using adapters or couplings compatible with both piping materials. Use dielectric fittings if both piping materials are metal. Refer to Division 15 Section "Basic Mechanical Materials and Methods" for dielectric fittings.

2.14 SERVICE-ENTRANCE PIPING

A. Connect standpipe and sprinkler piping to fire supply piping of size and in location indicated.

2.15 PIPING INSTALLATION

A. Refer to Division 15 Section for basic piping installation.

B. Locations and Arrangements: Drawing plans, schematics and diagram indicate general location and arrangement of piping.

1. Deviations from approved working plans for piping require written approval from authorities having jurisdiction. File written approval with Architect before deviating from approved working plans.

C. Install mechanical sleeve seal at pipe penetrations in basement and foundation walls. Refer to Division 15 Section.

D. Use approved fittings to make changes in direction, branch takeoffs from mains, and reductions in pipe sizes.

E. Install unions adjacent to each valve in pipes NPS 2 and smaller. Unions are not required on flanged devices or in piping installations using grooved joints.

F. Install flanges or flange adapters on valves, apparatus, and equipment having NPS 2-1/2 and larger connections grooved couplings may be used.

G. Install "Inspector's Test Connections" in sprinkler piping, complete with shutoff valve, sized and located according to NFPA 13.

H. Install sprinkler piping with drains for complete system drainage.

I. Install drain valves on standpipes.

J. Install ball drip valves to drain piping between fire department connections and check valves. Drain to floor drain or outside building. Install ball drips as needed on dry standpipe for drainage.

K. Install alarm devices in piping systems.

L. Hangers and Supports: Comply with NFPA 13 for hanger materials. Install according to NFPA 13 for sprinkler piping and to NFPA 14 for standpipes.

M. Seismic Protection: Install piping according to NFPA 13 – see Section 15070.

N. Install piping with grooved joints according to manufacturer's written instructions. Construct rigid piping joints, unless otherwise indicated, or required by NFPA 13 for flexibility in seismic zones.

O. Install pressure gages on riser. Include pressure gages with connection not less than NPS ¼ and with soft metal seated globe valve, arranged for draining pipe between gage and valve. Install gages to permit removal and install where they will not be subject to freezing.

2.16 VALVE INSTALLATION

A. Refer to Division 15 Section "Valves" for installing general-duty valves. Install fire-protection specialty valves, trim, fittings, controls, and specialties according to NFPA 13 and NFPA 14, manufacturer's written instructions, and authorities having jurisdiction.

B. Gate Valves: Install fire-protection-service valves supervised-open, located to control sources of water supply except from fire department connections. Provide permanent identification signs indicating portion of system controlled by each valve.

C. Alarm Check Valves: Install valves in vertical or horizontal position for proper direction of flow, including bypass check valve and retard chamber drain-line connection. Install valve trim in accordance with the valve manufacturer's appropriate trim diagrams. Install main drain to exterior.

D. Dry-Pipe Valves: Install trim sets for air supply, drain, priming level, alarm connections, ball drip valves, pressure gages, priming chamber attachment, and fill-line attachment. Test valve for proper operation. Install main drain to exterior.

1. Air-Pressure Maintenance Devices for Dry-Pipe Systems: Install shutoff valves to permit servicing without shutting down sprinkler system; bypass valve for quick system filling; pressure regulator or switch to maintain system pressure; strainer, pressure ratings with 14- to 60-psig adjustable range; and 175-psig maximum inlet pressure.
2. Install compressed-air supply piping from f.p.c. furnished compressed-air piping system.

2.17 SPRINKLER APPLICATIONS

A. General: Sprinkler heads shall be of the latest design closed spray type of 165 F unless specified otherwise or required by code. Heads in light hazard of shall be quick response type. Heads shall be a minimum orifice size of ½". Temperature rating of heads in elevator shafts shall be 286 F. Extra Large Orifice (ELO) heads shall not be used unless specified. Orifices larger than ½" may be used as required by density and spacing demands when specified. Use sprinklers according to the following applications:

1. Rooms without Ceilings: Upright and/or pendent sprinklers. Provide mechanical guards on all heads at or below 7'-0" height above the floor or where damage from room occupant use may occur.
2. Rooms with Suspended Ceilings: Recessed sprinklers.
3. Rooms with Suspended Ceilings: Concealed sprinklers.
4. Wall Mounting: Sidewall sprinklers with recessed escutcheon.
5. Spaces Subject to Freezing: Upright; pendent, dry-type; and sidewall, dry-type sprinklers.

6. Provide freeze proof type automatic sprinkler heads serving loading dock, canopies, unconditioned attic spaces, and any area subject to freezing and in other areas requiring their use.

2.18 SPRINKLER INSTALLATION

A. Every effort shall be required to ensure that the heads form a symmetrical pattern in the ceiling grid, lights, diffusers and grilles. Offsets shall be made in piping to accommodate ductwork in the ceiling. Heads should be symmetrical, and all piping run parallel or perpendicular to building lines.

1. In no case shall sprinkler heads be installed closer than approved distances from ceiling obstructions.
2. Automatic sprinkler heads located in corridors shall be in center line of corridor.

B. Do not install pendent or sidewall, wet-type sprinklers in areas subject to freezing. Use dry-type sprinklers (either glycol loops or compressed air-dry system) with water supply from heated space. See architectural plans for locations of all required areas.

C. Install sprinkler in top and bottom of elevator shafts as required by code.

2.19 LABELING AND IDENTIFICATION

A. Install labeling and pipe markers on equipment and piping according to requirements in NFPA 13 and NFPA 14 and in Section 15075 "Mechanical Identification."

2.20 FIELD QUALITY CONTROL

A. Flush, test, and inspect sprinkler piping according to NFPA 13, "System Acceptance" Chapter.

B. Replace piping system components that do not pass test procedures and retest to demonstrate compliance.

C. Report test results promptly and in writing to Architect and authorities having jurisdiction.

2.21 CLEANING

A. Clean dirt and debris from sprinklers.

B. Remove and replace sprinklers having paint other than factory finish.

2.22 PROTECTION

A. Protect sprinkler from damage until Substantial Completion.

2.23 COMMISSIONING

A. Verify that specialty valves, trim, fittings, controls, and accessories are installed and operate correctly.

B. Verify that air compressors and their accessories are installed and operate correctly.

C. Verify that specified tests of piping are complete and that "Material Test Certificates" are complete.

D. Verify that damaged sprinklers and sprinklers with paint or coating not specified are replaced with new, correct type.

E. Verify that sprinklers are correct types, have correct finishes and temperature ratings, and have guards as required for each application.

F. Drain dry-pipe sprinkler piping.

G. Pressurize and check dry-pipe sprinkler piping air-pressure maintenance devices and air compressors.

H. Fill wet-pipe sprinkler piping with water.

I. Adjust operating controls and pressure settings.

J. Coordinate with fire alarm tests. Operate as required.

2.24 DEMONSTRATION & TESTS

A. Demonstrate equipment, specialties, and accessories. Review operating and maintenance information.

B. All tests will be conducted as required by the local authority having jurisdiction, and in no case less than those required by NFPA standards. As a minimum, piping in the sprinkler system shall be tested at a water pressure at 200 psi for a period of not less two hours, or at 50 psi. Bracing shall be in place, and air shall be removed from the system through the hydrants and drain valves before the test pressure is applied. No apparent leaks will be permitted on interior or underground piping.

C. The local jurisdiction having authority shall be notified at least three working days in advance of all tests and flushing. This includes any flushing of undergrounds, hydrostatic testing, or flow testing that may be required.

D. This contractor shall make all the required tests to the sprinkler system as required by code. He shall be responsible to assure that the Contractor Test Certificates for the overhead and underground work are completed and delivered to the owner's insurance underwriter to assure proper insurance credit.

E. All tests requiring the witnessing by local authorities will be the responsibility of this contractor. If tests are not run or do not have the proper witness, then they will be run later, and all damage caused by the system, or caused in uncovering the system for such test, will be borne by this contractor.

F. Trip test dry pipe sprinkler system as required by code and authority having jurisdiction.

2.25 WARRANTY

A. This contractor shall warranty the sprinkler system and all its components for one year from the date of acceptance by the owner. Any costs incurred to extend any warranties of materials to assure this time frame shall be borne by this contractor.

END OF SECTION

SECTION 22 05 23 – GENERAL DUTY VALVES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes valves for building services piping.

1.2 REFERENCES

A. AGA Z21.22 (American Gas Association) - Relief Valves and Automatic Gas Shutoff Devices for Hot Water Supply Systems.

B. ASME B16.3 (American Society of Mechanical Engineers) - Malleable Iron Threaded Fittings.

C. AWS (American Welding Society) - Welding and Brazing Qualifications.

D. MSS SP-67 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Butterfly Valves.

E. MSS SP-71 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Cast Iron Swing Check Valves, Flanged and Threaded Ends.

F. MSS SP-78 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Cast Iron Plug Valves, Flanged and Threaded Ends.

G. MSS SP-80 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Bronze Gate, Globe, Angle and Check Valves.

H. MSS SP-85 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends.

I. MSS SP-110 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

1.3 SUBMITTALS

A. Submit product data in accordance with the General Conditions of the Contract.

B. Product Data: Submit Manufacturers catalog information with valve data and ratings for each service.

C. Welders Certificate: Include welders certification of compliance with ASME SEC IX., AWS D1.1.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit installation instructions, spare parts lists, exploded assembly views.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept valves on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

PART 2 PRODUCTS

2.1 PLUMBING VALVES: Refer to piping schematics, riser diagrams, and sheets for listed pressure ratings. Some levels are up to 300 psi and some levels are at 60 psi.

2.2 GATE VALVES

A. Acceptable manufacturers:
1. Bronze and Iron Body Valves: Jenkins, Powell, Stockham, Lunkenheimer, Milwaukee, Red-White, Walworth, Crane, Grinnell, Nibco.
2. Ball Valves: James Bury, Worcester, Jenkins, Milwaukee, Apollo, Powell, Nibco.
3. Butterfly Valves: Centerline, DeZurik, Fisher, Victaulic, Keystone, Grinnell, Flowseal.
4. Gas Cock: Peter, Healy or Crane.
5. Lubricated Plug Valves: Homestead, Nordstrom, Powell, Wallworth.

B. Up to and Including 3 inches (80 mm): MSS SP-80, Class 125, bronze body, bronze trim, rising stem, hand-wheel, inside screw, solid wedge disc, solder or threaded ends.

C. 2 inches (50 mm) and Larger: MSS SP-70, Class 125, iron body, bronze trim, outside screw and yoke, hand-wheel, solid wedge disc, flanged ends. Furnish chain-wheel operators for valves 6 inches (150 mm) and larger mounted over 8 feet (2400 mm) above floor.

2.3 GLOBE VALVES

A. Up to and Including 3 inches (80 mm): MSS SP-80, Class 125, bronze body, bronze trim, hand-wheel, bronze disc, solder or threaded ends.

B. 2 inches (50 mm) and Larger: MSS SP-85, Class 125, iron body, bronze trim, hand-wheel, outside screw and yoke, renewable bronze plug-type disc, renewable seat, flanged ends. Furnish chain-wheel operators for valves 6 inches (150 mm) and larger mounted over 8 feet (2400 mm) above floor.

2.4 BALL VALVES

A. Construction, 4 inches (100 mm) and Smaller: MSS SP-110, Class 150, 400 psi rated CWP, bronze, two-piece body, chrome plated brass ball, regular port, teflon seats and stuffing box ring, blow-out proof stem, lever handle, solder or threaded ends.

2.5 PLUG VALVES

A. Construction 2-1/2 inches (65 mm) and Larger: MSS SP-78, 350 psi CWP, cast iron body and plug, pressure lubricated, teflon or Buna N packing, flanged or grooved ends. Furnish lever operator with setscrew.

2.6 BUTTERFLY VALVES

A. Construction 1-1/2 inches (40 mm) and Larger: MSS SP-67, 300 psi (1380 kPa) CWP, cast or ductile iron body. Nickel-plated ductile iron disc, resilient replaceable EPDM seat, wafer ends, extended neck, infinite position lever handle with memory stop. Furnish gear operators for valves 8 inches (150 mm) and larger, and chain-wheel operators for valves mounted over 8 feet (2400 mm) above floor.

2.7 SWING CHECK VALVES

A. Up to and Including 3 inches (80 mm):

1. MSS SP-80, Class 125, bronze body and cap, bronze swing disc with rubber seat, solder or threaded ends.

B. 2 inches (50 mm) and Larger:
1. MSS SP-71, Class 12, iron body, bronze swing disc, renewable disc seal and seat, flanged or grooved ends – rated for minimum 350 psi.

2.8 SPRING LOADED CHECK VALVES

A. Construction: Class 125, iron body, bronze trim, stainless steel springs, bronze disc, Buna N seals, wafer style ends.

2.9 WATER PRESSURE REDUCING VALVES

A. Up to 2 inches (50 mm):

1. Construction: MSS SP-80, bronze body, stainless steel and thermoplastic internal parts, fabric reinforced diaphragm, strainer, threaded ends.

B. Over 2 inches (50 mm):
1. Construction: MSS SP-85, cast iron body, bronze fitted, elastomeric diaphragm and seat disc, flanged.

2.10 RELIEF VALVES

1. Construction: AGA Z21.22 certified, bronze body, teflon seat, steel stem and springs, automatic, direct pressure actuated.
2. Construction: AGA Z21.22 certified, bronze body, Teflon seat, stainless steel stem and springs, automatic, direct pressure actuated, temperature relief maximum 210 degrees F (98.9 degrees C), capacity ASME SEC IV certified and labeled.

2.11 GATE VALVES

A. Acceptable manufacturers:
1. Bronze and Iron Body Valves: Jenkins, Powell, Stockham, Lunkenheimer, Milwaukee, Red-White, Walworth, Crane, Grinnell, Nibco.
2. Ball Valves: James Bury, Worcester, Jenkins, Milwaukee, Apollo, Powell, Nibco.
3. Butterfly Valves: Centerline, DeZurik, Fisher, Victaulic, Keystone, Grinnell, Flowseal.
4. Gas Cock: Peter, Healy or Crane.
5. Lubricated Plug Valves: Homestead, Nordstrom, Powell, Wallworth.

6. Construction: Bronze body, bronze trim, union bonnet, rising stem, hand-wheel, inside screw, solid wedge disc, solder or threaded ends.

B. Over 2 inches (50 mm):
1. Construction: Iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, solid wedge disc with bronze seat rings, flanged or grooved ends.

2.12 GLOBE OR ANGLE VALVES

1. Construction: Bronze body, bronze trim, union bonnet, rising stem and hand-wheel, inside screw with renewable composition disc and bronze seat, solder or threaded ends.

B. Over 2 inches (50 mm):
1. Construction: Iron body, bronze trim, bolted bonnet, rising stem, hand-wheel, outside screw and yoke, rotating plug-type disc with renewable seat ring and disc, flanged ends.

2.13 BALL VALVES

1. Construction: Bronze, two-piece body, stainless steel ball, teflon seats and stuffing box ring, lever handle with balancing stops, solder or threaded ends.

2.14 PLUG VALVES

1. Construction: Bronze body, bronze tapered plug, full port opening, non-lubricated, Teflon packing, threaded ends.
2. Operator: One plug valve wrench for every ten plug-valves with minimum of one wrench.

B. Over 2 inches (50 mm):
1. Construction: Cast iron body and plug, full port opening, pressure lubricated, teflon packing, flanged ends.
2. Operator: Each plug valve with wrench with setscrew.

2.15 BUTTERFLY VALVES

A. Body: Cast or ductile iron with resilient replaceable EPDM seat, wafer or lug ends, extended neck.

B. Disc: Aluminum bronze.

C. Operator: Infinite position lever handle with memory stop.

2.16 SWING CHECK VALVES

1. Construction: Bronze body, bronze trim, bronze rotating swing disc, with composition disc, solder or threaded ends.

B. Over 2 inches (50 mm):
1. Construction: Iron body, bronze trim, bronze or bronze faced rotating swing disc, renewable disc and seat, flanged ends.

2.17 SPRING LOADED CHECK VALVES

A. Construction: Iron body, bronze trim, split plate, hinged with stainless steel spring, resilient seal bonded to body, wafer or threaded lug ends.

2.18 FLANGES, UNIONS, AND COUPLINGS – rated up to 350 psi.

A. Unions for Pipe 2 inches (50 mm) and Under:
1. Ferrous Piping: 150 psig (1034 kPa) malleable iron, threaded.
2. Copper Pipe: Bronze, soldered joints.

B. Flanges for Pipe Over 2 inches (50 mm):
1. Ferrous Piping: 150 psig (1034 kPa) forged steel, slip-on.
2. Copper Piping: Bronze.

C. Gaskets: 1/16-inch (1.6 mm) thick preformed neoprene.

D. Grooved and Shouldered Pipe End Couplings rated for minimum 350 psi:
1. Housing Clamps: Malleable iron to engage and lock designed to permit some angular deflection, contraction, and expansion.
2. Sealing Gasket: C-shape elastomer composition for operating temperature range from 30 degrees F to 230 degrees F.
3. Housing Clamps: Ductile iron, cast with offsetting, angle-pattern bolt pads, coated with copper-colored enamel, to engage and lock, designed to permit some angular deflection, contraction and expansion.
4. Sealing Gaskets: QuickVic™ Grade "EHP" EPDM elastomer composition for operating temperature range from -30 degrees F to 250 degrees F
5. Accessories: Plated steel bolts and nuts.
6. Design: "Installation Ready" stab-on design, for direct 'stab' installation onto roll grooved copper tube without prior field disassembly and no loose parts. Victaulic Style 607H QuickVic™.

E. Accessories: Steel bolts, nuts, and washers.

F. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, and water impervious isolation barrier.

2.19 TEMPERATURE-ACTUATED WATER MIXING VALVES

A. Individual-Fixture, Water Tempering:

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

a. Powers; a Watts Industries Co.
b. Watts Industries, Inc.; Water Products Div.
c. Zurn Plumbing Products Group; Wilkins Div.

2. Standard: ASSE 1070, thermostatically controlled water tempering valve.
3. Pressure Rating: 125 psig minimum, unless otherwise indicated.
4. Body: Bronze body with corrosion-resistant interior components.
5. Temperature Control: Adjustable.
6. Inlets and Outlet: Threaded.
7. Finish: Rough or chrome-plated bronze.

B. TMV-1 Thermostatic Mixing Valve: Leonard TM-80 thermostatic mixing valve with 1" inlets, 1-1/4" outlet, cold water bypass with volume control/shutoff and cabinet.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify Piping System is ready for installation.

3.2 INSTALLATION

A. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

B. Install valves with stems upright or horizontal, not inverted.

C. Use grooved mechanical couplings and fasteners only in accessible locations.

D. Install unions downstream of valves and at equipment or apparatus connections. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

E. Install ball or butterfly valves for shut-off and to isolate each piece of equipment, part of systems, or vertical risers.

F. Install globe, ball or butterfly valves for throttling, bypass, or manual flow control services.

G. Provide spring loaded check valves on discharge of water pumps.

H. Provide plug valves in natural gas systems for shut-off service.

I. Provide flow controls in water re-circulating systems as indicated on Drawings.

J. Use lug end butterfly valves to isolate equipment.

K. Use 3/4-inch (20 mm) ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment.

L. Provide check valve for backflow prevention.

M. Provide access means for each valve. Coordinate access means with General Contractor.

N. Provide isolation valve at each branch take-off serving two or more fixtures or items of equipment.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Conform to applicable piping specification for hangers and insulation.

END OF SECTION

SECTION 22 05 29 - HANGERS AND SUPPORTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes pipe and equipment supports, hangers, anchors, bases sleeves and sealing of work to adjacent construction.

1.2 REFERENCES

A. ASME B31.9 (American Society of Mechanical Engineers) - Building Services Piping.

B. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

C. AWS D1.1 (American Welding Society) - Structural Welding Code.

D. MSS SP58 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Pipe Hangers and Supports - Materials, Design and Manufacturer.

E. MSS SP69 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Pipe Hangers and Supports - Selection and Application.

F. MSS SP89 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Pipe Hangers and Supports - Fabrication and Installation Practices.

1.3 QUALITY ASSURANCE

A. Perform Work in accordance with AWS D1.1 for welding hanger and support attachments to building structure.

1.4 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 PIPE HANGERS AND SUPPORTS

A. Manufacturers:

1. B-Line, Fee and Mason, Grinnell, PH. D and Michigan

B. General:

1. Hangers, and accessories shall be sized with a safety factor of five (5) times the actual load.
2. Hangers for insulated piping shall be oversized to accommodate insulation thickness. Provide with insulation shields with inserts or insulation saddles as required in Section 15080 – Mechanical Insulation.

3. Copper clad hangers shall be used for copper piping systems. Provide heavy density mildew and moisture rot proof felt pad securely attached to the hanger or 5 mil thick polyvinyl chloride coating to prevent contact between the pipe and hanger.

C. Plumbing Piping – DWV:
1. Conform to ASME B31.9 ASTM F708 MSS SP58 MSS SP69 MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 38 mm): Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches (50 mm) and Over: Hot Dipped Galvanized, Carbon steel, adjustable, clevis.
4. Multiple or Trapeze Hangers: Hot dipped galvanized, steel channels with welded spacers and hanger rods.
5. Wall Support for Pipe Sizes to 3 inches (76 mm): Cast iron hook.
6. Wall Support for Pipe Sizes 4 inches (100 mm) and Over: Welded hot dipped galvanized steel bracket and wrought hot dipped galvanized steel clamp.
7. Vertical Support: Hot dipped galvanized steel riser clamp.
8. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
9. Copper Pipe Support: Copper-plated, Carbon-steel adjustable, ring.

D. Plumbing Piping – Water:
1. Conform to ASME B31.9 ASTM F708 MSS SP 58 MSS SP69 MSS SP89.
2. Hangers Pipe Sizes ½ to 1-1/2 inch (13 to 38 mm): Hot dipped galvanized, carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches (50 mm) and Over: Hot dipped galvanized, carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches (50 to 100 mm): Hot dipped galvanized, carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inches (150 mm) and Over: Adjustable, Hot dipped galvanized, steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Hot dipped galvanized, steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches (150 mm) and Over: Hot dipped galvanized, steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall support for pipe sizes to 3 inches (76) mm): Cast iron hook.
9. Wall support for pipe sizes 4 inches (100 mm) and Over: Welded, hot dipped galvanized, steel bracket and wrought hot dipped galvanized steel clamp.
10. Wall support for hot pipe sizes 6 inches (150 mm) and Over: Welded hot dipped galvanized, steel bracket and wrought hot dipped galvanized, steel clamp with adjustable steel yoke and cast-iron roll.
11. Vertical Support: Hot dipped galvanized, steel riser clamp.
12. Floor support for cold pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
13. Floor support for hot pipe sizes to 4 inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

14. Floor support for hot pipe sizes 6 inches (150 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or hot dipped galvanized steel support.
15. Copper Pipe Support: Copper-plated, Hot Dipped Galvanized, Carbon-steel ring.

E. Hydronic Piping:
1. Conform to ASME B31.9 ASTM F708 MSS SP58 MSS SP69 MSS SP89.
2. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (13 to 38 mm): Hot Dipped Galvanized, Carbon steel, adjustable swivel, split ring.
3. Hangers for Cold Pipe Sizes 2 inches (50 mm) and Over: Hot Dipped Galvanized, Carbon steel, adjustable, clevis.
4. Hangers for Hot Pipe Sizes 2 to 4 inches (50 to 100 mm): Carbon steel, adjustable, clevis.
5. Hangers for Hot Pipe Sizes 6 inches (150 mm) and Over: Adjustable, Hot dipped galvanized, steel yoke, cast iron roll, double hanger.
6. Multiple or Trapeze Hangers: Hot dipped galvanized, steel channels with welded spacers and hanger rods.
7. Multiple or Trapeze Hangers for Hot Pipe Sizes 6 inches (150 mm) and Over: Hot dipped galvanized, steel channels with welded spacers and hanger rods, cast iron roll.
8. Wall Support for Pipe Sizes to 3 inches (76 mm): Cast iron hooks.
9. Wall Support for Pipe Sizes 4 inches (100 mm) and Over: Welded, hot dipped galvanized, steel bracket and wrought hot dipped galvanized steel clamp.
10. Wall Support for Hot Pipe Sizes 6 inches (150 mm) and Over: Welded, hot dipped galvanized steel bracket and wrought, hot dipped galvanized, steel clamp with adjustable steel yoke and cast-iron roll.
11. Vertical Support: Hot dipped galvanized steel riser clamp.
12. Floor Support for Cold Pipe: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or hot dipped galvanized steel support.
13. Floor Support for Hot Pipe Sizes to 4 Inches (100 mm): Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or hot dipped galvanized steel support.
14. Floor Support for Hot Pipe Sizes 6 inches (150 mm) and Over: Adjustable cast iron roll and stand, steel screws, and concrete pier or hot dipped galvanized steel support.
15. Copper Pipe Support: Copper-plated, carbon steel ring.

2.2 ACCESSORIES

A. Hanger Rods: Mild steel threaded both ends, threaded on one end, or continuous threaded.

2.3 INSERTS

A. Inserts: Malleable iron case of galvanized steel shell and expander plug for threaded connection with lateral adjustment, top slot for reinforcing rods, lugs for attaching to forms; size inserts to suit threaded hanger rods.

2.4 FLASHING

A. Metal Flashing: 26 gage galvanized steel.

B. Metal Counterflashing: 22 gage galvanized steel.

C. Lead Flashing:
1. Waterproofing: 5 lb./sq. ft (24.5 kg/sq m) sheet lead
2. Soundproofing: 1 lb./sq. ft (5 kg/sq m) sheet lead.

D. Flexible Flashing: 47 mil thick sheet butyl; compatible with roofing.

E. Caps: Steel, 22 gage (0.8 mm) minimum; 16 gage (1.5 mm) at fire resistant elements.

2.5 EQUIPMENT CURBS

A. Fabrication: Welded 18 gage (1.2 mm) galvanized steel shell and base, mitered 3-inch can't, variable step to match roof insulation, 1-1/2-inch-thick insulation, factory installed wood nailer.

2.6 SLEEVES

A. Sleeves for Pipes Through Non-Fire Rated Floors: 18 gage (1.2 mm) thick galvanized steel.

B. Sleeves for Pipes Through Non-Fire Rated Beams, Walls, Footings, and Potentially Wet Floors: Steel pipe or 18 gage thick galvanized steel.

C. Sleeves for Pipes Through Fire Rated and Fire Resistive Floors and Walls, and Fire Proofing: Prefabricated fire rated sleeves including seals, UL listed Sleeves for Round Ductwork: Galvanized steel.

D. Sleeves for Rectangular Ductwork: Galvanized steel or wood.

E. Fire-Stopping Insulation: Glass fiber type, non-combustible.

PART 3 EXECUTION

3.1 INSTALLATION

3.2 INSERTS

A. Install inserts for placement in concrete forms.

B. Install inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.

C. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).

D. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

E. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut recessed into and grouted flush with slab.

3.3 PIPE HANGERS AND SUPPORTS

A. Support horizontal piping as scheduled.

B. Install hangers with minimum 1/2-inch (13 mm) space between finished covering and adjacent work.

C. Place hangers within 12 inches (300 mm) of each horizontal elbow.

D. Use hangers with 1-1/2 inch (38 mm) minimum vertical adjustment.

E. Support horizontal cast iron pipe adjacent to each hub, with 5 feet (1.5 m) maximum spacing between hangers.

F. Support vertical piping at every floor. Support vertical cast iron pipe at each floor at hub.

G. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.

H. Support riser piping independently of connected horizontal piping.

I. Provide copper plated hangers and supports for copper piping.

J. Design hangers for pipe movement without disengagement of supported pipe.

3.4 EQUIPMENT BASES AND SUPPORTS

A. Provide reinforced concrete housekeeping pads, minimum 4 thick and extending 6 inches (150 mm) beyond supported equipment. Refer to Architectural Concrete Specifications.

B. Provide templates, anchor bolts, and accessories for mounting and anchoring equipment.

C. Construct supports of Steel pipe and fittings. Brace and fasten with flanges bolted to structure.

D. Provide rigid anchors for pipes after vibration isolation components are installed.

3.5 FLASHING

A. Provide flexible flashing and metal Counterflashing where piping and ductwork penetrate weather or waterproofed walls, floors, and roofs.

B. Flash vent and soil pipes projecting 3 inches (75 mm) minimum above finished roof surface with lead worked 1-inch (25 mm) minimum into hub, 8 inches (200

mm) minimum clear on sides with 24 x 24 inches (600 x 600 mm) sheet size. For pipes through outside walls, turn flanges back into wall and caulk, metal counter-flash, and seal.

C. Flash floor drains in floors with topping over finished areas with lead, 10 inches (250 mm) clear on sides with minimum 36 x 36-inch (910 x 910 mm) sheet size. Fasten flashing to drain clamp device.

D. Seal floor drains watertight to adjacent materials.

E. Provide acoustical sound control around ducts and pipes penetrating equipment rooms. Fill openings with fiberglass blanket and caulk each side of opening with non-hardening caulking compound.

F. Provide curbs for mechanical roof installations 14 inches minimum high above roofing surface. Flash and counter-flash with sheet metal; seal watertight. Attach counterflashing mechanical equipment and lap base flashing on roof curbs. Flatten and solder joints.

G. Adjust storm collars tight to pipe with bolts; caulk around top edge. Use storm collars above roof jacks. Screw vertical flange section to face of curb.

3.6 SLEEVES

A. Set sleeves in position in forms. Provide reinforcing around sleeves.

B. Size sleeves large enough to allow for movement due to expansion and contraction. Provide for continuous insulation wrapping.

C. Extend sleeves through floors 1 inch above finished floor level. Caulk sleeves.

D. Where piping or ductwork penetrates floor, ceiling, or wall, close off space between pipe or duct and adjacent work with fire stopping insulation and caulk. Provide close fitting metal collar or escutcheon covers at both sides of penetration.

E. Install chrome plated steel escutcheons at finished surfaces.

3.7 SCHEDULES

A. Install pipe hangers in accordance to IPC Section 308.

END OF SECTION

SECTION 22 05 48 - MECHANICAL SOUND, VIBRATION AND SEISMIC CONTROL

PART 1 GENERAL

1.1 SUMMARY

A. Section includes vibration isolation. Seismic anchorage for all isolated and non-isolated equipment, ductwork and piping systems furnished and installed under Division 15, 21, 22, & 23.

B. Related Sections:
1. Section 22 05 29 – Hangers and Supports
2. Section 23 21 16 – Piping Specialties: Product requirements for Supports, anchors and piping expansion compensation for placement by this section.
3. Section 23 31 00 – Ducts
4. Section 23 33 00 – Duct Accessories: Product requirements for both solid and flexible duct connectors for duct silencers specified for placement by this section.

1.2 PERFORMANCE REQUIREMENTS

A. Provide seismic anchorage and bracing for all equipment, ductwork and piping in accordance with seismic zone D of the 2018 International Building Code.
1. Where required, supports, anchorage and bracing of all equipment, piping and ductwork, shall be designed by a professional engineer working for the restraint manufacturer and qualified with experiences in the seismic bracing of mechanical systems. The seismic engineer shall establish anchorage requirement specific to the equipment submitted, reviewed and accepted by the Architect/Engineer for the project.

2. Furnished equipment shall meet the requirements of the seismic codes with bases and supports designed to accommodate seismic support.

3. Where required, prior to starting mechanical work, contractor is to submit to mechanical engineer seismic details and drawings by a licensed seismic engineer for all equipment requiring seismic restraint. These drawings are to be stamped and signed and will then be reviewed with engineer and city.

4. Upon completion of the project, the licensing seismic engineer when required shall perform a walk through of the project site and submit a written observation report to the mechanical engineer and to the city. Contractor shall notify engineer and the city when seismic engineer is to perform site visit.

B. Provide vibration isolation on motor driven equipment over 0.5 hp (0.35 kW), plus connected piping and ductwork.

C. Provide minimum static deflection of isolators for equipment as follows:
1. Slab on Grade, Under 20 hp (15 kW)

a. Under 400 rpm: Rubber Floor Isolator or Hanger
b. 400 – 600 rpm: 1 inch (25 mm)
c. 600 - 800 rpm: 0.5 inch (12 mm)
d. 800 - 900 rpm: 0.2 inch (5 mm)
e. 1100 - 1500 rpm: 0.14 inch (4 mm)
f. Over 1500 rpm: 0.1 inch (3 mm)

2. Slab on Grade, Over 20 hp (15 kW)
a. Under 400 rpm: Rubber Floor Isolators or Hangers
b. 400 - 600 rpm: 2 inches (50 mm)
c. 600 - 800 rpm: 1 inch (25 mm)
d. 800 - 900 rpm: 0.5 inch (12 mm)
e. 1100 - 1500 rpm: 0.2 inch (5 mm)
f. Over 1500 rpm: 0.15 inch (4 mm)

3. Upper Floors, Normal
a. Under 400 rpm: Rubber Floor Isolators or Hangers
b. 400 - 600 rpm: 3.5 inch (90 mm)
c. 600 - 800 rpm: 2 inches (50 mm)
d. 800 - 900 rpm: 1 inch (25 mm)
e. 1100 - 1500 rpm: 0.5 inch (12 mm)
f. Over 1500 rpm: 0.2 inch (5 mm)

D. Maintain sound level of spaces at levels not to exceed those listed below by utilizing acoustical devices.

E. Maintain rooms at following maximum sound levels, in Noise Criteria (NC) as defined by current ASHRAE Handbook Standards.

1.3 SUBMITTALS

A. Submit shop drawings calculations and product data in accordance with the general provisions of the specifications.

B. Shop Drawings: Indicate inertia bases and locate vibration isolators, with static and dynamic load on each. Indicate assembly, materials, thickness, dimensional data, pressure losses, acoustical performance, layout, and connection details for sound attenuation products fabricated for this project.

C. Product Data: Submit schedule of vibration isolator type with location and load on each. Submit catalog information indicating, materials and dimensional data.

D. Design Data: Submit calculations for seismic and vibration requirements for all equipment to be restrained and isolated. Drawings and calculations submitted for seismic bracing and anchors shall bear the engineer's signed professional seal.

E. Prior to starting mechanical work, if necessary, contractor is to submit to mechanical engineer seismic details and drawings by a licensed seismic engineer for all equipment requiring seismic restraint. These drawings are to be stamped and signed and will then be reviewed with engineer and city.

F. Upon completion of the project, mechanical contractor is to have the licensing seismic engineer perform a walk through of the project site and submit a written

observation report to the mechanical engineer and to the city. Contractor shall notify engineer and the city when seismic engineer is to perform site visit.

G. Manufacturer's Installation Instructions: Submit special procedures and setting dimensions. Indicate installation requirements maintaining integrity of sound isolation.

H. Manufacturer's Certificate: Certify isolators meet or exceed specified requirements.

I. Manufacturer's Field Reports: Indicate sound isolation and seismic restraint installation is complete and in accordance with instructions.

1.4 QUALITY ASSURANCE

A. Perform Work in accordance with International Building Code (IBC), Smacna Seismic Restraint Manual, AMCA 300 ANSI S1.13 ARI 575 ASA 16 ANSI S1.36 standards and recommendations of ASHRAE 68.

B. Maintain one copy of each document on site.

1.5 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

C. Design application of seismic restraint systems under direct supervision of Professional Engineer experienced in design of this Work and licensed in the State that the work is being performed in.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 VIBRATION ISOLATORS

A. Open Spring Isolators:
   1. Spring Isolators:
      a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
      b. Code: Color code springs for load carrying capacity.
   2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
   3. Spring Mounts: Furnish with leveling devices, minimum 0.25 inch (6 mm) thick neoprene sound pads, and zinc chromate plated hardware.

4. Sound Pads: Size for minimum deflection of 0.05 inch (1.2 mm); meet requirements for neoprene pad isolators.

B. Restrained Spring Isolators:
1. Spring Isolators:
   a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Spring Mounts: Furnish with leveling devices, minimum 0.25 inch (6 mm) thick neoprene sound pads, and zinc chromate plated hardware.
4. Sound Pads: Size for minimum deflection of 0.05 inch (1.2 mm); meet requirements for neoprene pad isolators.
5. Restraint: Furnish mounting frame and limit stops.

C. Closed Spring Isolators:
1. Spring Isolators:
   a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.
2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25-inch (7 mm) clearance.

D. Restrained Closed Spring Isolators:
1. Spring Isolators:
   a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.
2. Type: Closed spring mount with top and bottom housing separated with neoprene rubber stabilizers.
3. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
4. Housings: Incorporate neoprene isolation pad meeting requirements for neoprene pad isolators, and neoprene side stabilizers with minimum 0.25-inch (7 mm) clearance and limit stops.

E. Spring Hanger:
1. Spring Isolators:
   a. For Exterior and Humid Areas: Furnish hot dipped galvanized housings and neoprene coated springs.
   b. Code: Color code springs for load carrying capacity.
2. Springs: Minimum horizontal stiffness equal to 75 percent vertical stiffness, with working deflection between 0.3 and 0.6 of maximum deflection.
3. Housings: Incorporate rubber hanger with threaded insert.
4. Misalignment: Capable of 20-degree hanger rod misalignment.

F. Neoprene Pad Isolators:
1. Rubber or neoprene-waffle pads.
a. 30 durometers.
b. Minimum 1/2 inch (13 mm) thick.
c. Maximum loading 40 psi (275 kPa).
d. Height of ribs: not to exceed 0.7 times width.
2. Configuration: 1/2-inch (13 mm) thick waffle pads bonded each side of 1/4-inch (6 mm) thick steel plate.

G. Rubber Mount or Hanger: Molded rubber designed for 0.5 inches (13 mm) deflection with threaded insert.

H. Glass Fiber Pads: Neoprene jacketed pre-compressed molded glass fiber.

I. Seismic Snubbers:
1. Type: Non-directional and double acting unit consisting of interlocking steel members restrained by neoprene elements.
2. Neoprene Elements: Replaceable, minimum of 0.75 inch (18 mm) thick.
3. Capacity: 4 times load assigned to mount groupings at 0.4-inch (10 mm) deflection.
4. Attachment Points and Fasteners: Capable of withstanding 3 times rated load capacity of seismic snubber.

PART 3 EXECUTION

3.1 EXAMINATION

3.2 INSTALLATION

A. Install isolation for motor driven equipment.
1. Bases:
2. Set steel bases for 1-inch (25 mm) clearance between housekeeping pad and base.
3. Set concrete inertia bases for 2-inch (50 mm) clearance between housekeeping pad and base.
4. Adjust equipment level.

B. Install spring hangers without binding.

C. On closed spring isolators, adjust so side stabilizers are clear under normal operating conditions.

D. Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height. When full load is applied, adjust isolators to load to allow shim removal.

E. Provide resiliently mounted equipment, piping, and ductwork with seismic snubbers. Provide each inertia base with minimum of four seismic snubbers located close to isolators. Snub equipment designated for post disaster use to

0.05-inch (1.5 mm) maximum clearance. Provide other snubbers with clearance between 0.15 inch (4 mm) and 0.25 inch (7 mm).

F. Support piping connections to isolated equipment resiliently as follows:
1. Up to 4-inch (100 mm) Diameter: First three points of support.
2. 5 to 8-inch (125 to 200 mm) Diameter: First four points of support.
3. 10-inch (250 mm) Diameter and Over: First six points of support.
4. Select three hangers closest to vibration source for minimum 1.0-inch (25 mm) static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0-inch (25 mm) static deflection or 1/2 static deflection of isolated equipment.

G. Connect wiring to isolated equipment with flexible hanging loop.

3.3 FIELD QUALITY CONTROL

A. Quality Requirements: Testing, adjusting, and balancing.

B. Inspect isolated equipment after installation and submit report. Include static deflections.

C. After start-up, final corrections and balancing of systems take octave band sound measurements over full audio frequency range in areas adjacent to mechanical equipment rooms, duct and pipe shafts, and other critical locations. Provide one-third octave band measurements of artificial sound sources in areas indicated as having critical requirements. Submit complete report of test results including sound curves.

PIPE ISOLATION SCHEDULE

Pipe Size Inch (mm)	Isolated Distance from Equipment
1 (25)	120 diameters (3.0 m)
2 (50)	90 diameters (4.5 m)
3 (80)	80 diameters (6.0 m)
4 (100)	75 diameters (7.5 m)
6 (150)	60 diameters (9.0 m)
8 (200)	60 diameters (12.0 m)
10 (250)	54 diameters (13.5 m)
12 (300)	50 diameters (15.0 m)
16 (400)	45 diameters (18.0 m)
24 (600)	38 diameters (23.0 m)
Over 24 (600)	

EQUIPMENT ISOLATION SCHEDULE

ISOLATED EQUIPMENT	BASE TYPE THICKNESS	ISOLATOR TYPE DEFLECTION
HVAC Pumps	B/C	2/3

Chillers	A	2
Fans (over 10 H.P.)	C	4

BASE TYPES:

A = No base, isolators attached directly to equipment
B = Structural steel rails or base
C = Concrete inertia base
D = Curb-mounted base

ISOLATOR TYPES:

1 = Rubber or glass fiber pad
2 = Rubber floor isolator or hanger
3 = Spring floor isolator or hanger
4 = Restrained spring isolator
5 = Thrust restraint
6 = Spring and rubber in series hanger

NOTES:

1. Contractor shall provide vibration isolation and calculations stamped by a licensed professional engineer.
2. To avoid isolator resonance problems, select isolator deflection so that natural frequency is 40% or less than lowest operating speed of equipment (see ASHRAE HVAC Applications handbook, current edition).

END OF SECTION

SECTION 22 05 53 - MECHANICAL IDENTIFICATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes nameplates, tags, stencils and pipe markers.

1.2 REFERENCES

A. ASME A13.1 (American Society of Mechanical Engineers) - Scheme for the Identification of Piping Systems.

B. NFPA 99 (National Fire Protection Association) – All.

1.3 SUBMITTALS

A. Submit product data and shop drawings in accordance with the General Conditions of the Contract.

B. Product Data: Submit manufacturers catalog literature for each product required.

PART 2 PRODUCTS

2.1 NAMEPLATES

A. Product Description: Laminated three-layer plastic with engraved letters in contrasting background color.

2.2 TAGS

1. Brass with stamped letters; tag size minimum 1-1/2 inches diameter with finished edges. Provide with brass chains for installation.

B. Information Tags:

1. Clear plastic with printed "Danger," "Caution," or "Warning" and message; size 3-1/4 x 5-5/8 inches (83 x 143 mm) with grommet and self-locking nylon ties.

C. Tag Chart: Typewritten letter size list of applied tags and location plastic laminated.

2.3 STENCILS

A. Stencils: With clean cut symbols and letters of following size:

1. Up to 1 1/4 inches Outside Diameter of Insulation or Pipe: 1/2-inch-high letters.
2. 1-1/2 to 2 inches outside diameter of insulation of pipe: ¾ inch high letters.
3. 2-1/2 to 6 inches Outside Diameter of Insulation or Pipe: 1 1/4-inch high letters.

4. Outside Diameter of Insulation or Pipe: 2 1/2 inches high letters.
5. Over 10 inches outside diameter of pipe or insulation: 3-1/2-inch-high letters.
6. Ductwork and Equipment: 2-1/2 inches high letters.

B. Stencil Paint: As specified in Architectural Painting Specifications, semi-gloss enamel, colors and lettering size conforming to ASME A13.1.

2.4 PIPE MARKERS

A. Color and Lettering: Conform to ASME A13.1.

B. Plastic Pipe Markers:
1. Manufacturer:
   a. Set mark type snap-around markers.
2. Factory fabricated, flexible, semi-rigid plastic, preformed to fit around pipe or pipe covering. Larger sizes may have maximum sheet size with spring fastener.

C. Plastic Tape Pipe Markers:
1. Manufacturer:
   a. Brady Type 350.
2. Flexible, vinyl film tape with pressure sensitive adhesive backing and printed markings, with legend, size and color coding.

2.5 CEILING TACKS

A. Description: Steel with 3/4-inch (19 mm) diameter color-coded head.

B. Color code as follows:
1. HVAC equipment: Yellow.
2. Fire dampers/smoke dampers: Red.
3. Plumbing valves: Green.
4. Heating/cooling valves: Blue.

2.6 LABELS

A. Description: Laminated Mylar, size 1.9 x 0.75 inches, adhesive backed with printed identification.

PART 3 EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Architectural Painting Specifications for stencil painting.

3.2 INSTALLATION

A. Apply stencil painting in accordance with Architectural Painting Specifications.

B. Install identifying devices after completion of coverings and painting.

C. Install plastic nameplates with corrosive-resistant mechanical fasteners, or adhesive.

D. Install labels with sufficient adhesive for permanent adhesion and seal with clear lacquer. For unfinished canvas covering, apply paint primer before applying labels.

E. Install tags using corrosion resistant chain. Number tags consecutively by location.

F. Identify RTU's, air handling units, pumps, heat transfer equipment, tanks, and water treatment devices with plastic nameplates. Identify in-line pumps and other small devices with tags.

G. Identify control panels and major control components outside panels with plastic nameplates.

H. Identify valves in main and branch piping with tags.

I. Identify air terminal units and radiator valves with numbered tags.

J. Tag automatic controls, instruments, and relays. Key to control schematic.

K. Identify piping, concealed or exposed, with plastic pipe markers, plastic tape pipe markers or stenciled painting. Use tags on piping 3/4-inch (20 mm) diameter and smaller. Identify service, flow direction, and pressure. Install in clear view and align with axis of piping. Locate identification not to exceed 10 feet (6 m) on straight runs including risers and drops, adjacent to each valve and tee, at each side of penetration of structure or enclosure, and at each obstruction.

L. Provide ceiling tacks to locate valves or dampers above T-bar type panel ceilings. Locate in corner of panel closest to equipment.

3.3 SCHEDULES

IDENTIFICATION

1. Domestic Cold-Water Piping.
   a. Background Color: Green
2. Domestic Hot Water.
   a. Background Color: Yellow
3. Hot water Heating.
   a. Background Color: Yellow
   b. With Directional Arrow.
4. Natural Gas.
   a. Background Color: Orange
5. Ductwork.

a. Identification Type: N/A

6. Chilled Water
   a. Background Color: Blue
   b. With Directional Arrow.
7. Cooling Tower
   a. Background Color: Light Green
   b. With Directional Arrow.

END OF SECTION

SECTION 22 07 00 - MECHANICAL INSULATION

PART 1 GENERAL

1.1 SUMMARY

A. Section includes ductwork insulation, duct liner, insulation jackets, covering, and thermal insulation for piping systems including vapor retarders, jackets and accessories.

B. Related Sections:
1. Section 22 05 29 – Hangers and Supports: Execution requirements for inserts for placement by this section.
2. Section 22 05 53 – Mechanical Identification: Product requirements for mechanical identification for placement by this section.

1.2 REFERENCES

A. ASTM C177 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded Hot Plate Apparatus.

B. ASTM C195 - Standard Specification for Mineral Fiber Thermal Insulating Cement.

C. ASTM C449/C449M - Standard Specification for Mineral Fiber Hydraulic-Setting Thermal Insulating and Finishing Cement.

D. ASTM C518 - Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus.

E. ASTM C533 - Standard Specification for Calcium Silicate Block and Pipe Thermal Insulation.

F. ASTM C534 - Standard Specification for Preformed Flexible Elastomeric Cellular Thermal Insulation in Sheet and Tubular Form.

G. ASTM C547 - Standard Specification for Mineral Fiber Preformed Pipe Insulation.

H. ASTM C552 - Standard Specification for Cellular Glass Thermal Insulation.

I. ASTM C553 - Standard Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications.

J. ASTM C591 - Standard Specification for Unfaced Preformed Rigid Cellular Polyurethane Thermal Insulation.

K. ASTM C592 - Standard Specification for Mineral Fiber Blanket Insulation and Blanket-Type Pipe Insulation (Metal-Mesh Covered) (Industrial Type).

L. ASTM C610 - Standard Specification for Expanded Perlite Block and Pipe Thermal Insulation.

M. ASTM C612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation.

N. ASTM C1071 - Standard Specification for Thermal and Acoustical Insulation (Glass Fiber, Duct Lining Material).

O. ASTM C1126- Standard Specification for Preformed Closed Cell Phenolic Foam Pipe and Board Insulation.

P. ASTM C1136 – Standard Specification for Flexible, Low Permeance Vapor Retarders for Thermal Insulation.

Q. ASTM D1784 - Standard Specification for Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (CPVC) Compounds.

R. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.

S. ASTM E96 - Standard Test Methods for Water Vapor Transmission of Materials.

T. ASTM E162 - Standard Test Method for Surface Flammability of Materials Using a Radiant Heat Energy Source.

U. ASTM G21 - Standard Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi.

V. NAIMA (North American Insulation Manufacturers Association) - National Insulation Standards.

W. SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) - HVAC Duct Construction Standards - Metal and Flexible.

1.3 SUBMITTALS

A. Product Data: Submit product description, thermal characteristics and list of materials and thickness for each service, and location, as per the general conditions of the contract.

B. Manufacturer's Installation Instructions: Submit manufacturers published literature indicating proper installation procedures.

1.4 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.

B. Applicator: Company specializing in performing Work of this section with minimum three years experience.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept materials on site in original factory packaging, labeled with manufacturer's identification, including product density and thickness.

B. Protect insulation from weather and construction traffic, dirt, water, chemical, and mechanical damage, by storing in original wrapping.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Install insulation only when ambient temperature and humidity conditions are within range recommended by manufacturer.

B. Maintain temperature during and after installation for minimum period of 24 hours.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Certain-Teed

Owens-Corning

Johns-Manville

Armstrong

Knauf

Dow Chemical

2.2 GLASS MINERAL FIBER, FLEXIBLE BLANKET DUCT WRAP

A. Insulation: Glass Fiber Blanket Thermal Insulation for Commercial and Industrial Applications. Supply and return air ducts and plenums shall be insulated with a minimum of R-6 insulation installed where located in unconditioned spaces. Where located outside the building in Climate Zone 6B, insulation shall be a minimum of R-12.

B. Vapor Retarder Jacket: ASTM 1136, Type II Flexible and Low Permeance Vapor Retarders for Thermal Insulation. Perm rating shall not exceed .24 when tested in accordance with ASTM E96, Procedure A.

C. Manufacturers:
1. Manufacturers:

Certain-Teed

Owens-Corning

Johns-Manville

Armstrong

Knauf
Dow Chemical

2. Kraft paper reinforced with glass fiber yarn and bonded to aluminized film, with pressure sensitive rubber-based adhesive.

D. Indoor Vapor Retarder Finish:
1. Manufacturers:

Certain-Teed

Owens-Corning

Johns-Manville

Armstrong

Knauf

Dow Chemical

2.3 CELLULAR GLASS PIPE INSULATION

A. Insulation: ASTM C552, Type II – pipe and tubing insulation, Class 2 - Jacketed.
1. Conductivity (Chilled Water Pipe) ASTM C177 or ASTM C518, 0.21-0.27 at 75 degrees F.
2. Conductivity (Heating Water Pipe) ASTM C177 or ASTM C518, 0.25-0.29 at 180 degrees F.

B. Vapor retarder jacket: Perm rating shall not exceed 0.25 when tested in accordance with ASTM E96, Procedure A.

2.4 PROTECTIVE INSULATION JACKET (PIPE INSULATION EXPOSED TO WEATHER)

A. Aluminum Jacket: ASTM B209.
1. Thickness: 0.016-inch-thick sheet.
2. Finish: Smooth.
3. Joining: Longitudinal slip joints and 2-inch (50 mm) laps.
4. Fittings: 0.016-inch-thick die shaped fitting covers with factory attached protective liner.
5. Metal Jacket Bands: 3/8-inch-wide; 0.015-inch-thick aluminum.

2.5 GLASS FIBER DUCT LINER, FLEXIBLE Insulation for Interior of sheet metal ducts.

A. Insulation: ASTM C1071 Thermal and Acoustical Insulation Glass Fiber, Duct Lining Material, Type I

B. Adhesive:
1. Waterproof, ASTM E162 fire-retardant type.

C. Liner Fasteners: Galvanized steel, welded with integral head.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify piping, equipment and ductwork has been tested before applying insulation materials.

B. Verify surfaces are clean and dry, with foreign material removed.

3.2 INSTALLATION

A. Install in accordance with NAIMA National Insulation Standards.

B. Exposed Piping: Locate insulation and cover seams in least visible locations.

C. For hot piping conveying fluids over 110 degrees F, insulate flanges and unions at equipment.

D. Glass fiber insulated pipes conveying fluids above ambient temperature:
1. Furnish factory-applied or field-applied standard jackets. Secure with outward clinch expanding staples or pressure sensitive adhesive system on standard factory-applied jacket and butt strips or both.
2. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe. Finish with glass cloth and adhesive or PVC fitting covers.

E. Inserts and Shields:
1. Application: Piping or Equipment 1-1/2 inches diameter or larger.
2. Shields: Galvanized steel between pipe hangers or pipe hanger rolls and inserts.
3. Insert location: Between support shield and piping and under finish jacket.
4. Insert configuration: Minimum 6 inches (150 mm) long, of thickness and contour matching adjoining insulation; may be factory fabricated.
5. Insert material: Compression resistant insulating material suitable for planned temperature range and service.

F. Continue insulation through penetrations of building assemblies, rtu, or portions of assemblies having fire resistance rating of one hour or less. Provide intumescent firestopping when continuing insulation through assembly. Finish at supports, protrusions, and interruptions. Refer to Section 07840 for penetrations of assemblies with fire resistance rating greater than one hour.

G. All isolation valves, circuit setters, or any equipment requiring adjustment or access shall be made accessible with accessible insulated fittings.

H. Exterior Applications: Provide vapor retarder jacket. Insulate fittings, joints, and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor retarder cement. Cover with stainless steel jacket with seams located at 3 or 9 o'clock position on side of horizontal piping with overlap facing down to shed water or on bottom side of horizontal equipment.

I. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires, or bands.

J. Fill joints, cracks, seams, and depressions with bedding compound to form smooth surface. On cold equipment, use vapor retarder cement.

K. Glass fiber insulated equipment containing fluids above ambient temperature: Provide standard jackets, with or without vapor retarder, factory-applied or field-applied. Finish with glass cloth and adhesive.

L. Finish insulation at supports, protrusions, and interruptions.

M. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.

N. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation for easy removal and replacement without damage.

O. Insulated ductwork conveying air below ambient temperature:
1. Provide insulation with vapor retarder jackets.
2. Finish with tape and vapor retarder jacket.
3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
4. Insulate entire system including fittings, joints, flanges, fire dampers, flexible connections, and expansion joints.

P. Duct Liner Application:
1. Adhere insulation with adhesive for 100 percent coverage.
2. Secure insulation with mechanical liner fasteners. SMACNA Standards for spacing.
3. Seal and smooth joints. Seal and coat transverse joints.
4. Seal liner surface penetrations with adhesive.
5. Duct dimensions indicated are net inside dimensions required for airflow. Increase duct size to allow for insulation thickness.

Q. On cold & hot water piping that feeds exterior hose bibs & sill cocks, insulate entire pipe all the way to the fixture for freeze protection.

R. Install PVC jacket on the interior exposed insulation in the mechanical boiler room and in the mechanical penthouse.

S. All heating water storage tanks are to be insulated with 2" fiberglass insulation cloth coated and sewn with tight seal.

3.3 SCHEDULES

A. Plumbing Systems:
1. Domestic & Industrial Hot Water Supply and Recirculation Systems:
a. Insulate entire system with fiberglass pipe covering with all service jacket and self seal lap. Insulation thickness as follows: 1" thick for pipes less than 1½", 1½" thick for all pipes 1½" and larger.
2. Domestic & Industrial Cold Water:
a. Horizontal mains and elbows to vertical risers / drops: 3/4" thick for all pipe less than 1" and 1" thick for all pipes 1" and larger - fiberglass pipe covering with all service jacket and self-seal lap.
3. Primary Roof Drains:
a. Horizontal mains and vertical to and including drain bowls with ½ inch thick fiberglass pipe covering with all service jacket and self-seal lap.
b. Bowls of secondary roof drains shall be insulated with ½ "thick foil scrim face.
4. Fittings:
a. Pre-molded PVC fitting covers with fiberglass insert. In return air plenums use insulating cement finished with 6-ounce canvas and heavy coat of vapor barrier mastic coating.

B. Heating System (Supply and Return Piping)
1. Fiberglass pipe covering with all-service jacket and self-seal lap.
2. Thickness as follows: 1½" thick for pipe sizes up to not including 1½". 2" thick for pipes sizes 1½" and larger.
3. Insulate all air separators on all heating systems.

C. Air Distribution System:
1. For the RTU's & MAU's: All supply air duct is to be wrapped up to the diffuser. All return air grilles shall have lined sound boots painted flat black if a plenum return is utilized. The return air duct, where shown, is to be lined from all return air grilles if rectangular ductwork is shown and wrapped if round duct is shown.

2. Supply ductwork (not indicated to be lined): Supply and return air ducts and plenums shall be insulated with a minimum of R-6 insulation where located in unconditioned spaces. Where located outside the building in Climate Zone 6B, insulation shall be a minimum of R-12
3. Lined supply ductwork.
   a. Insulate with R-6 duct liner with continuous sheet metal edge protector at entering and leaving edges.
   b. Coat transverse joints prior to installation.
   c. Line ductwork in rectangular ductwork downstream of VAV or fan terminal boxes, transfer air ducts and supply plenums above air devices.
   d. Pipe insulation exposed to weather.

D. Provide aluminum jacket and fitting covers on all piping exposed to weather

END OF SECTION

SECTION 22 11 00 - DOMESTIC WATER PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes domestic & industrial water piping, valves, fittings, hangers, pumps, water softeners, controls and accessories.

B. Related Sections:
1. Section 22 05 29: Hangers and Supports.
2. Section 22 05 48 – Mechanical Sound, Vibration, and Seismic Control: Product requirements for vibration isolators for placement by this section.
3. Section 22 07 00 – Mechanical Identification: Product requirements for pipe identification and valve tags for placement by this section.

1.2 REFERENCES

A. ASME B16.1 (American Society of Mechanical Engineers) - Cast Iron Pipe Flanges and Flanged Fittings Class 25, 125, 250 and 800.

B. ASME B16.18 (American Society of Mechanical Engineers) - Cast Copper Alloy Solder Joint Pressure Fittings.

C. ASME B16.22 (American Society of Mechanical Engineers) - Wrought Copper and Bronze Solder Joint Pressure Fittings.

D. ASME B16.26 (American Society of Mechanical Engineers) - Cast Bronze Fittings for Flared Copper Tubes.

E. ASME B31.9 (American Society of Mechanical Engineers) - Building Service Piping.

F. ASTM B32 - Solder Metal.

G. ASTM B42 - Seamless Copper Pipe.

H. ASTM B88 - Seamless Copper Water Tube (ASTM B88M - Seamless Copper Water Tube [Metric]).

I. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

J. AWS A5.8 (American Welding Society) - Brazing Filler Metal.

K. AWWA C651 (American Water Works Association) - Disinfecting Water Mains.

L. ASTM F1476 – Grooved Mechanical Couplings.

M. ASTM A536 – Ductile Iron Casings.

N. MSS SP58 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Pipe Hangers and Supports - Materials, Design and Manufacturer.

O. MSS SP-67 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Butterfly Valves.

P. MSS SP69 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Pipe Hangers and Supports - Selection and Application.

Q. MSS SP-70 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Cast Iron Gate Valves, Flanged and Threaded Ends.

R. MSS SP-71 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Cast Iron Swing Check Valves, Flanged and Threaded Ends.

S. MSS SP-78 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Cast Iron Plug Valves, Flanged and Threaded Ends.

T. MSS SP-80 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Bronze Gate, Globe, Angle and Check Valves.

U. MSS SP-85 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Cast Iron Globe & Angle Valves, Flanged and Threaded Ends.

V. MSS SP89 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Pipe Hangers and Supports - Fabrication and Installation Practices.

W. MSS SP-110 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Ball Valves Threaded, Socket-Welding, Solder Joint, Grooved and Flared Ends.

X. AWWA C606 (American Water Works Association) – Grooved and Shouldered Joints.

Y. UL 1479 (National Fire Protection Association) - Fire Tests of Through-Penetration Firestops.

Z. ASME A1126.1 (American Society of Mechanical Engineers) - Water Hammer Arrestors.

AA. ASSE 1011 (American Society of Sanitary Engineering) - Hose Connection Vacuum Breakers.

BB. ASSE 1012 (American Society of Sanitary Engineering) - Backflow Preventers with Immediate Atmospheric Vent.

CC. ASSE 1013 (American Society of Sanitary Engineering) - Backflow Preventers, Reduced Pressure Principle.

DD. ASSE 1019 (American Society of Sanitary Engineering) - Wall Hydrants, Frost Proof Automatic Draining Anti-Backflow Types.

EE. AWWA C506 (American Water Works Association) - Backflow Prevention Devices - Reduced Pressure Principle and Double Check Valve Types.

FF. PDI WH-201 (Plumbing and Drainage Institute) - Water Hammer Arrestors.

GG. ASHRAE 90A (American Society of Heating, Refrigerating and Air Conditioning Engineers) - Energy Conservation in New Building.

1.3 SYSTEM DESCRIPTION

A. Where more than one piping system material is specified, provide compatible system components and joints. Provide flanges, union, and couplings at locations requiring servicing.

B. Use unions, flanges, and couplings downstream of valves and at equipment or apparatus connections. Use non-conducting dielectric connections whenever jointing dissimilar metals in open systems. Do not use direct welded or threaded connections to valves, equipment or other apparatus.

C. Provide pipe hangers and supports in accordance with ASME B31.1, ASME B31.9, MSS SP69.

D. Use ball, or butterfly valves for shut-off and to isolate equipment, part of systems, or vertical risers.

E. Use globe ball or butterfly valves for throttling, bypass, or manual flow control services.

F. Use potable rated spring-loaded check valves on discharge of hot water heating water pumps.

G. Use 3/4-inch (20 mm) ball valves with cap for drains at main shut-off valves, low points of piping, bases of vertical risers, and at equipment. Pipe to nearest floor drain

1.4 SUBMITTALS

A. Submittals: Provide as per the General Conditions of the Contract.

B. Product Data:
1. Submit data on pipe materials; pipe fittings, valves, and accessories. Submit manufacturers catalog information. Indicate valve data and ratings.

C. Manufacturer's Installation Instructions: Submit installation instructions for valves and accessories.

D. Grooved joint couplings and fittings shall be shown on drawings and product submittals and shall be specifically identified with the applicable manuf. style or series number.

E. To assure uniformity and compatibility of piping components in grooved piping systems, all grooved products utilized shall be supplied by a single manufacturer.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves and equipment.

B. Operation and Maintenance Data: Submit spare parts list, exploded assembly views and recommended maintenance intervals.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.

B. Provide temporary protective coating on cast iron and steel valves.

C. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.

D. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.8 WATER PIPING BURIED WITHIN 5 FEET (1500 mm) OF BUILDING

A. Copper Tubing: ASTM B42, hard drawn.
   1. Fittings: ASME B16.18 cast copper alloy or ASME B16.22 wrought copper and bronze.
   2. Joints: AWS A5.8, BCuP silver braze.

B. Copper Tubing: ASTM B42, annealed
   1. Fittings: ASME B16.26 cast bronze.
   2. Joints: Flare

1.9 WATER PIPING, ABOVE GRADE

A. Copper Tubing: ASTM B88 (ASTM B88M), Type L, hard drawn.
   1. Fittings: ASME B16.18, cast copper alloy or ASME B16.22, wrought copper and bronze.
   2. ASME B16.22, wrought copper, or ASME B16.18 bronze castings with copper tubing sized grooved ends (flaring of tube and fitting ends to IPS dimensions is not permitted).
   3. Joints: ASTM B32, solder, Grade 95TA.
   4. Joints: grooved mechanical couplings.

B. Copper Tubing: ASTM B88 (ASTM B88M), Type L, hard drawn.
   1. Fittings: Cast iron, coated.
   2. ASME B16.22, wrought copper, or ASME B16.18 bronze castings with copper tubing sized grooved ends (flaring of tube and fitting ends to IPS dimensions is not permitted).
   3. Joints: Grooved mechanical couplings.

4. Joints: grooved mechanical couplings.
5. Piping from the domestic water booster pump up to the penthouse shall be rated for a minimum of 350 psi.

1.10 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 3 inches (80 mm) and Under:
1. Ferrous pipe: Class 150 malleable iron threaded unions.
2. Copper tube and pipe: Class 150 bronze unions with soldered joints.

B. Pipe Size Over 3 inches (25 mm):
1. Ferrous pipe: Class 150 malleable iron threaded or forged steel slip-on flanges; preformed neoprene gaskets.
2. Copper tube and pipe: Class 150 slip-on bronze flanges; preformed neoprene gaskets.

C. Grooved and Shouldered Pipe End Couplings rated for minimum 350 psi:
1. Housing: Malleable iron clamps to engage and lock, designed to permit some angular deflection, contraction, and expansion; steel bolts, nuts, and washers; galvanized for galvanized pipe.
2. Sealing gasket: "C" shape composition sealing- gasket.
3. Housing Clamps: Ductile iron, cast with offsetting, angle-pattern bolt pads, coated with copper-colored enamel, to engage and lock, designed to permit some angular deflection, contraction and expansion.
4. Sealing Gaskets: EPDM elastomer composition for operating temperature range from -30 degrees F to 250 degrees F
5. Accessories: Plated steel bolts and nuts.
6. Design: “Installation Ready” stab-on design, for direct ‘stab’ installation onto roll grooved copper tube without prior field disassembly and no loose parts.

D. Dielectric Connections: Union with galvanized or plated steel threaded end, copper solder end, water impervious isolation barrier.

E. Dielectric Connections: Waterway fitting with zinc-plated steel or ductile iron body with male threaded or grooved ends and LTHS high temperature polyolefin polymer lining.

1.11 PIPE HANGERS AND SUPPORTS

A. Provide as per Section 220529.

1.12 STRAINERS

A. Size 2 inch (50 mm) and Under:
1. Threaded brass body for 175 psi (1200 kPa) CWP, Y pattern with 1/32 inch (0.8 mm) stainless steel perforated screen.

B. Size 1-1/2 inch (40 mm) to 4 inches (100 mm):
1. Class 125, flanged iron body, Y pattern with 1/16-inch (1.6 mm) stainless steel perforated screen.

C. Size 5 inch (125 mm) and Larger:
1. Class 125, flanged iron body, basket pattern with 1/8 inch (2 mm) stainless steel perforated screen.

1.13 FIRE STOP SYSTEMS

A. General Purpose Fire Stopping Sealant: Water based, non-slumping, premixed sealant with intumescent properties, rated for 3 hours in accordance with ASTM E814 and UL 1479.

B. General Purpose Vibration Resistant Fire Stopping Sealant: Silicone based, non-slumping, premixed sealant with intumescent properties, vibration and moisture resistant, rated for 3 hours in accordance with ASTM E814 and UL 1479.

PART 2 EXECUTION

2.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavate

2.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel or groove plain end pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

2.3 INSTALLATION

A. Install Work in accordance with International or Uniform Plumbing Code and local / jurisdictional codes.

B. Install non-conducting dielectric connections wherever jointing dissimilar metals.

C. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

D. Install piping to maintain headroom without interfering with use of space or taking more space than necessary.

E. Group piping whenever practical at common elevations.

F. Grooved joint piping systems shall be installed in accordance with the manufacturer's guidelines and recommendations. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components. The gasket style and elastomeric material (grade) shall be verified as suitable for the intended service as specified. Gaskets shall be molded and produced by manuf. Grooved end shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove for proper gasket sealing. A factory-trained field representative shall provide on-site training for contractor's field personnel in the proper use of grooving tools and installation of grooved piping

products. Factory-trained representative shall periodically review the product installation. Contractor shall remove and replace any improperly installed products.

G. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 220529.

H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with General Contractor.

I. Establish elevations of buried piping outside the building to obtain not less than 3-1/2 ft of cover.

J. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

K. Install valves with stems upright or horizontal, not inverted.

L. Install water piping in accordance with ASME B31.9.

M. Sleeve pipes passing through partitions, walls and floors.

N. Inserts:
1. Provide inserts for placement in concrete forms.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.

O. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9 ASTM F708 and MSS SP89, and IPC Table.
2. Support horizontal piping as schedule
3. Install hangers to provide minimum 1/2-inch (15 mm) space between finished covering and adjacent work.
4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
5. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
7. Where piping is installed in parallel and at same elevation, provide multiple pipe or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping.

P. Install potable water protection devices on plumbing lines where contamination of domestic water may occur; on boiler feed water lines, janitor rooms, fire sprinkler systems, premise isolation, irrigation systems, flush valves, interior and exterior hose bibs.

Q. Pipe relief from valves, back-flow preventers and drains to nearest floor drain.

R. Install water hammer arrestors in accordance to plumbing drainage institute standard WH-201. Provide 8" x 8" access panel to provide access to arrestor.

2.4 SERVICE CONNECTIONS

A. Provide new water service complete with approved reduced pressure back-flow preventer and pressure reducing valve and sand strainer.

B. Provide sleeve in wall for service main and support at wall with reinforced-concrete bridge. Caulk enlarged sleeve and make watertight with pliable material. Anchor service main inside to concrete wall.

END OF SECTION

SECTION 22 13 00 - SANITARY WASTE AND VENT PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes pipe, pipe fittings, connections and equipment for sanitary sewer piping systems. This section also includes floor drains, cleanouts, interceptors, manholes and sewage ejectors.

B. Related Sections: Section 220529: Hangers and Supports.
1. Section 220553 - Mechanical Identification: Product requirements for pipe identification for placement by this section.

1.2 REFERENCES

A. ASME B13 (American Society of Mechanical Engineers) - Malleable Iron Threaded Fittings.

B. ASME B123 (American Society of Mechanical Engineers) - Cast Copper Alloy Solder Joint Drainage Fittings - DWV.

C. ASME B31.9 (American Society of Mechanical Engineers) - Building Services Piping.

D. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

E. ASTM A74 - Cast Iron Soil Pipe and Fittings.

F. ASTM C564 - Rubber Gaskets for Cast Iron Soil Pipe and Fittings.

G. ASTM E814 - Fire Tests of Through-Penetration Fire Stops.

H. ASTM F708 - Design and Installation of Rigid Pipe Hangers.

I. ASME A1121.1 (American Society of Mechanical Engineers) - Floor Drains.

J. CISPI 301 (Cast Iron Soil Pipe Institute) - Cast Iron Soil Pipe and Fittings for Hubless Cast Iron Sanitary Systems.

K. CISPI 310 (Cast Iron Soil Pipe Institute) - Joints for Hubless Cast Iron Sanitary Systems.

L. MSS SP58 (Manufacturers Standardization Society of the Valve and Fittings Industry) - Pipe Hangers and Supports - Materials, Design and Manufacturer.

M. SP89 - Pipe Hangers and Supports - Fabrication and Installation Practices.

N. UL 1479 (Underwriters Laboratories, Inc.) - Fire Tests of Through-Penetration Firestops.

1.3 SUBMITTALS

A. Provide in accordance with the General Conditions of the Contract.

B. Product Data: Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalog information. Indicate component sizes, rough-in requirements, service sizes, and finishes.

C. Manufacturer's Installation Instructions: Submit installation instructions for material and equipment.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

1.5 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 All grease waste pipe shall be cast iron unless otherwise specified.

2.2 SANITARY SEWER PIPING BURIED WITHIN 5 FEET (1500 mm) OF BUILDING AND/OR STUBBED UP 12" ABOVE FINISHED FLOOR:

A. Sch. 40 Solid Core PVC Pipe: ASTM D2665 or ASTM D3034.
1. Fittings: PVC.
2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.

B. Sch. 40 Solid Core PVC Pipe: ASTM D2665, ASTM D3034, or ASTM F679.
1. Fittings: PVC.
2. Joints: ASTM F477, elastomeric gaskets.

2.3 SANITARY SEWER AND VENT PIPING, ABOVE GRADE

A. Sch. 40 Solid Core PVC Pipe: ASTM D2665 or ASTM D3034.
1. Fittings: PVC.
2. Joints: ASTM D2855, solvent weld with ASTM D2564 solvent cement.
3. PVC and Cast-iron piping are listed. Plastic piping is not allowed to be installed in return air plenums. Contractor is allowed to use Plastic piping below grade and up the walls to 12" below the ceiling level of a return air plenum. All piping located above the ceilings is to be cast iron piping if a return air plenum is utilized.

B. Sch. 40 Solid Core PVC Pipe: ASTM D2665, ASTM D3034, or ASTM F679.
   1. Fittings: PVC.
   2. Joints: ASTM F477, elastomeric gaskets.
   3. PVC and Cast-iron piping are listed. Plastic piping is not allowed to be installed in return air plenums. Contractor is allowed to use Plastic piping below grade and up the walls to 12" below the ceiling level of a return air plenum. All piping located above the ceilings is to be cast iron piping if a return air plenum is utilized

C. Cast Iron Pipe: CISPI 301, hubless, service weight.
   1. Fittings: Cast iron.
   2. Joints: Neoprene gaskets and stainless-steel clamp-and-shield assemblies.
   3. All elbows joining a stack more than 2 stories shall use extra heavy duty no-hub bands (minimum of 4 bands on each pipe) exceeding minimum CISPI 310 requirements.

2.4 PIPE HANGERS AND SUPPORTS

A. Drain, Waste, and Vent: Conform to ASME B31.9, ASTM F708.

B. Hangers for Pipe Sizes 1/2 to 1-1/2 inch (15 to 40 mm): Carbon steel, adjustable swivel, split ring.

C. Hangers for Pipe Sizes 2 inches (50 mm) and Over: Carbon steel, adjustable, clevis.

D. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

E. Wall Support for Pipe Sizes to 3 inches (80 mm): Cast iron hooks.

F. Wall Support for Pipe Sizes Over 3 inches (100 mm): Welded steel bracket and wrought steel clamp.

G. Vertical Support: Steel riser clamp.

H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

I. Copper Pipe Support: Carbon-steel, copper-plated adjustable ring.

2.5 FIRE STOP SYSTEMS

A. General Purpose Fire Stopping Sealant: Water based, non-slumping, premixed sealant with intumescent properties, rated for 3 hours in accordance with ASTM E814 and UL 1479.

B. General Purpose Vibration Resistant Fire Stopping Sealant: Silicone based, non-slumping, premixed sealant with intumescent properties, vibration and moisture resistant, rated for 3 hours in accordance with ASTM E814 and UL 1479.

2.6 FLOOR DRAINS

A. Manufacturers: Wade, JR Smith, Zurn, or equal.

B. Provide as scheduled on the Drawings.

C. Floor Drain: Lacquered cast iron two-piece body with drainage flange, heavy duty grate 6 inches (150 mm) 12 inches (300 mm) wide, 12 inches (300 mm) long, dome strainer, end plates with gaskets.

D. Contractor must verify with G.C., engineer, and/or owner a water tight seal on all floor drains and floor sinks installed in the penthouse. Water tight seal includes seal between fixture and concrete floor, piping, and fixture itself.

2.7 FLOOR SINKS

A. Manufacturers: Wade, J.R. Smith, Zurn, or equal.

B. Provide as scheduled on the Drawings.

C. Contractor must verify with G.C., engineer, and/or owner a water tight seal on all floor drains and floor sinks installed in the penthouse. Water tight seal includes seal between fixture and concrete floor, piping, and fixture itself.

2.8 CLEANOUTS

A. Manufacturers: Wade, J.R. Smith, Zurn, or equal.

B. Exterior Surfaced Areas: Round cast nickel bronze access frame and non-skid cover.

C. Exterior Unsurfaced Areas: Line type with lacquered cast iron body and round epoxy coated cover with gasket.

D. Interior Finished Floor Areas: Galvanized cast iron body with anchor flange, threaded top assembly, and round scored cover with gasket in service areas and round depressed cover with gasket to accept floor finish in finished floor areas.

E. Interior Finished Wall Areas: Line type with lacquered cast iron body and round epoxy coated cover with gasket, and round stainless-steel access cover secured with machine screw.

F. Interior Unfinished Accessible Areas: Calked or threaded type. Provide bolted stack cleanouts on vertical rainwater leaders.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions.

3.3 INSTALLATION

A. Install Work in accordance with International or Uniform Plumbing Code and current local / jurisdictional standards.

B. Extend cleanouts to finished floor or wall surface. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Provide clearances at cleanout for snaking drainage system.

C. Encase exterior cleanouts in concrete flush with grade.

D. Install floor cleanouts at elevation to accommodate finished floor.

E. Provide non-conducting dielectric connections wherever jointing dissimilar metals.

F. Route piping in orderly manner and maintain gradient. Route parallel and perpendicular to walls.

G. Install piping to maintain headroom. Do not spread piping, conserving space.

H. Install floor drains, floor sinks, and floor cleanouts in the penthouse with a water tight seal between fixture and concrete. Verify water tight teal by flooding drain and continuous water flow around fixture from concrete for a period of 8 hours.

I. Group piping whenever practical at common elevations.

J. Provide clearance in hangers and from structure and other equipment for installation of insulation and access to valves and fittings. Refer to Section 220700.

K. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with General Contractor.

L. Install piping penetrating roofed areas to maintain integrity of roof assembly.

M. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.

N. Prepare exposed, unfinished pipe, fittings, supports, and accessories ready for finish painting.

O. Install bell and spigot pipe with bell end upstream.

P. Sleeve pipes passing through partitions, walls and floors.

Q. Inserts:
1. Provide inserts for placement in concrete forms.
2. Provide inserts for suspending hangers from reinforced concrete slabs and sides of reinforced concrete beams.
3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches (100 mm).
4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
5. Where inserts are omitted, drill through concrete slab from below and provide through-bolt with recessed square steel plate and nut flush with top of slab.

R. Pipe Hangers and Supports:
1. Install in accordance with ASME B31.9, ASTM F708.
2. Support horizontal piping as scheduled.
3. Install hangers to provide minimum 1/2-inch (15 mm) space between finished covering and adjacent work.
4. Place hangers within 12 inches (300 mm) of each horizontal elbow.
5. Use hangers with 1-1/2 inch (40 mm) minimum vertical adjustment. Design hangers for pipe movement without disengagement of supported pipe.
6. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
7. Where installing several pipes in parallel and at same elevation, provide multiple pipe hangers or trapeze hangers.
8. Provide copper plated hangers and supports for copper piping packing between hanger or support and piping.

END OF SECTION

SECTION 22 40 00 - PLUMBING FIXTURES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes water closets, urinals, lavatories, faucets, sinks, service sinks, and electric water coolers.

B. Related Sections:
1. Section 22 11 00 – Domestic Water Piping: Supply connections to plumbing fixtures.
2. Section 22 13 00 – Sanitary Waste and Vent Piping: Waste connections to plumbing fixtures.

1.2 REFERENCES

A. ARI 1010 (Air-Conditioning and Refrigeration Institute) - Drinking Fountains and self-contained Mechanically Refrigerated Drinking Water Coolers.

B. ASME A112.6.1 (American Society of Mechanical Engineers) - Supports for Off-the-Floor Plumbing Fixtures for Public Use.

C. ASME A112.18.1 (American Society of Mechanical Engineers) - Finished and Rough Brass Plumbing Fixture Fittings.

D. ASME A112.19.1 (American Society of Mechanical Engineers) - Enameled Cast Iron Plumbing Fixtures.

E. ASME A112.19.2 (American Society of Mechanical Engineers) - Vitreous China Plumbing Fixtures.

F. ASME A112.19.3 (American Society of Mechanical Engineers) - Stainless Steel Plumbing Fixtures.

G. ASME A112.19.4 (American Society of Mechanical Engineers) - Porcelain Enameled Formed Steel Plumbing Fixtures.

H. ASME A112.19.5 (American Society of Mechanical Engineers) - Trim for Water-Closet Bowls, Tanks, and Urinals.

1.3 SUBMITTALS

A. Submittal: Provide in accordance with the General Conditions of the Contract.

B. Product Data: Submit catalog illustrations of fixtures, sizes, rough-in dimensions, utility sizes, trim, and finishes.

C. Manufacturer's Installation Instructions: Submit installation methods and procedures.

1.4 CLOSEOUT SUBMITTALS

A. Provide in accordance with the General Conditions of the Contract.

B. Operation and Maintenance Data: Submit fixture, trim, exploded view and replacement parts lists.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Accept fixtures on site in factory packaging. Inspect for damage.

B. Protect installed fixtures from damage by securing areas and by leaving factory packaging in place to protect fixtures and prevent use.

PART 2 PRODUCTS

2.1 Products scheduled in the mechanical plans have been selected to meet the requirements for a LEED Gold / Silver. All fixtures submitted must meet or exceed the scheduled selected fixtures.

2.2 FLUSH VALVE WATER CLOSETS

A. Manufacturers: Kohler, Eljer, and American Standard, or equal.

B. Provide as scheduled on the Drawings.

2.3 WALL HUNG URINALS (if applicable).

A. Manufacturers: Kohler, American Standard, and Eljer, or equal.

B. Provide as scheduled on the Drawings.

2.4 LAVATORIES

A. Manufacturers: Kohler, American Standard, and Eljer, or equal.

B. Provide as scheduled on the Drawings.

2.5 FAUCETS

A. Manufacturers: Just, Zurn, Chicago Faucet, Kohler, and Moen.

2.6 ELECTRIC WATER COOLERS

A. Manufacturers: Elkay, Oasis, and Sunroc, or equal.

B. Provide as scheduled on the Drawings.

2.7 SERVICE SINKS

A. Manufacturers: Kohler, Eljer, and American Standard, or equal.

B. Provide as scheduled on the Drawings.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify walls and floor finishes are prepared and ready for installation of fixtures.

B. Verify electric power is available and of correct characteristics.

C. Confirm millwork is constructed with adequate provision for installation of counter top lavatories and sinks.

3.2 PREPARATION

A. Rough-in fixture piping connections in accordance with minimum sizes indicated in fixture rough-in schedule for particular fixtures.

3.3 INSTALLATION

A. Install Work in accordance with Uniform Plumbing Code and local / jurisdictional codes.

B. Install each fixture with trap, easily removable for servicing and cleaning.

C. Provide chrome plated rigid or flexible supplies to fixtures with loose key stops, reducers, and escutcheons.

D. Install components level and plumb.

E. Install and secure fixtures in place with wall carriers and bolts.

F. Seal fixtures to wall and floor surfaces with sealant color to match fixture.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Review millwork shop-drawings. Confirm location and size of fixtures and openings before rough in and installation.

3.5 ADJUSTING

A. Adjust stops or valves for intended water flow rate to fixtures without splashing, noise, or overflow.

3.6 CLEANING

A. Clean plumbing fixtures and equipment.

3.7 PROTECTION OF INSTALLED CONSTRUCTION

A. Do not permit use of fixtures before final acceptance.

END OF SECTION

SECTION 23 00 15 - GENERAL MECHANICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Coordination and project conditions.

B. Products, product options and substitutions.

C. Closeout procedures.

D. Bids and Submittals.

E. Test and inspection.

F. Regulatory requirements.

G. Cutting and patching.

H. Special procedures.

I. Alternate Bid Pricing: Equipment List

1.2 COORDINATION AND PROJECT CONDITIONS

A. Coordinate scheduling, submittals, and Work of various sections of Project Manual to ensure efficient and orderly sequence of installation of interdependent construction elements.

B. Provide all labor, materials and equipment necessary for completely finished and operational systems as described and specified.

C. Mechanical Equipment: Rooftop heating & air conditioning equipment, large vent stacks and similar features, if essential, are to be architecturally screened from view or painted, so as to be nonreflective to neighboring properties. Color determined by architect.

D. Verify utility requirements and characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing, connecting to, and placing in service, operating equipment.

E. Coordinate space requirements, supports, and installation of mechanical Work indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with lines of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs. Provide incidental items such as offsets, fittings and accessories required for a completely operational mechanical system.

F. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within construction. Coordinate locations of fixtures and outlets with finish elements.

G. Coordinate completion and clean-up of Work in preparation for Substantial Completion.

H. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.3 BIDS & SUBMITTAL PROCEDURES

A. During the bid phase, contractors / vendors will submit prior approvals for equipment to the engineer for approval. If there is no response from the engineer on any prior approval, then the equipment and/or material submitted has not been approved.

B. Equipment and fixtures are bid "or equal". This means the schedule sheets on the plans and the specifications are the minimum performance all equipment/fixtures must meet or exceed. In order to meet the "or equal", contractor/vendor must verify material type, physical size, weight, performance, efficiency, voltage, amps, controls, and any other item.

C. Transmit each submittal with Architect/Engineer accepted form.

D. Sequentially number transmittal forms. Mark revised submittals with original number and sequential alphabetic suffix.

E. Identify Project, Contractor, subcontractor and supplier; pertinent drawing and detail number, and specification section number, appropriate to submittal.

F. Apply Contractor's stamp, signed or initialed certifying that review, approval, verification of products required, field dimensions, adjacent construction Work, and coordination of information is in accordance with requirements of the Work and Contract Documents.

G. Schedule submittals to expedite Project and deliver to Architect/Engineer. Coordinate submission of related items. Mechanical & plumbing plans reflect engineers choice that ALL equipment must meet or exceed in performance listed in the plans. Contractors can bid equipment "As Equal" for all equipment.

H. For each submittal for review, allow 15 days excluding delivery time to and from Contractor.

I. Identify variations from Contract Documents and product or system limitations, which may be detrimental to successful performance of completed Work.

J. Allow space on submittals for Contractor and Architect/Engineer review stamps.

K. When revised for resubmission, identify changes made since previous submission.

L. Distribute copies of reviewed submittals as appropriate. Instruct parties to promptly report inability to comply with requirements.

M. Submittals not requested will not be recognized or processed.

1.4 PROPOSED PRODUCTS LIST

A. Within 15 days after date of Owner-Contractor Agreement Notice to Proceed, submit list of major products proposed for use, with name of manufacturer, trade name, and model number of each product.

B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.

1.5 PRODUCT DATA

A. Product Data: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents. Provide copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes as described.

B. Submit number of copies Contractor requires, plus two copies Architect/Engineer will retain.

C. Mark each copy to identify applicable products, models, options, and other data. Supplement manufacturers' standard data to provide information specific to this Project.

D. Indicate product utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

E. After review distribute in accordance with Submittal Procedures article above and provide copies for record documents described.

1.6 SHOP DRAWINGS

A. Shop Drawings: Submit to Architect/Engineer for review for limited purpose of checking for conformance with information given and design concept expressed in Contract Documents. Produce copies and distribute in accordance with SUBMITTAL PROCEDURES article and for record documents purposes described in Section 01700.

B. Indicate special utility and electrical characteristics, utility connection requirements, and location of utility outlets for service for functional equipment and appliances.

1.7 TEST REPORTS

A. Submit for Architect/Engineer's knowledge as contract administrator or for Owner.

B. Submit test reports for information for limited purpose of assessing conformance with information given and design concept expressed in Contract Documents.

1.8 CERTIFICATES

A. When specified in individual specification sections, submit certification by manufacturer, installation/application subcontractor, or Contractor to Architect/Engineer, in quantities specified for Product Data.

B. Indicate material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.

C. Certificates may be recent or previous test results on material or Product but must be acceptable to Architect/Engineer.

1.9 MANUFACTURER'S INSTRUCTIONS

A. When specified in individual specification sections, submit printed instructions for delivery, storage, assembly, installation, start-up, adjusting, and finishing, to Architect/Engineer for delivery to Owner in quantities specified for Product Data.

B. Indicate special procedures, perimeter conditions requiring special attention, and special environmental criteria required for application or installation.

1.10 QUALITY CONTROL AND CONTROL OF INSTALLATION

A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce Work of specified quality.

B. Comply with manufacturer's instructions, including each step-in sequence.

C. When manufacturers' instructions conflict with Contract Documents, request clarification form Architect/Engineer before proceeding.

D. Comply with specified standards as minimum quality for the Work except where more stringent tolerances, codes, or specified requirements indicate higher standards or more precise workmanship.

E. Perform Work by persons qualified to produce required and specified quality.

F. Balancing contractor shall meet mechanical engineer on site and perform random water, hydronic, and/or air test to verify documented balance reports. The location of the tests shall be the discretion of the mechanical engineer.

G. Verify field measurements are as indicated on Shop Drawings or as instructed by manufacturer.

H. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion, or disfigurement.

1.11 TOLERANCES

A. Monitor fabrication and installation tolerance control of products to produce acceptable Work. Do not permit tolerances to accumulate.

B. Comply with manufacturer's tolerances. When manufacturers' tolerances conflict with Contract Documents, request clarification form Architect/Engineer before proceeding.

C. Adjust products to appropriate dimensions; position before securing products in place.

1.12 REFERENCES

A. For products or workmanship specified by association, trade, or other consensus standards, comply with requirements of standard, except when more rigid requirements are specified or are required by applicable codes.

B. Conform to reference standard and all applicable codes, ordnances and regulations in effect, except where specific date is established by code.

C. Obtain copies of standards where required by product specification sections.

D. When specified reference standards conflict with Contract Documents, request clarification from Architect/Engineer before proceeding.

E. Comply with the latest editions of the following:
   a. 2018 International Mechanical Code;
   b. 2018 International Plumbing Code;
   c. 2018 International Building Code;
   d. 2018 International Fuel Gas Code
   e. 2018 International Fire Code.
   f. NFPA 99
   g. State Department of Health Standards
   h. 2018 International Energy Conservation Code;
   i. All National Fire Protection Standards;
   j. Current Adopted National Electric Code;

F. Neither contractual relationships, duties, nor responsibilities of parties in Contract nor those of Architect/Engineer shall be altered from Contract Documents by mention or inference otherwise in reference documents.

1.13 PRODUCTS

A. Furnish products of qualified manufacturers suitable for intended use. Furnish products of each type by single manufacturer unless specified otherwise.

B. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

C. Furnish interchangeable components from same manufacturer for components being replaced.

1.14 PRODUCT DELIVERY REQUIREMENTS

A. Transport and handle products in accordance with manufacturer's instruction.

B. Promptly inspect shipments to ensure products comply with requirements, quantities are correct, and products are undamaged.

C. Provide equipment and personnel to handle products by methods to prevent soiling, disfigurement, or damage.

1.15 PRODUCT STORAGE AND HANDLING REQUIREMENTS

A. Store and protect products in accordance with manufacturers' instructions.

B. Store with seals and labels intact and legible.

C. Store sensitive products in weather tight, climate controlled, enclosures in an environment favorable to product.

D. For exterior storage of fabricated products, place on sloped supports above ground.

E. Provide bonded off-site storage and protection when site does not permit on-site storage or protection.

F. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.

G. All duct is to arrive on site clean, new, and in working order. All supply duct is to arrive cleaned and bagged seal. Once all duct is installed, all ends are to be bagged sealed until final termination is installed.

H. Store loose granular materials on solid flat surfaces in well-drained area. Prevent mixing with foreign matter.

I. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.

1.16 PRODUCT OPTIONS

A. Products Specified by Reference Standards or by Description Only: any product meeting those standards or description.

B. Products Specified by Naming One or More Manufacturers: products of one of manufacturers named and meeting specifications, no options or substitutions allowed.

C. Products Specified by Naming One or More Manufacturers with Provision for Substitutions: Submit request for substitution for any manufacturer not named in accordance with the following article.

1.17 PRODUCT SUBSTITUTION PROCEDURES

A. Architect/Engineer will consider requests for Substitutions only within 15 days after date established in Notice to Proceed.

B. Substitutions may be considered when a product becomes unavailable through no fault of Contractor.

C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.

D. A request constitutes a representation that Contractor:
1. Has investigated proposed product and determined that it meets or exceeds quality level of specified product.
2. Will provide same warranty for Substitution as for specified product.
3. Will coordinate installation and make changes to other Work which may be required for the Work to be complete with no additional cost to Owner.
4. Waives claims for additional costs or time extension which may subsequently become apparent.
5. Will reimburse Owner and Architect/Engineer for review or redesign services associated with re-approval by authorities having jurisdiction.

E. Substitutions will not be considered when they are indicated or implied on Shop Drawing or Product Data submittals, without separate written request, or when acceptance will require revision to Contract Documents.

F. Substitution Submittal Procedure:
1. Submit three copies of request for Substitution for consideration. Limit each request to one proposed Substitution.
2. Submit Shop Drawings, Product Data, and certified test results attesting to proposed product equivalence. Burden of proof is on proposer.
3. Architect/Engineer will notify Contractor in writing of decision to accept or reject request.

1.18 CLOSEOUT PROCEDURES

A. Submit written certification that Contract Documents have been reviewed, Work has been inspected, and that Work is complete in accordance with Contract Documents and ready for Architect/Engineer's review.

1.19 FINAL CLEANING

A. Execute final cleaning prior to final project assessment.

B. Clean equipment and fixtures to sanitary condition with cleaning materials appropriate to surface and material being cleaned.

C. Clean debris from roofs, gutters, downspouts, and drainage systems.

D. Remove waste and surplus materials, rubbish, and construction facilities from site.

1.20 STARTING OF SYTEMS

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Architect/Engineer seven days prior to start-up of each item.

C. Verify each piece of equipment or system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify tests, meter readings, and specified electrical characteristics agree with those required by equipment or system manufacturer.

E. Verify wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable manufacturer's representative and Contractors' personnel in accordance with manufacturers' instructions.

G. When specified in individual specification Sections, require manufacturer to provide authorized representative to be present at site to inspect, check, and approve equipment or system installation prior to start-up, and to supervise placing equipment or system in operation.

1.21 DEMONSTRATION AND INSTRUCTIONS

A. Demonstrate operation and maintenance of products to Owner's personnel two weeks prior to date of Substantial Completion.

B. Demonstrate Project equipment and instruct by manufacturer's representative who is knowledgeable about the Project.

C. For equipment or systems requiring seasonal operation, perform demonstration for other season within six months.

D. Utilize operation and maintenance manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

E. Demonstrate start-up, operation, control, adjustment, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at scheduled time agreed time, at designated location.

F. Prepare and insert additional data in operations and maintenance manuals when need for additional data becomes apparent during instruction.

1.22 TESTING, ADJUSTING AND BALANCING

A. Independent firm will perform services specified in Section 23 05 93.

B. Reports will be submitted by independent firm to Architect/Engineer indicating observations and results of tests and indicating compliance or non-compliance with requirements of Contract Documents.

1.23 PROTECTING INSTALLED CONSTRUCTION

A. Protect installed Work and provide special protection where specified in individual specification sections.

B. Provide temporary and removable protection for installed products. Control activity in immediate work area to prevent damage.

1.24 PROJECT RECORD DOCUMENTS

A. Maintain on site one set of the following record documents; record actual revisions to the Work:
1. Drawings.
2. Specifications.
3. Addenda.
4. Change Orders and other modifications to the Contract.
5. Reviewed Shop Drawings, Product Data, and Samples.
6. Manufacturer's instruction for assembly, installation, and adjusting.

B. Ensure entries are complete and accurate, enabling future reference by Owner.

C. Store record documents separate from documents used for construction.

D. Record information concurrent with construction progress, not less than weekly.

E. Specifications: Legibly mark and record at each product section description of actual products installed, including the following:
1. Manufacturer's name and product model and number.
2. Product substitutions or alternates utilized.
3. Changes made by Addenda and modifications.

F. Record Drawings and Shop Drawings: Legibly mark each item to record actual construction including:
1. Measured depths of foundations in relation to finish first floor datum.
2. Measured horizontal and vertical locations of underground utilities and appurtenances, referenced to permanent surface improvements.
3. Measured locations of internal utilities and appurtenances concealed in construction, referenced to visible and accessible features of the Work.
4. Field changes of dimension and detail.
5. Details not on original Contract drawings.

G. Submit documents to Architect/Engineer.

1.25 OPERATION AND MAINTENANCE DATA

A. Submit data bound in 8-1/2 x 11-inch (A4) text pages, three D side ring binders with durable plastic cloth covers.

B. Prepare binder cover with printed title "OPERATION AND MAINTENANCE INSTRUCTIONS", title of project, and subject matter of binder when multiple binders are required.

C. Internally subdivide binder contents with permanent page dividers, logically organized as described below; with tab titling clearly printed under reinforced laminated plastic tabs.

D. Drawings: Provide with reinforced punched binder tab. Bind in with text; fold larger drawings to size of text pages.

E. Contents: Prepare Table of Contents for each volume, with each product or system description identified, typed on white paper, in three parts as follows:
   1. Part 1: Directory, listing names, addresses, and telephone numbers of Architect/Engineer, Contractor, Subcontractors, and major equipment suppliers.
   2. Part 2: Operation and maintenance instructions, arranged by system and subdivided by specification section. For each category, identify names, addresses, and telephone numbers of Subcontractors and suppliers. Identify the following:
      a. Significant design criteria.
      b. List of equipment.
      c. Parts list for each component.
      d. Operating instructions.
      e. Maintenance instructions for equipment and systems.
      f. Maintenance instructions for [special] finishes, including recommended cleaning methods and materials, and special precautions identifying detrimental agents.
   3. Part 3: Project documents and certificates, including the following:
      a. Shop drawings and product data.
      b. Air and water balance reports.
      c. Certificates.
      d. Photocopies of warranties and bonds.

1.26 MANUAL FOR EQUIPMENT AND SYSTEMS

A. Submit two copies of preliminary draft or proposed formats and outlines of contents before start of Work. Architect/Engineer will review draft and return one copy with comments.

B. For equipment, or component parts of equipment put into service during construction and operated by Owner, submit documents within ten days after acceptance.

C. Submit one copy of completed volumes 15 days prior to final inspection. Draft copy be reviewed and returned [after final inspection], with Architect/Engineer comments. Revise content of document sets as required prior to final submission.

D. Submit three sets of revised final volumes in final form within 10 days after final inspection.

E. Each Item of Equipment and Each System: Include description of unit or system, and component parts. Identify function, normal operating characteristics, and limiting conditions. Include performance curves, with engineering data and tests, and complete nomenclature and model number of replaceable parts.

F. Operating Procedures: Include start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and special operating instructions.

G. Maintenance Requirements: Include routine procedures and guide for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.

H. Include original manufacturer's parts list, illustrations, assembly drawings, and diagrams required for maintenance.

I. Include Contractor's coordination drawings, with color coded piping diagrams as installed.

J. Include charts of valve tag numbers, with location and function of each valve, keyed to flow and control diagrams.

K. Include list of original manufacturer's spare parts, current prices, and recommended quantities to be maintained in storage.

L. Include listing in Table of Contents for design data, with tabbed dividers and space for insertion of data.

1.27 SPARE PARTS AND MAINTENANCE PRODUCTS

A. Furnish spare parts, maintenance, and extra products in quantities specified in individual specification sections.

B. Deliver to Project site. Obtain receipt.

PART 2 - PRODUCTS FOR ALTERNATE BIDS

Not Used.

PART 3 EXECUTION

Not Used.

END OF SECTION

SECTION 23 05 93 - TESTING, ADJUSTING AND BALANCING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes testing, adjusting, and balancing of air systems, testing, adjusting, and balancing of hydronic systems, measurement of final operating condition of HVAC systems, sound measurement of equipment operating conditions, vibration measurement of equipment operating conditions.

1.2 REFERENCES

A. AABC (Associated Air Balance Council) - National Standards for Total System Balance.

B. ASHRAE 111 (American Society of Heating, Refrigerating and Air-Conditioning Engineers) - Practices for Measurement, Testing, Adjusting, and Balancing of Building Heating, Ventilation, Air-conditioning, and Refrigeration Systems.

C. NEBB (National Environmental Balancing Bureau) - Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems.

D. Refer to Spec Section 22 05 53: Mechanical Identification.

1.3 SUBMITTALS

A. Provide in accordance with the General Conditions of the Contract.

B. Test Reports: Indicate data on AABC National Standards for Total System Balance forms or NEBB Report forms.

C. Field Reports: Indicate deficiencies preventing proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.

D. Prior to commencing Work, submit report forms or outlines indicating adjusting, balancing, and equipment data required.

E. Submit draft copies of report for review prior to final acceptance of Project. Furnish final copies for Architect/Engineer and for inclusion in operating and maintenance manuals.

F. Furnish reports in 3-ring binder manuals, complete with table of contents page and indexing tabs, with cover identification at front and side. Include set of reduced drawings with air outlets and equipment identified to correspond with data sheets and indicating thermostat locations.

G. Include detailed procedures, agenda, sample report forms and copy of AABC National Project Performance Guaranty and Copy of NEBB Certificate of Conformance Certification prior to commencing system balance.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of flow measuring stations balancing valves and rough setting.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with AABC National Standards for Field Measurement and Instrumentation, Total System Balance or NEBB Procedural Standards for Testing, Balancing and Adjusting of Environmental Systems

B. Maintain one copy of each document on site.

1.6 QUALIFICATIONS

A. Agency: Company specializing in testing, adjusting, and balancing of systems specified in this section with minimum 10 years documented experience Certified by NEBB.

B. Perform Work under supervision of NEBB Certified Testing, Balancing and Adjusting Supervisor.

1.7 SEQUENCING

A. Sequence balancing between completion of systems tested and Date of Substantial Completion.

1.8 SCHEDULING

A. Schedule and provide assistance in final adjustment and test of life safety system with Fire Authority.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify systems are complete and operable before commencing work. Verify the following:
1. Systems are started and operating in safe and normal condition.
2. Temperature control systems are installed complete and operable.
3. Proper thermal overload protection is in place for electrical equipment.
4. Final filters are clean and in place. If required, install temporary media in addition to final filters.
5. Duct systems are clean of debris.
6. Fans are rotating correctly.
7. Fire and volume dampers are in place and open.
8. Air coil fins are cleaned and combed.

9. Access doors are closed, and duct end caps are in place.
10. Air outlets are installed and connected.
11. Duct system leakage is tested and meets specification set points.
12. Hydronic systems are flushed, filled, and vented. T & B contractor must have the flush & cleaning reports on hand when performing test & balancing.
13. Pumps are rotating correctly.
14. All springs (inertia bases, in-line pumps, supply fans, exhaust fans, etc.) have the factory shipping support blocks removed.
15. Springs have been adjusted to vibration movement distances.
16. Proper strainer baskets are clean and in place or in normal position.
17. Service and balancing valves are open.

a. If T & B contractor notices any discrepancy, he is to notify the M.C. and G.C. within 24 hours, document the findings, and proceed.

B. Submit field reports. Report defects and deficiencies noted during performance of services, preventing system balance.

3.2 PREPARATION

A. Furnish instruments required for testing, adjusting, and balancing operations. Make instruments available to Architect/Engineer to facilitate spot checks during testing.

3.3 INSTALLATION TOLERANCES

A. Air Handling (RTU's and MAU's) & Exhaust Systems: Adjust to within plus or minus 10 percent of design.

B. Air Outlets and Inlets: Adjust total to within plus 10 percent and minus 5 percent of design to space. Adjust outlets and inlets in space to within plus or minus 10 percent of design.

C. Hydronic Systems: Adjust to within plus or minus 10 percent of design.

3.4 ADJUSTING

A. Verify recorded data represents actual measured or observed conditions.

B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.

C. After adjustment, take measurements to verify balance has not been disrupted. If disrupted, verify correcting adjustments have been made.

D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.

E. At final inspection, recheck random selections of data recorded in report. Recheck points or areas as selected and witnessed by Owner.

F. Check and adjust systems approximately six months after final acceptance and submit report.

3.5 AIR SYSTEM PROCEDURE

A. Adjust air handling and distribution systems to obtain required or design supply, return, and exhaust air quantities at site altitude.

B. Make air quantity measurements in main ducts by Pitot tube traverse of entire cross-sectional area of duct.

C. Measure air quantities at air inlets and outlets.

D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts.

E. Use volume control devices to regulate air quantities only to extent adjustments do not create objectionable air motion or sound levels. Effect volume control by using volume dampers located in ducts.

F. Vary total system air quantities by adjustment of fan speeds. Provide sheave drive changes to vary fan speed. Vary branch air quantities by damper regulation.

G. Provide system schematic with required and actual air quantities recorded at each outlet or inlet.

H. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across fan. Make allowances for 50 percent loading of filters.

I. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.

J. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.

K. At modulating damper locations, take measurements and balance at extreme conditions. Balance variable volume systems at maximum airflow rate, full cooling, and at minimum airflow rate, full heating.

L. Measure building static pressure and adjust supply, return, and exhaust air systems to obtain required relationship between each to maintain approximately 0.025 inches positive static pressure near building entries.

M. Verify modulating fire/smoke dampers operates properly.

3.6 WATER SYSTEM PROCEDURE

A. Adjust water systems, after air balancing, to obtain design quantities.

B. Use calibrated Venturi tubes, orifices, or other metered fittings and pressure gauges to determine flow rates for system balance. Where flow-metering

devices are not installed, base flow balance on temperature difference across various heat transfer elements in system.

C. Adjust systems to obtain specified pressure drops and flows through heat transfer elements prior to thermal testing. Perform balancing by measurement of temperature differential in conjunction with air balancing.

D. Effect system balance with automatic control valves fully open or in normal position to heat transfer elements.

E. Effect adjustment of water distribution systems by means of balancing cocks, valves, and fittings. Do not use service or shut-off valves for balancing unless indexed for balance point.

F. Where available pump capacity is less than total flow requirements or individual system parts, simulate full flow in one part by temporary restriction of flow to other parts.

G. Check and adjust if necessary MAU evap sump level. Verify sump height is maintained as pumps start & stop.

H. Verify proper operation of domestic water booster pump (if designed) by simulating low pressure conditions and high-pressure conditions.

I. Verify sewage ejector proper operation (if applicable) by turning off one pump and making sure back-up pumps automatically turns on. Also verify and document and document pump off water height, pump #1 on water level, pump #2 water level, pump #3, and high-water alarm height.

J. Verify & document domestic water pressure at the following locations:
1. Inlet to building.
2. After double check valves.
3. After domestic water booster pump.
4. Pressure entering penthouse floor.

3.7 SYSTEM TESTING

A. Test & balance contractor is to include in his bid to provide an additional 10 hours of on-site return trips, changes to the system, "tweaks", equipment changes and adjustments, engineer requested changes or adjustments after the building has been issued its Certificate of Occupancy.

B. Test & Balance Contractor must have the flush & cleaning reports of all systems while on-site balancing.

C. Test & Balance contractor shall verify system operation including but not limited to:
1. Domestic heating water pump aqua stat set point and proper on/off operation.
2. MAU automatic drain/fill operation.
3. RTU full economizer operation.
4. Domestic hot water recirc pumps start/stop properly.
5. Domestic hot water temp is set properly & operating properly.

6. Domestic water booster pump start/stops properly and controls proper water pressure via VFD to pressure sensor.

END OF SECTION

SECTION 23 08 00 - COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Commissioning is to performed from 2012 IECC, Section C408.

1.2 SUMMARY

A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.

B. Related Sections:

1. Section 019113 "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.

B. CxA: Commissioning Authority.

C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.

D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 INFORMATIONAL SUBMITTALS

A. Certificates of readiness.

B. Certificates of completion of installation, prestart, and startup activities.

1.5 ALLOWANCES

A. Not applicable.

1.6 UNIT PRICES

A. Not applicable.

1.7 CONTRACTOR'S RESPONSIBILITIES

A. Perform commissioning tests at the direction of the CxA.

B. Attend construction phase controls coordination meeting.

C. Attend testing, adjusting, and balancing review and coordination meeting.

D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.

E. All work by the G.C, mechanical contractor, plumbing contractor, test & balance contractor, and ATC contractor is to include the work for the commissioning. This includes, but not limited to systems adjusting and balancing, air systems balancing, hydronic systems balancing, functional performance testing, economizer operation of applicable equipment, water flushing & cleaning reports, and all other documented reports.

F. Provide information requested by the CxA for final commissioning documentation.

G. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

H. Send a copy of the Preliminary Commissioning Report to the building owner. The building owner will need to send a letter of transmittal to the Code Official that he has received the Preliminary Commissioning Report. Preliminary Commissioning Report shall be made available for review for the code official.

I. Operating and Maintenance Manual from section 23 05 93 and including the items from IECC Section C408.2.5.1 & C408.2.5.2.

J. Test & Balance Contractor is to compile a written report describing the activities and measurements completed in accordance with C408.2.2. Once completed, send a copy of the report to the CxA.

1.8 CxA'S RESPONSIBILITIES

A. Develop a commissioning plan:
   1. A narrative description of the activities that will be accomplished during each phase of commissioning, including the personnel intended to accomplish each of the activities.
   2. A listing of the specific equipment, appliances or systems to be tested and a description of the tests to be performed.
   3. Functions to be tested, including, but not limited to calibrations and economizer controls.

4. Conditions under which the test will be performed. At a minimum, testing shall affirm winter and summer design conditions and full outside air conditions.
5. Measurable criteria for performance.

B. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.

C. Direct commissioning testing.

D. Verify testing, adjusting, and balancing of Work are complete.
1. Prepare a preliminary report of commissioning test procedures and results. Reports are to incorporate the following:
   a. Itemization of deficiencies found during testing required by IECC Section C408 that have not been corrected at the time of report preparation.
   b. Deferred tests than cannot be performed of climate conditions.
   c. Climatic conditions required for performance of the deferred test.

E. Provide test data, inspection reports, and certificates in Systems Manual and in accordance with 2012 IECC, Section C408.

F. Prepare a Final Commissioning Report per Section C408.2.5.4

1.9 COMMISSIONING DOCUMENTATION

A. Provide the following information to the CxA for inclusion in the commissioning plan:

1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.
4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.

B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.

C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.

D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).

E. Inspect and verify the position of each device and interlock identified on checklists.

F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.

G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 Testing AND BALANCING VERIFICATION

A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.

B. Notify the CxA at least **10** days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.

C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.

1. The CxA will notify testing and balancing **Contractor 10** business days in advance of the date of field verification. Notice will not include data points to be verified.
2. The testing and balancing **Contractor** shall use the same instruments (by model and serial number) that were used when original data were collected.
3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.

4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.

B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.

C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.

D. The CxA along with the HVAC&R Contractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.

E. Tests will be performed using design conditions whenever possible.

F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

G. The CxA may direct that set points be altered when simulating conditions is not practical.

H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.

I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.

J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R systems, subsystems, and equipment Testing Procedures

A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in HVAC boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.

B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Section 230900 "Building Automation System" and

Section 230993 "Sequence and Operations for HVAC Controls.". Assist the CxA with preparation of testing plans.

C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in HVAC piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:

1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
2. Description of equipment for flushing operations.
3. Minimum flushing water velocity.
4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.

D. Energy Supply System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of gas & hot water systems and equipment at the direction of the CxA. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

E. Refrigeration System Testing (if applicable): Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

F. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.

G. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 23 08 00

SECTION 23 11 13 – NATURAL GAS PIPING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes piping, fittings, and valves.

B. Related Sections:
1. Section 22 05 29: Hangers and Supports.
2. Section 22 05 23: Valves.
3. Section 22 05 53: – Mechanical Identification: Product requirements for valve and pipe identification for placement by this section.

1.2 REFERENCES

A. ASME Section IX (American Society of Mechanical Engineers) - Welding and Brazing Qualifications.

B. ASME B16.3 (American Society of Mechanical Engineers) - Malleable Iron Threaded Fittings.

C. ASME B31.2 (American Society of Mechanical Engineers) - Fuel Gas Piping.

D. ASME B31.9 (American Society of Mechanical Engineers) - Building Service Piping.

E. ASME B36.10 (American Society of Mechanical Engineers) - Welded and Seamless Wrought Steel Pipe.

F. ASTM A53 - Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless.

G. ASTM A234/A234M - Pipe Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and Elevated Temperatures

H. AWS D1.1 (American Welding Society)-Structural Welding Code.

I. NFPA 54 (National Fire Protection Association) – National Fuel Gas Code.

J. UL 1479 (Underwriters Laboratories, Inc.) - Fire Tests of Through-Penetration Firestops.

1.3 SUBMITTALS

A. Submittals: Provide in accordance with the General Conditions of the Contract.

B. Product Data: Submit data on pipe materials, pipe fittings, valves and accessories. Submit manufacturers catalog information. Indicate valve data and ratings.

1.4 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of valves, piping system, and system components.

B. Operation and Maintenance Data: Submit installation instructions, spare parts lists.

1.5 QUALITY ASSURANCE

A. Perform Work in accordance with NFPA 54 and local gas company jurisdiction standards.

B. Perform Work in accordance with ASME B31.2, ASME B31.9 code for installation of piping systems and ASME Section IX for welding materials and procedures.

C. Perform Work in accordance with applicable authority for welding hanger and support attachments to building structure.

1.6 ENVIRONMENTAL REQUIREMENTS

A. Do not install underground piping when bedding is wet or frozen.

1.7 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

PART 2 PRODUCTS

2.1 NATURAL GAS PIPING BURIED WITHIN 5 FEET OF BUILDING

B. A. Steel Pipe: ASTM A53 Schedule 40 black.
1. Fittings: ASTM A234/A234M forged steel welding type.
2. Joints: ASME B31.1, ASME B31.2, ASME B31.9 and ASME Section 9, welded.
3. Jacket: AWWA C105 polyethylene jacket or double layer, half-lapped 10 mil (0.25 mm) polyethylene tape.

2.2 NATURAL GAS PIPING, ABOVE GRADE

A. Steel Pipe: ASTM A53 Schedule 40 black.
4. Fittings: ASME B16.3, malleable iron, or ASTM A234/A234M forged steel welding type.
5. Joints: NFPA 54, threaded or welded to ASME B31.2, ASME B31.9.

2.3 FLANGES, UNIONS, AND COUPLINGS

A. Pipe Size 2 inches (50 mm) and Under:
6. Ferrous pipe: 150 psi (1034 kPa) malleable iron threaded unions.
7. Copper tube: 150 psi (1034 kPa) bronze unions with brazed joints.

C. Pipe Size Over 2 inches (50 mm):

1. Ferrous pipe: 150 psi (1034 kPa) forged steel slip-on flanges; 1/16 inch (1.6 mm) thick preformed neoprene gaskets.
2. Copper tube: 150 psi (1034 kPa) slip-on bronze flanges; 1/16 inch (1.6 mm) thick preformed neoprene gaskets.

2.4 PIPE HANGERS AND SUPPORTS

A. Conform ASME B31.2, ASME 31.9.
B. Hangers for Pipe Sizes ½ to 1-1/2 inch (15 to 40 mm): Carbon steel, adjustable swivel, split ring.

D. Hangers for Pipe Sizes 2 inches (50 mm) and Over: Carbon steel, adjustable, clevis.

E. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.

F. Wall Support for Pipe Sizes to 3 inches (80 mm): Cast iron hook.

G. Vertical Support: Steel riser clamp.

H. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.

2.5 FIRE STOP SYSTEMS

A. General Purpose Fire Stopping Sealant: Water based, non-slumping, premixed sealant with in tumescent properties, rated for 3 hours in accordance with ASTM E814 and UL 1479.

B. General Purpose Vibration Resistant Fire Stopping Sealant: Silicone based, non-slumping, premixed sealant with in tumescent properties, vibration and moisture resistant, rated for 3 hours in accordance with ASTM E814 and UL 1479.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify excavations are to required grade, dry, and not over-excavated.

3.2 PREPARATION

A. Ream pipe and tube ends. Remove burrs. Bevel plain end ferrous pipe.

B. Remove scale and dirt, on inside and outside, before assembly.

C. Prepare piping connections to equipment with flanges or unions

3.3 INSTALLATION

A. Install natural gas piping in accordance with ASME B31.2.

B. Provide non-conducting dielectric connections wherever jointing dissimilar metals. Install in accordance with NACE RP-01-69.

C. Route piping in orderly manner and maintain gradient.

D. Install piping to conserve building space and not interfere with use of space.

E. Group piping whenever practical at common elevations.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Provide access where valves and fittings are not exposed. Coordinate size and location of access doors with General Contractor.

I. Where pipe support members are welded to structural building framing, scrape, brush clean, weld, and apply one coat of zinc rich primer.

J. Provide support for utility meters in accordance with requirements of utility company.

K. Pipe vents from gas pressure reducing valves to outdoors and terminate in weatherproof hood.

L. Install identification on piping systems including underground piping. Refer to Section 22 05 53.

M. Install valves with stems upright or horizontal, not inverted.

N. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the work, and isolating parts of completed system.

O. Provide new gas service. Gas service distribution piping to have initial minimum pressure. As shown in the Drawings.

END OF SECTION

SECTION 23 31 00 - DUCTS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes metal ductwork, nonmetallic ductwork, casing and plenums, buried ductwork, kitchen hood ductwork, duct cleaning.

B. Related Sections:
1. Section 22 05 29 – Hangers and Supports: Product requirements for hangers, supports and sleeves for placement by this section.

1.2 REFERENCES

A. ASTM A36 - Structural Steel.

B. ASTM A90 - Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.

C. ASTM A167 - Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.

D. ASTM A366 - Steel, Sheet, Carbon, Cold Rolled, Commercial Quality.

E. ASTM A568 - Steel, Sheet, Carbon, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled.

F. ASTM A569 - Steel, Carbon (0.15 Maximum, Percent), Hot-Rolled Sheet and Strip, Commercial Quality.

G. ASTM B209 - Aluminum and Aluminum-Alloy Sheet and Plate.

H. NFPA 90A (National Fire Protection Association) - Installation of Air Conditioning and Ventilating Systems.

I. NFPA 90B (National Fire Protection Association) - Installation of Warm Air Heating and Air Conditioning Systems.

J. SMACNA (Sheet Metal Air Conditioning Contractors' National Association) - HVAC Air Duct Leakage Test Manual.

K. SMACNA (Sheet Metal Air Conditioning Contractors' National Association) - HVAC Duct Construction Standards - Metal and Flexible.

L. SMACNA (Sheet Metal Air Conditioning Contractors' National Association) - Fibrous Glass Duct Construction Standards.

M. UL 181 (Underwriters Laboratories, Inc.) - Factory-Made Air Ducts and Connectors.

1.3 PERFORMANCE REQUIREMENTS

A. No variation of duct configuration or sizes other than those of equivalent or lower loss coefficient is permitted except by written permission. Size round ducts installed in place of rectangular ducts in accordance with ASHRAE table of equivalent rectangular and round ducts.

1.4 SUBMITTALS

A. Provide in accordance with the General Conditions of the Contract.

B. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

C. Manufacturer's Installation Instructions: Submit special procedures for glass fiber ducts.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: Record actual locations of ducts and duct fittings. Record changes in fitting location and type. Show additional fittings used.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.

B. Construct ductwork to NFPA 90A and NFPA 90B standards.

C. All duct is to arrive on site cleaned and bagged seal. Once installed, duct is to be bagged capped until next duct is ready to be installed. No duct is to be left open during construction either installed or waiting to be installed.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealant.

1.8 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.9 WARRANTY

A. Furnish 1-year manufacturers warranty for ducts.

PART 2 PRODUCTS

2.1 DUCT MATERIALS

A. Galvanized Steel Ducts: ASTM A525 and ASTM A527 galvanized steel sheet, lock-forming quality, having G60 zinc coating of in conformance with ASTM A90.

B. Steel Ducts: ASTM A366 A569 A568.

C. Aluminum Ducts: ASTM B209; aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock: Alloy 6061- T6 or of equivalent strength.

D. Fasteners: Rivets, bolts, or sheet metal screws.

E. Hanger Rod: ASTM A36; steel, galvanized threaded both ends, threaded one end, or continuously threaded.

2.2 DUCTWORK FABRICATION

A. Fabricate and support in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings. Furnish duct material, gages, reinforcing, and sealing for operating pressures indicated.

B. Construct T's, bends, and elbows with minimum radius 1-1/2 times centerline duct width. Where not possible and where rectangular elbows are used, provide turning vanes. Where acoustical lining is indicated, furnish turning vanes of perforated metal with glass fiber insulation.

C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.

D. Fabricate continuously welded round and oval duct fittings two gages heavier than duct gages indicated in SMACNA Standard. Minimum 4 inch (100 mm) cemented slip joint, brazed or electric welded. Prime coat welded joints.

E. Provide standard 45-degree lateral wye takeoffs. When space does not allow 45-degree lateral wye takeoff, use 90-degree conical tee connections.

F. Radius elbows shall be used in lieu of 90's with turning vanes. If there is any conflict on the plans, coordinate with engineer prior to construction.

G. All high-pressure take-offs from the shaft shall have high efficiency take-off's. All low-pressure take-offs shall have HET's.

H. Refer to IMC Section 513. IMC Section 513.10.2 states, "Duct materials and joints shall be capable of withstanding temperatures and pressures to which they are exposed as determined in accordance with 513.10.1. Ducts shall be constructed and supported in accordance with Chapter 6. Ducts shall be leak tested to 1.5 times the maximum design pressure in accordance with nationally accepted practices. Measured leakage shall not exceed 5% of the design flow. Results of

such testing shall be a part of the documentation procedure. Ducts shall be supported directly from fire-resistance-rated structural elements of the building by substantial, noncombustible supports.

2.3 INSULATED FLEXIBLE DUCTS

A. Manufacturers: Flex Master

B. When using flexible duct, contractor is to install rigid duct with a 90° elbow facing down, then install flex duct vertically from the 90° elbow to the grille or register. There are cases where this is not possible, and we understand this.

C. Two ply vinyl film supported by helical wound spring steel wire; fiberglass insulation; polyethylene aluminized vapor barrier film.
1. Pressure Rating: 10 inches wg (2.50 kPa) positive and 1.0 inches wg (250 Pa) negative.
2. Maximum Velocity: 4000 fpm (20.3 m/sec).
3. Temperature Range: -10 degrees F to 160 degrees F (-23 degrees C to 71 degrees C).

2.4 GLASS FIBER DUCTS

A. Fabricate in accordance with SMACNA Fibrous Glass Duct Construction Standards, except as indicated on Drawings. (Return air boots and transfer ducts only).

B. Pressure sensitive tape, UL approved. 2 inch (50mm) wide pressure sensitive tape, UL approved.

C. Machine-fabricate glass fiber ducts and fittings. Make only minor on site manual adjustments.

D. Staple duct joints and tape with 3 inches (75 mm) wide 2 mil (0.05) thick or 2 inches (50 mm) wide 3 mil (0.75 mm) thick aluminum.

PART 3 EXECUTION

3.1 EXAMINATION

A. Section 01300 - Administrative Requirements: Coordination and project conditions.

B. Verify sizes of equipment connections before fabricating transitions.

3.2 INSTALLATION

A. Install and seal ducts in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Install glass fiber ducts in accordance with SMACNA Fibrous Glass Duct Construction Standards. Obtain manufacturer's inspection and acceptance of fabrication and installation at beginning of installation.

C. During construction, install temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.

D. Use crimp joints with or without bead or beaded sleeve couplings for joining all round ducts.

E. Use double nuts and lock washers on threaded rod supports.

F. Connect flexible ducts to metal ducts with draw bands. Maximum flex duct length 4'.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Install openings in ductwork where required to accommodate thermometers and controllers. Install pitot tube openings for testing of systems. Install pitot tube complete with metal can with spring device or screw to prevent air leakage. Where openings are provided in insulated ductwork, install insulation material inside metal ring.

B. Connect terminal units to supply ducts directly. Do not use flexible duct to change direction.

3.4 CLEANING

A. Section 01700 - Execution Requirements: Final cleaning.

B. Clean duct system and force air at high velocity through duct to remove accumulated dust. To obtain sufficient air flow, clean one half of system completely before proceeding to another half. Protect equipment with potential to be harmed by excessive dirt with temporary filters, or bypass during cleaning.

3.5 SCHEDULES

DUCTWORK MATERIAL SCHEDULE

AIR SYSTEM	MATERIAL
Supply (Heating Systems)	Galvanized Steel, Aluminum
Supply (System with Cooling Coils)	Galvanized Steel, Aluminum
Return and Relief	Galvanized Steel, Aluminum
General Exhaust	Galvanized Steel, Aluminum

Transfer Air and Sound Boots	Fibrous Glass Duct.

END OF SECTION

SECTION 23 32 00 – DUCT AIR LEAKAGE TESTING

PART 1 GENERAL

1.1 SUMMARY

A. Section includes roadmap to successful duct air leakage testing.

B. Related Sections:
1. Section 23 31 00: Ducts
2. Section 23 33 00: Duct accessories.

1.2 REFERENCES

A. AABC National Standard

B. SMACNA (Sheet Metal Air Conditioning Contractors' National Association) - HVAC Air Duct Leakage Test Manual.

C. SMACNA (Sheet Metal Air Conditioning Contractors' National Association) - HVAC Duct Construction Standards - Metal and Flexible.

D. SMACNA (Sheet Metal Air Conditioning Contractors' National Association) - Fibrous Glass Duct Construction Standards.

E. ASHRAE Fundamentals Handbook – current edition.

F. UL 181 (Underwriters Laboratories, Inc.) - Factory-Made Air Ducts and Connectors.

1.3 PERFORMANCE REQUIREMENTS

A. The Engineer is to specify the systems to be tested for duct air leakage (supply, return, and air handler).

B. Engineer is to specify the test pressure that does not exceed the pressure rating of the duct construction.

C. Engineer is to specify the system's maximum allowable duct leakage percentage.

D. The Mechanical Contractor shall:
1. Prepare the duct / air handler section(s) to be tested.
2. Provide connections for duct leakage test apparatus.
3. Pre-test the system prior to scheduling the air balance agency testing to prevent failed tests and schedule delays.
4. Take corrective action to seal the ducts when the maximum allowable leakage rate is exceeded.
5. Allow sealant enough curing time before any duct pressurization.

E. The Air Balance Agency shall report:
1. The date of the test.

2. The name and phase of the project.
3. A complete description of the ductwork tested, including location, sealing classification, and duct classification.
4. The test design static pressure and the actual test static pressure.
5. The test design maximum allowable leakage rate and the actual leakage rate.
6. The calculation of the duct test section maximum allowable leakage rate.
7. The tested result, "pass" or "fail".
8. The orifice size, manufacturer, orifice tube serial #, and calibration date.
9. The actual orifice pressure differential and the actual airflow.
10. The name of the technician performing the test and any other inspectors or engineers witnessing the tests.

1.4 SUBMITTALS

A. Provide in accordance with the General Conditions of the Contract.

B. Test Reports: Indicate pressure tests performed. Include date, section tested, test pressure, and leakage rate, following SMACNA HVAC Air Duct Leakage Test Manual.

C. All duct (supply, return, exhaust) is to be tested under a positive test pressure. ASHRAE/SMACNA/TIMA 1985, Swim and Griggs 1995 have confirmed that longitudinal seam, transverse joint, and assembled duct leakage can be represented from equation (1) and that for the same construction, leakage is not significantly different in the negative and positive modes.
1. Equation (1): $Q = C\Delta p_s^N$
2. Q = duct leakage rate.
3. C = constant reflecting area characteristics of leakage path.
4. Δp_s = static pressure differential from duct interior to exterior, in H_2O.
5. N = exponent relating turbulent or laminar floe in leakage path.

1.5 CLOSEOUT SUBMITTALS

A. Project Record Documents: See 1.3, E.

1.6 QUALITY ASSURANCE

A. Perform Work in accordance with SMACNA - HVAC Duct Construction Standards - Metal and flexible.

B. Perform work in accordance with AABC National Standards.

C. With no significant difference in leakage rate results, PVE, Inc. requests to always tests all duct and under a positive pressure. A positive pressure allows the use of smoke or wave of your hand across duct connections to identify leaks. Under negative pressure, the identification or areas of leakage is much more difficult, more time consuming, and almost impossible at times.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Do not install duct sealant when temperatures are less than those recommended by sealant manufacturers.

B. Maintain temperatures during and after installation of duct sealant.

PART 2 PRODUCTS

2.1 TEST CRITERIA

A. The supply air & return air main ducts are to be pressurized to 1½ times the design fan static pressure with 1% of the system total design CFM as the maximum allowable leakage rate. Test all floors of the building and all duct loops on all floors. Each floor is to be tested independently and documented for each floor.

B. Exhaust air main ducts are to be pressurized to 1½ times the fan design static pressure with 2% of the system total design CFM as the maximum allowable leakage rate.

2.2 TEST SECTIONS AND PRE-TEST

A. Mechanical contractor may elect to separate the systems into sections such as risers, shafts, loops per floor, etc.

B. Mechanical contractor should pre-test each section prior to any air balance agency testing, inspector witnessing, mechanical engineer witnessing, duct insulation installation, duct shafts are closed up, or any other structural construction that will have an impact is continued.

PART 3 RESULTS

3.1 CONCLUSION

A. For a medium or high-pressure design (2" W.G. and up) SMACNA specifies that: "Total allowable leakage should not exceed 1% of the total system design air flow rate." However, comparisons have shown that leakage rates greater than 1% reflects a 39% annual increase to operate the fans.

B. United McGill maintains that a quality fabricated duct system, properly installed and sealed, should achieve leakage rates as low as 0.5% of 1%. Since the power required to operate HVAC RTU's and MAU's is normally the largest contributor to building energy costs, every effort should be made to reduce this expenditure.

END OF SECTION

SECTION 23 33 00 - DUCT ACCESSORIES

PART 1 GENERAL

1.1 SUMMARY

A. Section includes back-draft dampers, combination fire-and-smoke dampers, duct access doors, fire dampers, smoke dampers, volume control dampers, flexible duct connections and duct test holes.

B. Related Sections:
1. Division 16 - Wiring Devices: Execution requirements for connection of electrical Combination Smoke and Fire Dampers specified by this section.

1.2 REFERENCES

A. All Fire/Smoke Dampers are to be rated per IFC, NFPA 99, IBC, & UL Standards for High Rise Buildings. Coordinate with Fire Alarm Contractor and Plans for F/S Dampers with factory installed end switches.

B. NFPA 90A (National Fire Protection Association) - Installation of Air Conditioning and Ventilating Systems.

C. NFPA 92A (National Fire Protection Association) - Smoke Control Systems.

D. SMACNA (Sheet Metal Air Conditioning Contractors' National Association) - HVAC Duct Construction Standards - Metal and Flexible.

E. UL 33 (Underwriters Laboratories, Inc.) - Heat Responsive Links for Fire-Protection Service.

F. UL 555 (Underwriters Laboratories, Inc.) - Fire Dampers and Ceiling Dampers.

G. UL 555S (Underwriters Laboratories, Inc.) - Leakage Rated Dampers for Use in Smoke Control Systems.

1.3 SUBMITTALS

A. Provide in accordance with the General conditions of the Drawings.

B. Product Data: Submit data for shop fabricated assemblies including volume control dampers duct access doors and hardware used. Include electrical characteristics and connection requirements.

C. Manufacturer's Installation Instructions: Submit for Fire and Combination Smoke and Fire Dampers.

1.4 CLOSEOUT SUBMITTALS

A. Section 01700 - Execution Requirements: Closeout procedures.

B. Project Record Documents: Record actual locations of access doors and test holes.

C. Operation and Maintenance Data: Submit for Combination Smoke and Fire Dampers.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Protect dampers from damage to operating linkages and blades.

1.6 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.7 COORDINATION

A. Coordinate Work where appropriate with building control Work.

PART 2 PRODUCTS

2.1 COMBINATION FIRE AND SMOKE DAMPERS

A. Fabricate in accordance with NFPA 90A, UL 555, and UL 555S.

B. Multiple-Blade Dampers: Fabricate with 16 gage (1.5 mm) galvanized steel frame and blades. Furnish oil-impregnated bronze or stainless-steel sleeve bearings and plated steel axles, stainless steel jamb seals, 1/8 x 1/2-inch (3.2 x 12.7 mm) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock, and 1/2-inch (12.7 mm) actuator shaft.

C. Operators: UL listed and labeled spring return electric type suitable for 120 volts, single phase, 60 Hz. Furnish end switches to indicate damper position. Locate damper operator on interior or exterior of duct and link to damper operating shaft.

D. Normally Closed Smoke Responsive Fire Dampers: Curtain type, opening by gravity upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure.

E. Normally Open Smoke Responsive Fire Dampers: Curtain type, closing upon actuation of Electro thermal link, flexible stainless-steel blade edge seals to produce constant sealing pressure, stainless steel springs with locking devices to maintain positive closure for units mounted horizontally.

F. Electro Thermal Link: Fusible link melting at 165 degrees F; 120 volts, single phase, 60 Hz; UL listed and labeled.

G. All Fire / Smoke Dampers are to UL Listed & Rated for High Rise Applications utilizing a smoke management system and come factory installed with end switches for fire alarm contractor to integrate into the fire alarm panels.

2.2 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible.

B. Fabrication: Rigid and close fitting of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, furnish minimum 1 inch (25 mm) thick insulation with sheet metal cover.
1. Less Than 12 inches (300 mm) square, secure with sash locks.
2. Up to 18 inches (450 mm) Square: Furnish two hinges and two sash locks.
3. Up to 24 x 48 inches (600 x 1200 mm): Three hinges and two compression latches with outside and inside handles.
4. Larger Sizes: Furnish additional hinge.
5. Access panels with sheet metal screw fasteners are not acceptable.

2.3 FIRE DAMPERS

A. Fabricate in accordance with NFPA 90A and UL 555, and manufacturer's condition of listing. Permanently mark dampers for use in static systems.

B. Horizontal Dampers: Galvanized steel, 22 gage (0.76 mm) frame, stainless steel closure spring, and lightweight, heat retardant non-asbestos fabric blanket.

C. Curtain Type Dampers: Galvanized steel with interlocking blades. Furnish stainless steel closure springs and latches for horizontal installations conditions. Configure with blades out of air stream except for 1.0-inch 250 Pa pressure class ducts up to 12 inches (300 mm) in height.

D. Multiple Blade Dampers: 16 gage (1.5 mm) galvanized steel frame and blades, oil-impregnated bronze or stainless-steel sleeve bearings and plated steel axles, 1/8 x 1/2 inch (3.2 x 12.7 mm) plated steel concealed linkage, stainless steel closure spring, blade stops, and lock.

E. Fusible Links: UL 33, separate at 160 with adjustable link straps for combination fire/balancing dampers.

2.4 VOLUME CONTROL DAMPERS.

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.

B. Multi-Blade Damper: Fabricate of opposed blade pattern with maximum blade sizes 8 x 72 inch (200 x 1825 mm). Assemble center and edge crimped blades in prime coated or galvanized frame channel with suitable hardware.

C. End Bearings: Except in round ductwork 12 inches and smaller, furnish end bearings. On multiple blade dampers, furnish oil-impregnated nylon or sintered bronze bearings. Furnish closed end bearings on ducts having pressure classification over 2 inches wg.

D. Quadrants:

1. Furnish locking, indicating quadrant regulators on single and multi-blade dampers.
2. On insulated ducts mount quadrant regulators on standoff mounting brackets, bases, or adapters.
3. Where rod lengths exceed 30 inches (750 mm) furnish regulator at both ends.

2.5 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA HVAC Duct Construction Standards - Metal and Flexible, and as indicated on Drawings.

B. Connector: Fabric crimped into metal edging strip.
1. Fabric: UL listed fire-retardant neoprene coated woven glass fiber fabric conforming to NFPA 90A, minimum density 30 oz per sq yd.
2. Net Fabric Width: Approximately 3 inches wide.
3. Metal: 3-inch-wide, 24 gage galvanized steel.

C. All Flex Duct Connectors shall be tested in accordance with UL 181 and listed as Class 0 or Class 1.

2.6 DUCT TEST HOLES

A. Temporary Test Holes: Cut or drill in ducts. Cap with neat patches, neoprene plugs, threaded plugs, or threaded or twist-on metal caps.

B. Permanent Test Holes: Factory fabricated, air tight flanged fittings with screw cap. Furnish extended neck fittings to clear insulation.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify rated walls are ready for fire damper installation.

B. Verify ducts and equipment installation are ready for accessories.

3.2 INSTALLATION.

A. Install in accordance with NFPA 90A and follow SMACNA HVAC Duct Construction Standards - Metal and Flexible. Refer to Section 23 31 00 for duct construction and pressure class.

B. Install duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, combination fire and smoke dampers, and as indicated on Drawings. Install minimum 8 x 8-inch (200 x 200 mm) size for hand access, 18 x 18-inch (450 x 450 mm) size for shoulder access, and as indicated on Drawings. Install 8 x 8 inch (100 x 100 mm) for balancing dampers only. Review locations prior to fabrication.

C. Install duct test holes required for testing and balancing purposes.

D. Provide fire dampers, combination fire and smoke dampers at locations as indicated on Drawings. Install with required perimeter mounting angles, sleeves, breakaway duct connections, corrosion resistant springs, bearings, bushings and hinges.

E. Install smoke dampers and combination smoke and fire dampers in accordance with NFPA 92A.

3.3 DEMONSTRATION AND TRAINING

A. Demonstrate re-setting of fire dampers to Owner's representative.

END OF SECTION

SECTION 23 36 00
AIR TERMINAL UNITS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes constant volume terminal units, variable volume terminal units, fan powered terminal units, variable volume regulators, integral sound attenuation, integral heating coils, integral damper motor operators, integral controls.

B. Related Sections:

1. Section 230923 – Direct Digital Control System.

1.2 REFERENCES

A. NFPA 90A (National Fire Protection Association) - Installation of Air Conditioning and Ventilation Systems.

B. UL 181 (Underwriters Laboratories, Inc.) - Factory-Made Air Ducts and Connectors.

1.3 SUBMITTALS

A. Provide in accordance with the General Conditions of the Contract.

B. Product Data: Submit data indicating configuration, general assembly, and materials used in fabrication. Include catalog performance ratings indicating airflow, static pressure, and NC designation. Include electrical characteristics and connection requirements. Include schedules listing discharge and radiated sound power level for each of second through sixth octave bands at inlet static pressures of 1 inch to 4 inches wg (250 to 1000 Pa).

C. Manufacturer's Installation Instructions: Submit support and hanging details, and service clearances required.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: Submit manufacturer's descriptive literature, operating instructions, maintenance and repair data, and parts lists. Include directions for resetting constant volume regulators.

1.5 FIELD MEASUREMENTS

A. Verify field measurements prior to fabrication.

1.6 COORDINATION

A. Coordinate Work with 15910 – Direct Digital Control System.

PART 2 PRODUCTS

2.1 AIR TERMINAL UNITS

A. Manufacturers: Price, Titus, & Tuttle & Bailey.

B. Ceiling mounted variable air volume fan powered supply air control terminals for connection to single duct, central air systems, with electronic variable volume controls, hot water heating coils.

C. Identify each terminal unit with identification label and airflow indicator. Include unit nominal airflow, maximum factory-set airflow and minimum factory-set airflow and coil type.

2.2 SINGLE DUCT VARIABLE VOLUME AND VAV REHEAT UNITS

A. Basic Assembly:
1. Casings: Minimum 22 gage galvanized steel.
2. Lining: Minimum 1 inch thick neoprene or vinyl coated glass fiber insulation, 1.5 lb./cu ft (24 g/L) density, meeting NFPA 90A requirements and UL 181 erosion requirements.
3. Plenum Air Inlets: Round stub connections for duct attachment.
4. Plenum Air Outlets: S slip-and-drive connections.

B. Basic Unit:
1. Configuration: Air volume damper assembly inside unit casing. Locate control components inside protective metal shroud.
2. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings; maximum damper leakage: 2 percent of design air flow at 1 inch inlet static pressure.
3. Mount damper operator to position damper normally open.

C. Hot Water Heating Coil:
1. Construction: 1/2 inch (13 mm) copper tube mechanically expanded into aluminum plate fins, leak tested under water to 200 psig (10380 kPa) pressure, factory installed.
2. Capacity: As indicated on Drawings.
3. All coils are to be 2 row.

D. Automatic Damper Operator:
1. Refer to Section 230923 – Direct Digital Control System.

E. Thermostat: Refer to Section 230923.

2.3 FAN POWERED VARIABLE VOLUME UNITS

A. Basic Assembly:
1. Casings: Minimum 22 gage galvanized steel.
2. Lining: Minimum 1 inch thick neoprene or vinyl coated glass fiber insulation, 1.5 lb./cu ft (24 g/L) density, meeting NFPA 90A requirements and UL 181 erosion requirements.
3. Plenum Air Outlets: S-slip and drive connections.

B. Basic Unit:
1. Configuration: Air volume damper assembly and fan in parallel arrangement inside unit casing. Locate control components inside protective metal shroud.
2. Volume Damper: Construct of galvanized steel with peripheral gasket and self-lubricating bearings; maximum damper leakage: 2 percent of design air flow at 1 inch rated inlet static pressure.
3. Mount damper operator to position damper normally open.

C. Automatic Damper Operator:

D. Fan Assembly
1. Fan: Forward curved centrifugal type with direct drive permanent-split-capacitor type, thermally protected motor.
2. Speed Control: Infinitely adjustable with and electronic controls.
3. Isolation: Fan/motor assembly on rubber isolators.

E. Hot Water Heating Coil:
1. Construction: 1/2 inch (13 mm) copper tube mechanically expanded into aluminum plate fins, leak tested under water to 200 psig (10 380 kPa) pressure, factory installed.
2. Capacity: As scheduled on Drawings.
3. All coils are to be 2 row.

F. Wiring
1. Factory mount and wire controls. Mount electrical components in control box with removable cover. Incorporate single point electrical connection to power source.
2. Factory mount transformer for control voltage on electric and electronic control units. Furnish terminal strip in control box for field wiring of thermostat and power source.
3. Wiring Terminations: Wire fan and controls to terminal strip. Furnish terminal lugs to match branch-circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box.
4. Disconnect Switch: Factory mount disconnect switch.

G. Controls:
1. Refer to Section 230923.

H. Thermostat:
1. Refer to Section 2309023.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify ductwork is ready to receive Work.

3.2 INSTALLATION

A. Connect to ductwork in accordance with Section 233100.

B. Install ceiling access doors or locate units above easily removable ceiling components.

C. Support units individually from structure. Do not support from adjacent ductwork.

D. Install lined ductwork downstream of units.

3.3 ADJUSTING

A. Section 230593 - Execution Requirements: Testing, adjusting, and balancing.

B. Reset volume with damper operator attached to assembly allowing flow range modulation from 100 percent of design flow to 0 percent full flow. Set units with heating coils for minimum 50 percent full flow.

END OF SECTION

SECTION 23 37 00 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SUMMARY

A. Section includes diffusers, registers/grilles, and louvers.

1.2 REFERENCES

A. ADC 1062 (Air Diffusion Council) - Certification, Rating and Test Manual.

B. AMCA 500 (Air Movement and Control Association) - Test Method for Louvers, Dampers and Shutters.

C. ASHRAE 70 (American Society of Heating, Refrigerating and Air Conditioning Engineers) - Method of Testing for Rating the Airflow Performance of Outlets and Inlets.

D. SMACNA (Sheet Metal and Air Conditioning Contractors' National Association) - HVAC Duct Construction Standard - Metal and Flexible.

1.3 SUBMITTALS

A. Provide as per the General Conditions.

B. Product Data: Submit data outlets and inlets sizes, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.

PART 2 PRODUCTS

2.1 CEILING SLOT DIFFUSERS

A. Manufacturers: Price, Titus, Tuttle & Bailey.

B. Type: As scheduled on the Drawings

C. Fabrication: Aluminum extrusions with factory baked enamel finish, color to be selected.

D. Frame: 1-1/4-inch margin with countersunk screw support clips for suspension system support clips for T bar mounting and gasket. Coordinate with ceiling type as shown on Architectural Drawings.

E. Plenum: Integral, galvanized steel, insulated.

2.2 CEILING GRID CORE EXHAUST AND RETURN REGISTERS/GRILLES (PERFORATED FACE)

A. Manufacturers: Titus, Price, Tempo, Tuttle & Bailey.

B. Type: Perforated and removable face as scheduled on the Drawings.

C. Coordinate mounting frame with ceiling type indicated on the Drawings.

D. Fabrication: Steel with steel or aluminum frame.

PART 3 EXECUTION

3.1 EXAMINATION

A. Verify inlet/outlet locations.

B. Verify ceiling and wall systems are ready for installation.

3.2 INSTALLATION

A. Install diffusers to ductwork with airtight connection.

B. Install balancing dampers on duct take-off to diffusers, grilles, and registers, whether or not dampers are furnished as part of diffuser, grille, and register assembly.

C. Paint visible portion of ductwork behind air outlets and inlets matte black.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Check location of outlets and inlets and make necessary adjustments in position to conform to architectural features, symmetry, and lighting arrangement.

3.4 SCHEDULES

END OF SECTION

Table of Contents

Part 1 - General

1.01 SYSTEM DESCRIPTION TPUZ SERIES

The heat pump air conditioning system shall be a Trane split system with Variable Speed Inverter Compressor technology (Other approved manufacturers include LG, & Daikin). The system shall consist of a

horizontal discharge, single phase outdoor unit, a matched capacity indoor

section that shall be equipped with a wired wall-mounted, wireless wall-mounted, wireless handheld, or other remote controller.

1.02 QUALITY ASSURANCE

1. The system components shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.
2. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
3. The units shall be rated in accordance with Air-conditioning, Heating and Refrigeration Institute's (AHRI) Standard 240 and bear the AHRI Certification label.
4. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to product and manufacturing quality and environmental management and protection set by the International Standard Organization (ISO).
5. A dry air holding charge shall be provided in the indoor section.

1.03 DELIVERY, STORAGE AND HANDLING

1. Unit shall be stored and carefully handled according to the manufacturer's recommendations.
2. The wireless remote controller, for the wall mounted and floor standing indoor units, shall be shipped inside the carton and packaged with the indoor unit and shall be able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.
3. The remote controller, for the ceiling suspended, ceiling recessed and ducted indoor units, either wireless or wired, shall be shipped separately.

Part 2 - Warranty

The units shall have a manufacturer's parts and defects warranty for a period five (5) years from date of installation. The compressor shall have an extended warranty of seven (7) years from date of installation.

If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty will not include labor.

Installing contractor shall meet manufacturer requirements to obtain extended manufacturer's limited parts and compressor warranty for a period of ten (10)

years to the original owner from date of installation. This warranty shall not include labor.

Manufacturer shall have a minimum of thirty eight (38) years continuous experience in the U.S. market.

All manufacturer technical and service manuals must be readily available for download by any local contractor should emergency service be required

Part 3 - ODU Outdoor Units

3.01 TPUZ SYSTEM

General:

1. The TPUZ Series outdoor units are specifically designed to work with the wall mounted, ducted, 4-way cassette, ceiling suspended and multi-position air handler indoor units. The connected indoor unit shall be of the same capacity as the outdoor unit. The outdoor units must have a thermally fused powder coated finish. The outdoor unit shall be completely factory assembled, piped and wired. Each unit shall be run tested at the factory.

2. If an alternate manufacturer is selected, any additional material, cost, and labor to install additional lines shall be incurred by the contractor. Contractor responsible for ensuring alternative brand compatibility in terms of availability, physical dimensions, weight, electrical requirements, etc.

3. Outdoor unit shall have a sound rating no higher than 53 dB(A). If an alternate manufacturer is selected, any additional material, cost, and labor to meet published sound levels shall be incurred by the contractor.

4. Refrigerant lines from the outdoor unit to the indoor units shall be insulated in accordance with the installation manual.

5. The outdoor unit shall meet performance requirements per schedule and be within piping limitations & acceptable ambient temperature ranges as described in respective manufacturers' published product catalogs. Non-published product capabilities or performance data are not acceptable.

6. The outdoor unit shall be capable of guaranteed operation in heating mode down to -13°F ambient temperatures and cooling mode up to 115°F without additional restrictions on line length & vertical separation beyond those published in respective product catalogs. Models with capacity data for required temperature range published as "for reference only" are not considered capable of guaranteed operation and are not acceptable. If an alternate manufacturer is selected, any additional material, cost, and labor to meet ambient operating range and performance shall be incurred by the contractor.

7. The outdoor unit shall be provided with a manufacturer supplied 20 gauge hot dipped galvanized wind baffle. The wind baffle shall allow for continuous cooling to 0FDB without any additional modifications to the unit.

Unit Cabinet:

1. The casing shall be fabricated of galvanized steel, bonderized, finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection. Assembly hardware shall be cadmium plated for weather resistance.

1. Cabinet color shall be Munsell 3Y 7.8/1.1.

2. Easy access shall be afforded to all serviceable parts by means of removable panel sections.

3. Two (2) mild steel mounting feet, traverse mounted across the cabinet base pan, welded mount, providing four (4) slotted mounting holes shall be furnished. Assembly shall withstand lateral wind gust up to 155 MPH to meet applicable weather codes.The casing(s) shall be fabricated of galvanized steel, bonderized and finished.

Fan:

1. 1, 1.5, 2 and 2.5 ton units shall be furnished with a single direct drive propeller type fan. 3, 3.5 ton units shall be furnished with a two (2) direct drive propeller type fans.

1. The outdoor unit fan motor(s) shall be a direct current (DC) motor and have permanently lubricated bearings.

2. The fan motor shall be mounted for quiet operation.

3. The fan shall be provided with a raised guard to prevent contact with moving parts.

4. The outdoor unit shall have horizontal discharge airflow.

Refrigerant and Refrigerant Piping

1. R410A refrigerant shall be required for systems.

2. Polyolester (POE) oil—widely available and used in conventional domestic systems—shall be required. Prior to bidding, manufacturers using alternate oil types shall submit material safety data sheets (MSDS) and comparison of hygroscopic properties for alternate oil with list of local suppliers stocking alternate oil for approval at least two weeks prior to bidding.

3. Refrigerant piping shall be phosphorus deoxidized copper (copper and copper alloy seamless pipes) of sufficient radial thickness as defined by the equipment manufacturer and installed in accordance with manufacturer recommendations.

4. All refrigerant piping must be insulated with ½" closed cell, CFC-free foam insulation with flame-Spread Index of less than 25 and a smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102. R value of insulation must be at least 3.

5. Refrigerant line sizing shall be in accordance with manufacturer specifications.

Coil:

1. The outdoor unit coil shall be of nonferrous construction with lanced or corrugated plate fins on copper tubing.

1. The coil shall be protected with an integral metal guard.

2. Refrigerant flow from the outdoor unit shall be regulated by means of an electronically controlled, precision, linear expansion valve.

3. All refrigerant lines between outdoor and indoor units shall be of annealed, refrigeration grade copper tubing, ARC Type, meeting ASTM B280 requirements, individually insulated in twin-tube, flexible, closed-cell, CFC-free (ozone depletion potential of zero), elastomeric material for the insulation of refrigerant pipes and tubes with thermal conductivity equal to or better than 0.27 BTU-inch/hour per Sq Ft / °F, a water vapor transmission equal to or better than 0.08 Perm-inch and superior fire ratings such that insulation will not contribute significantly to fire and up to 1" thick insulation shall have a Flame-Spread Index of less than 25 and a Smoke-development Index of less than 50 as tested by ASTM E 84 and CAN / ULC S-102.

4. All refrigerant connections between outdoor and indoor units shall be flare type.

Compressor:

1. The compressor shall be a high performance, hermetic, inverter driven, variable speed, dual rotary type manufactured by Mitsubishi Electric Corporation.

1. The compressor motor shall be direct current (DC) type equipped with a factory supplied and installed inverter drive package.

2. The compressor will be equipped with internal thermal overload protection.

3. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be automatically, intermittently applied to the compressor motor windings to maintain sufficient heat to vaporize any refrigerant. No crankcase heater is to be used.

4. Filters, sight glasses, and traps shall not be used, and no additional refrigerant oil shall be required.

5. The compressor shall be mounted so as to avoid the transmission of vibration.

6. The outdoor unit shall have an accumulator and high pressure safety switch.

Operating Range:

1. Operating Range shall be in accord with the Table below:

Operating Range		Indoor Intake Air Temp	Outdoor Intake Air Temp
Cooling	Maximum	95°F (35°C) DB, 71°F(21°C) WB	115°F (46°C) DB
	Minimum	67°F (19°C) DB, 57°F(14°C) WB	14°F (-10°C) DB
Heating	Maximum	80°F (27°C) DB, 67°F(19°C) WB	75°F (24°C) DB, 65°F(18°C) WB
	Minimum	70°F (21°C) DB, 60°F(16°C) WB	6°F (-14°C) DB, 5°F(-15°C) WB
			-12°F (-24°C) DB, -13°F(-25°C) WB*

Electrical:

1. The outdoor unit electrical power supply shall be 208/230 volts, 1-phase, 60 hertz.
2. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts.
3. The outdoor unit shall be controlled by microprocessors located in the indoor unit and outdoor unit. A 12 to 24 volt DC data stream shall communicate between the units providing all necessary information for full function control.
4. The outdoor unit shall be equipped with Pulse Amplitude Modulation (PAM) compressor inverter drive control for maximum efficiency with minimum power consumption.

Part 4 - Indoor Units

4.01 MEDIUM STATIC CEILING-CONCEALED DUCTED INDOOR UNIT

General:

1. The ceiling-concealed ducted indoor unit shall be factory assembled, wired and run tested. Contained within the unit shall be all factory wiring, piping, electronic modulating linear expansion device, control circuit board and fan motor. The unit shall have a self-diagnostic function, 3-minute time delay mechanism, and an auto restart function. Indoor unit and refrigerant pipes shall be charged with dehydrated air before shipment from the factory. The unit shall be suitable for use in plenums in accordance with UL1995 ed 4.

Unit Cabinet:

1. The unit shall be ceiling-concealed, ducted—with a 2-position, field adjustable return and a fixed horizontal discharge supply.
2. The cabinet panel shall have provisions for a field installed filtered outside air intake.

Fan:

1. Indoor unit shall feature multiple external static pressure settings ranging from 0.14 to 0.60 in. WG.
2. The indoor unit fan shall be an assembly with statically and dynamically balanced Sirocco fan(s) direct driven by a single motor with permanently lubricated bearings.
3. The indoor unit shall include an AUTO fan setting capable of maximizing energy efficiency by adjusting the fan speed based on the difference between controller set-point and space temperature. The indoor fan shall be capable of five (5) speed settings, Low, Mid1, Mid2, High and Auto.

Filter:

1. Return air shall be filtered by means of a standard factory installed washable return air filter.

Coil:

1. The indoor coil shall be of nonferrous construction with smooth plate fins on copper tubing. The tubing shall have inner grooves for high efficiency heat exchange. All tube joints shall be brazed with phos-copper or silver alloy.
2. The coils shall be pressure tested at the factory.
3. Coil shall be provided with a sloped drain pan. Units without sloped drain pans which must be installed cockeyed to ensure proper drainage are not allowed.
4. The unit shall be provided with an integral condensate lift mechanism able to raise drain water 27 inches above the condensate pan.

Electrical:

1. The unit electrical power shall be 208/230 volts, 1-phase, 60 hertz.
2. The system shall be equipped with A-Control – a system directing that the indoor unit be powered directly from the outdoor unit using a 3-wire, 14 gauge AWG connections plus ground.
3. The indoor unit shall not have any supplemental electrical heat elements.

Controls:

1. Indoor unit shall compensate for the higher temperature sensed by the return air sensor compared to the temperature at level of the occupant when in HEAT mode. Disabling of compensation shall be possible for individual units to accommodate instances when compensation is not required.

1. Control board shall include contacts for control of no less than two stages of external heat. The first stage of external heat may be energized when the space temperature is 2.7°F from set point for between 10-25 minutes (user adjustable). The second stage of external heat may be energized when the first stage has been active for no less than 5 minutes and the space temperature has not risen by more than 0.9°F.

2.

Part 5 - Controls

5.01 OVERVIEW

1. The control system shall consist of a minimum of one microprocessor on each indoor unit and one in the outdoor unit, communicating via A-Control data over power transmission. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired or wireless controller, providing emergency operation and controlling the outdoor unit. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Indoor units shall have the ability to control supplemental heat via connector CN24 and a 12 VDC output.

2. 5.For A-Control, a three (3) conductor 14 gauge AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units. If code requires a disconnect mounted near the indoor unit, a TAZ-MS303 3-Pole Disconnect shall be used – all three conductors must be interrupted.

3. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.

4. A remote controller needs to be selected and ordered separately from the unit unless the indoor unit is a wall mounted (excludes PKA), floor mounted or one-way ceiling recessed unit.

5.02 REMOTE CONTROLLERS

Deluxe Wired MA Remote Controller:

1. On wall mount (excludes PKA), floor mount and one-way ceiling recessed units the Deluxe Wired MA Remote Controller shall require a MAC-334IF-E Interface for communication.
2. The Deluxe Wired MA Remote Controller shall be capable of controlling up to 16 indoor units (defined as 1 group). When grouping M-Series units each unit requires a MAC-334IF-E Interface.
3. The Deluxe Wired MA Remote Controller shall only be used in same group with another Deluxe Wired MA Remote Controller, with up to two remote controllers per group.

Wired MA Remote Controller			
Item	**Description**	**Operation**	**Display**
ON/OFF	Run and stop operation for a single group	Each Group	Each Group
Operation Mode	Switches between Cool/Drying/Auto/Fan/Heat. Operation modes vary depending on the air conditioner unit.	Each Group	Each Group
Temperature Setting	Sets the temperature from 40°F – 87°F depending on operation mode and indoor unit.	Each Group	Each Group
Fan Speed Setting	Available fan speed settings depending on indoor unit.	Each Group	Each Group
Air Flow Direction Setting	Air flow direction settings vary depending on the indoor unit model.	Each Group	Each Group

Wired MA Remote Controller			
Item	**Description**	**Operation**	**Display**
Permit / Prohibit Local Operation	Individually prohibit operation of each local remote control function (Start/Stop, Change operation mode, Set temperature, Vane, Reset filter). *1: Centrally Controlled is displayed on the remote controller for prohibited functions.	N/A	Each Group *1
Display Indoor Unit Intake Temp	Measures and displays the intake temperature of the indoor unit when the indoor unit is operating.	N/A	Each Group
Display Backlight	Pressing a button lights up a backlight. The light automatically turns off after a certain period of time. (The brightness settings can be selected from Bright, Dark, and Light off.)	N/A	Each Unit
Error	When an error is currently occurring on an air conditioner unit, the afflicted unit and the error code are displayed	N/A	Each Unit
Test Run	Operates air conditioner units in test run mode. *2 The display for test run mode will be the same as for normal start/stop (does not display "test run").	Each Group	Each Group *2
Ventilation Equipment	Up to 16 indoor units can be connected to an interlocked system that has one LOSSNAY unit.	Each Group	N/A
Set Temperature Range Limit	Set temperature range limit for cooling, heating, or auto mode.	Each Group	Each Group
Schedule	Set up to 8 operations per day, 7 days per week. Operations include time on/off, mode and room temperature set point.	Each Group	Each Group

5.03 CMCN REMOTE CONTROLLERS: SYSTEM INTEGRATION

1. The CMCN shall be capable of supporting integration with Building Management Systems (BMS).

SECTION 26 05 00 - ELECTRICAL COMMON WORK AND GENERAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this and ALL other sections of Division 26, 27, 28 and 33.

B. Equipment requiring rough-ins and/or connections by Division 26 may be shown on the architectural drawings and/or specified in Sections 01 through 25. Division 26 is responsible for these rough-ins and/or connections whether shown on the electrical drawings or not.

1.2 SUMMARY

A. This Section includes general administrative and procedural requirements for electrical installations.

1. Product Substitutions.

2. Shop/Coordination Drawings.

3. Record Drawings and documentation.

4. Delivery, storage and handling.

5. Rough-ins

6. Electrical installations.

7. Cutting and patching

1.3 QUALITY ASSURANCE

A. Comply with the latest adopted IBC Codes, NFPA Codes ANSI, UL and applicable State and Local Codes.

B. Electrical work shall be done by trained licensed and experienced workers.

1.4 PRODUCT SUBSTUTIONS

A. Substitutions will be considered by submitting a duplicate written application (2-copies) to the offices of the Architect and Engineer five (5) working days prior to the day of the bidding. The application shall include:

1. A statement certifying that the proposed equipment is equal to that specified; that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents.

2. The specified and submittal catalog numbers of the equipment under consideration.

3. A pictorial and specification cut sheet or brochure.

B. All conflicts that arise from the use of substituted equipment shall be the responsibility of the Contractor, who shall bear all costs required to make the equipment comply with the intent of the contract documents or replace equipment with specified products.

1.5 SHOP/COORDINATION DRAWINGS

A. Prepare shop/coordination drawings which include product data cut sheets, performance data, wiring diagrams, dimensions, spatial/maintenance needs, etc along with 1/8" or larger detailed shop drawings as applicable denoting electrical equipment and materials in relationship with other systems, installations and building components. Coordinate with Divisions 22 and 23. Indicate locations where space is limited for installation and access and where sequencing and coordination of installations are of importance to the efficient flow of the work, including but not limited to the following:

1. Indicate the proposed locations of equipment, motor controllers, disconnects, duct smoke detectors, control panels and control devices. Include the following:

a. Control diagrams

b. Clearances for servicing and maintaining equipment and space for equipment disassembly required for periodic maintenance.

c. Equipment connections and support details

d. Exterior wall and foundation penetrations.

e. Fire rated wall and floor penetrations. (Refer to architectural plans)

f. Sizes and locations of required concrete pads and bases.

2. Indicate scheduling, sequencing, movement and positioning of large equipment in the building during construction.

3. Prepare floor plans, elevations and details to indicate penetrations in floors, walls and ceilings and their relationship to other penetrations and installations.

4. Coordinate "Lighting Fixture Schedule closely with architectural reflected ceiling plans. If device types shown on the electrical plans conflict with the architectural reflected ceiling plans, Architect shall be advised of discrepancies prior to fixture installation.

1.6 RECORD DRAWINGS/DOCUMENTS

A. Prepare record documents that indicate the following installed conditions.

1. Equipment locations dimensioned from prominent building lines.

2. Approved substitutions, Contract modifications and actual equipment and materials installed.

3. Addendum items, Change Orders and all changes made to the drawings from the bid documents shall be included on the Record Drawings

4. Contract modifications, actual equipment and materials installed.

5. All circuit designations as installed.

6. All underground electrical lines.

1.7 MAINTENANCE MANUALS

A. Assemble and submit maintenance manuals in accordance with the Division 1 Section of these specifications.

B. Maintenance Manuals materials shall be provided in 3-ring binders with all project details, assembled neatly with index page and section tabs.

C. Manual shall contain detailed maintenance information for all products install in the project.

D. Submit three copies of the maintenance manuals to the project Architect for approval from the project engineer.

1.8 DELIVERY, STORAGE AND HANDLING

A. Deliver products to the project properly identified with names, model numbers, types, grades compliance labels and other information needed for identification.

B. Handle carefully to prevent damage. Following manufacture's written instructions foe rigging. Replace damaged products.

C. Store in clean dry place off the ground. Protect from weather, water and physical damage.

PART 2 - PRODUCTS

A. Products are as specified by manufacturer name, description, and/or catalog number. Discrepancies between equipment specified and the intended function of equipment shall be brought to the attention of the Architect/Engineer in writing prior to bidding. Failure to report any conflict, including catalog numbers, discontinued products, etc., does not relieve the Contractor from meeting the intent of the contract documents nor shall it

change the contract cost. If the Contractor is unable to interpret any part of the plans and/or specifications, or should he find discrepancies therein, he shall bring this to the attention of the Architect/Engineer who will issue interpretation and/or additional instructions to Bidders before the project is bid.

B. Manufacturers: Furnish and install electrical products from manufacturers as specified or accepted through methods specified here in. The manufacturers descriptions and catalog numbers are to establish basic product quality required. Substitutions will be considered by submitting a duplicate written application (2-copies) to the offices of the Architect and Engineer five (5) working days prior to the day of the bidding. The application shall include the following: 1) A statement certifying that the equipment proposed is equal to that specified; that it has the same electrical and physical characteristics, compatible dimensions, and meets the functional intent of the contract documents; 2) The specified and submittal catalog numbers of the equipment under consideration; 3) A pictorial and specification brochure.

C. Any conflict arising from the use of substituted equipment shall be the responsibility of the Contractor, who shall bear all costs required to make the equipment comply with the intent of the contract documents.

D. Samples may be required for non-standard or substituted items before installation during construction. Provide all samples as required.

E. No materials or apparatus may be substituted after the bid opening except where the equipment specified has been discontinued.

F. Provide only equipment specified in the Contract Documents or approved by addendum.

G. Provide spare parts (fuses, diffusers, lamps, etc.) as specified. Transmit all spare parts to Owner's Representative prior to substantial completion.

PART 3 - EXECUTION

3.1 ROUGH-IN

A. Verify final locations for rough-ins with field measurements and with the requirements of the actual equipment to be connected.

B. Refer to equipment specifications in Divisions 02 through 26 for rough-in requirements. Equipment requiring rough in by Division 26 may be specified in sections other the Division 26.

C. Refer to architectural, civil, mechanical, security, telecommunications, kitchen, laundry etc drawings for equipment not shown on the Division 26 drawings that may require electrical connections by Division 26.

3.2 ELECTRICAL INSTALLATIONS

A. General: Sequence, coordinate and integrate the various elements of electrical systems, materials and equipment. Comply with the following requirements:

1. Coordinate electrical systems, equipment and materials installations with other build components.

2. Verify all dimensions by field measurement.

3. Furnish chases, slots and openings in other building components during progress of construction, as required to execute work specified in this section.

4. Furnish required supporting devices and sleeves to be set in poured-in place concrete and other structural components, as they are constructed.

5. Furnish and install 4" thick, concrete housekeeping pads for all floor mounted electrical equipment. Pads shall be 4" deep and 6" larger in each dimension than the equipment. Concrete requirements are as specified in Division 03.

6. Sequence, coordinate and integrate installations of electrical materials and equipment for efficient flow of work. Give particular attention to large equipment requiring positioning prior to closing in the building.

7. Where mounting heights are not detailed or dimensioned, install systems, materials and equipment to provide the maximum headroom possible.

8. Coordinate connection of electrical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies and controlling agencies. Provide required connection for each service.

9. Install systems, materials and equipment to conform with approved submitted data, including coordination drawings, to the greatest extent possible. Conform to arraignments indicated by the Contract Documents, recognizing that portions of the work are shown only in diagrammatic form. Where coordination requirements conflict with individual systems requirement, refer conflict to Engineer. Maintain manufacture's recommended clearances.

10. Install systems, materials level and plumb, parallel ad perpendicular to other building systems and components, where installed expose in finished spaces.

11. Install electrical equipment to facilitate servicing maintenance and repair of replacement of equipment components. Connect equipment for ease of disconnecting, with minimum of interference with other installations.

    a. Comply with working clearances identified in Article 110-26 2017 NEC and coordinate with Division 22 and 23 subcontractors to ensure that no piping, ductwork or equipment is installed in the exclusively dedicated space for switchboards or panelboards within the scope of Article 384.

12 Install access panel or doors where equipment is concealed behind finished surfaces.

13 Install systems, materials and equipment giving right-of-way priority to systems required to be install at a specific slope.

14 All penetrations of fire rated partitions by electrical services shall be fire stopped as required by the specifications and local codes. Refer to architectural drawings for locations for fire rated partitions.

15 All device and equipment requirements of Health Care Facilities in Article 517-2020 NEC, State Health Department, NFPA-101, and IBC for the occupancy type.

3.3 DEMOSTRATIONS

A. Provide start-up services and instruct Owners personnel for operation and maintenance of specified items of equipment.

B. Start-up equipment, only in accordance with manufacture's written instructions. Test controls and demonstrate compliance with requirements. Replace damaged or malfunctioning controls and equipment.

C. Train Owner's personnel on start-up and shutdown procedures, troubleshooting procedures, servicing and preventive maintenance scheduled procedures. Review with Owner'personnel the data contained in the Operating and Maintenance Manuals specified in this specification.

3.4 CUTTING AND PATCHING

A. General: Perform all cutting and patching required for the execution of this Division in
accordance with Division 01.

END OF SECTION

SECTION 26 05 19 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND 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. *Section Includes:*

1. Building wires and cables rated 600 V and less.

2. Connectors, splices, and terminations rated 600 V and less.

1.3 SUBMITTALS

A. Section 01 3323 Submittal Procedures: Shop Drawings, Product Data and Samples.

B. Section 26 0500 Shop Coordination Drawings

C. Product Data: Building wire and cable

D. Test Reports: Indicate procedures and values obtained.

1.4 CLOSEOUT SUBMITTALS

A. Section 01 7700 – Closeout Procedures:

B. Project Record Documents: Record actual locations of components and circuits.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For testing agency.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Electrical equipment, cables, devices and accessories listed and labeled as defined in NFPA 70 to be tested by Testing Agency. Testing Agency company to be member of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing

B. Comply with IEEE and NEC for all cable testing.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

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. Alcan Products Corporation; Alcan Cable Division.
2. Alpha Wire.
3. Essex Group Inc.
4. Diamond Wire & Cable Co.
5. General Cable Technologies Corporation.
6. Southwire Incorporated.

B. Produce Description: Single conductor Aluminum or Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Aluminum Conductors where specified for use, provide compact stranded aluminum alloy conductor material.

D. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for 600 Volt rating: Type THHN/THWN or Type XHHW for feeders as described in Conductor Schedule.

E. Multi-conductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for armored cable, Type AC metal-clad cable, Type MC mineral-insulated, metal-sheathed cable, Type MI nonmetallic-sheathed cable, Type NM.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include.

1. AFC Cable Systems, Inc.
2. Hubbell Power Systems, Inc.
3. O-Z/Gedney
4. 3M
5. Tyco Electronics

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

PART 3 - EXECUTION

3.1 GENERAL:

A. Install conductors, cables and accessories as indicated, in compliance with manufactures' written instructions, applicable requirements of NEC, NECA's "Standards of Installation" and in accordance with recognized industry practices to ensure that product meets installation requirements.

3.2 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper conductors for feeders #3 or smaller, copper or aluminum for feeders #2 and larger AWG. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for #10 AWG and smaller; stranded for #8 AWG and larger, except as noted on the drawings for special wire applications.

3.3 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Install electric conductors and cables as indicated in compliance with manufacture's written instructions, applicable requirements of NEC and NECA's "Standards of Installation" and in accordance with recognized industry practices.

B. Service Entrance: Type THHN/THWN single conductors in raceway or Type XHHW, single conductors in raceway for larger amperage requirements. Reference Conduit Conductor Schedule on the drawings.

C. Feeders Concealed above ceilings, or in walls, partitions, and crawlspaces: Type THHN/THWN, single conductors in raceway Metal-clad cable, Type MC Nonmetallic-sheathed cable, Type NM.

D. Feeders Concealed in Concrete, below Slabs-on-Grade, and underground: Type THHN/THWN, single conductors in raceway Type XHHW, single conductors in raceway.

E. Feeders in Cable Tray: Type THHN/THWN, single conductors in raceway Type XHHW, single conductors larger than No. 1/0 AWG Metal-clad cable, Type Nonmetallic-sheathed cable, Type NM.

F. Branch Circuits Exposed or Concealed in Ceilings, Walls, and Partitions: Type THHN/THWN, single conductors in raceway Metal-clad cable, Type MC Nonmetallic-sheathed cable, Type NM.

G. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN/THWN, single conductors in raceway.

H. Branch Circuits in Cable Tray: Type THHN/THWN, single conductors in raceway Metal-clad cable, Type MC.

I. Minimum Branch Circuit Conductor Size: Provide the following minimum sizes for distances listed on 20A branch circuits to prevent excessive voltage drop. The circuit length shall be measured along the length of the conductor form the circuit breaker

in the panelboard to the last device on the circuit. Increase raceway size to comply with conductor fill requirements of NFPA 70.

1. Branch Circuit Voltage of 120V:

    a. Circuit lengths less than 70 feet: Provide minimum #12 AWG conductor size.

    b. Circuit lengths between 70 feet and 110 feet: Provide minimum #10 AWG conductor size.

    c. c. Circuit lengths between 110 feet and 170 feet: Provide minimum #8 AWG conductor size.

    d. d. Circuit lengths greater than 170 feet: Perform voltage drop calculations and provide conductor size to keep branch circuit voltage drop less than 3% with a 15 amp load.

2. Branch Circuit Voltage of 277V:

    a. a. Circuit lengths less than 150 feet: Provide minimum #12 AWG conductor size.

    b. b. Circuit lengths between 150 feet and 240 feet: Provide minimum #10 AWG conductor size.

    c. c. Circuit lengths between 240 feet and 380 feet: Provide minimum #8 AWG conductor size.

    d. d. Circuit lengths greater than 380 feet: Perform voltage drop calculations and provide conductor size to keep branch circuit voltage drop less than 3% with a 15 amp load.

J. Fire Alarm Circuits:
1. Type THWN-2 in raceway for fire alarm power circuits, for horn circuits, and for strobe circuits.

2. Power-limited, fire-protective, signaling circuit cable in raceway for initiating loop circuits.

3. Twisted shielded pair in raceway for evacuation speakers.

K. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

L. Class 1 Control Circuits: Type THHN-THWN, in raceway.

M. Class 2 Control Circuits: Type THHN-THWN, in raceway.

3.4 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section 260533 "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means; including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

F. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

G. Complete cable tray systems installation according to Section 260536 "Cable Trays for Electrical Systems" prior to installing conductors and cables.

3.5 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material and that possess equivalent or better mechanical strength and insulation ratings than un-spliced conductors.

1. Use oxide inhibitor in each splice, termination, and tap for aluminum conductors.

2. Provide connectors and terminations for aluminum-alloy conductors of compression type only, listed under UL486-B and marked AL7CU for 75 degree rated circuits and AL9CU for 90 degree rated circuits

3.6 IDENTIFICATION

A. Identify and color-code all conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Color code as follows:

1. 120/208Volt –

Phase A	Black
Phase B	Red
Phase C	Blue
Neutral	White
Ground	Green.

2. Switch legs and travelers to be colors different than listed above

C. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.7 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.8 FIRESTOPPING

A. Apply firestopping to electrical penetrations of fire-rated floor and wall assemblies to restore original fire-resistance rating of assembly according to Section 078413 "Penetration Firestopping."

3.9 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test cable and wire for continuity of circuitry, and for short circuits, Megger test all circuits of 100 amp and greater rating. Correct malfunctions. Submit record in triplicate of megohmmeter readings to Architect/Engineer.

B. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.

2. Results that comply with requirements.

3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION

SECTION 26 05 26 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes grounding and bonding systems of all electrical and communications apparatus, machinery, appliances, building components and items required by NEC ART 250 to provide a permanent continuous, low impedance, grounding system.

B. Section includes grounding and bonding systems and equipment grounding systems of types listed below:

1. Underground Metal Water Piping
2. Metal Building Frames
3. Ground Electrodes
4. Ground Rods
5. Separately Derived Systems
6. Service Equipment
7. Enclosures
8. Equipment
9. Ground bonding common with lightning protection system.
10. Foundation Electrodes (UFER Ground)

1.3 SUBMITTALS

A. Submit Product Data: For each type of product indicated and or to be installed.

1.4 INFORMATIONAL SUBMITTALS

A. As-Built Data: Plans showing dimensioned as-built locations of grounding features specified in "Field Quality Control" Article, including the following:

1. Test wells.
2. Ground rods.

3. Ground rings.

4. UFER Ground

5. Grounding arrangements and connections for separately derived systems.

B. Qualification Data: For testing agency and testing agency field supervisor.

C. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For grounding to include in emergency, operation, and maintenance manuals.

1. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1) Tests shall determine if ground-resistance or impedance values remain within specified maximums, and instructions shall recommend corrective action if values do not.

2) Include recommended testing intervals.

1.6 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Certified by NETA to supervise on-site testing.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with UL 467 for grounding and bonding materials and equipment.

D. Comply with NFPA 780 and UL 96 when interconnection to the building Lightning Protection System.

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. Burndy; Part of Hubbell Electrical Systems.

2. ERICO International Corporation.

3. ILSCO.

4. CadWeld exothermic connections

5. O-Z/Gedney; A Brand of the EGS Electrical Group.

6. Robbins Lightning, Inc.

7. Siemens Power Transmission & Distribution, Inc.

2.2 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

2.3 CONDUCTORS

A. Insulated Conductors: Copper or Aluminum wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.

2. Stranded Conductors: ASTM B 8.

3. Tinned Conductors: ASTM B 33.

4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.

5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

2.4 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-Bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.5 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad 3/4 inch by 10 feet (19 mm by 3 m)

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for # **8** AWG and smaller, and stranded conductors for #6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare copper or aluminum conductor, as indicated on the drawings.

1. Bury at least 24 inches (600 mm) below grade.

2. Duct-Bank Grounding Conductor: Install ground conductor with feed conductors as indicated on the drawings or as per Article 250 NEC.

C. Isolated Grounding Conductors: Green-colored insulation with continuous yellow stripe. On feeders with isolated ground, identify grounding conductor where visible to normal inspection, with alternating bands of green and yellow tape, with at least three bands of green and two bands of yellow.

D. Grounding Bus: Install in electrical equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus horizontally, on insulated spacers 2 inches (50 mm) minimum from wall, 12 inches (150 mm) above finished floor unless otherwise indicated.

2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down; connect to horizontal bus.

E. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.

2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.

3. Connections to Ground Rods at Test Wells: Bolted connectors.

4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING AT THE SERVICE

A. Equipment grounding conductors and grounding electrode conductors shall be connected to the ground bus. Install a main bonding jumper between the neutral and ground buses.

3.3 GROUNDING SEPARATELY DERIVED SYSTEMS

A. Generator: Install grounding electrode(s) at the generator location. The electrode shall be connected to the equipment grounding conductor and to the frame of the generator.

3.4 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

B. Grounding Manholes and Handholes: Install a driven ground rod through manhole or handhole floor, close to wall, and set rod depth so 4 inches (100 mm) will extend above finished floor. If necessary, install ground rod before manhole is placed and provide No. 1/0 AWG bare, tinned-copper conductor from ground rod into manhole through a waterproof sleeve in manhole wall. Protect ground rods passing through concrete floor with a double wrapping of pressure-sensitive insulating tape or heat-shrunk insulating sleeve from 2 inches (50 mm) above to 6 inches (150 mm) below concrete. Seal floor opening with waterproof, nonshrink grout.

C. Grounding Connections to Manhole Components: Bond exposed-metal parts such as inserts, cable racks, pulling irons, ladders, and cable shields within each manhole or handhole, to ground rod or grounding conductor. Make connections with No. 4 AWG minimum, stranded, hard-drawn copper bonding conductor. Train conductors' level or plumb around corners and fasten to manhole walls. Connect to cable armor and cable shields according to written instructions by manufacturer of splicing and termination kits.

D. Pad-Mounted Transformers and Switches: Install two ground rods and ground ring around the pad. Ground pad-mounted equipment and noncurrent-carrying metal items associated with substations by connecting them to underground cable and grounding electrodes. Install tinned-copper conductor not less than No. 2 AWG for ground ring and for taps to equipment grounding terminals. Bury ground ring not less than 6 inches (150 mm) from the foundation. Grounding method to be in accordance with Utility Company requirements.

3.5 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. Feeders and branch circuits.

2. Lighting circuits.

3. Receptacle circuits.

4. Single-phase motor and appliance branch circuits.

5. Three-phase motor and appliance branch circuits.

6. Flexible raceway runs.

7. Armored and metal-clad cable runs.

8. Busway Supply Circuits: Install insulated equipment grounding conductor from grounding bus in the switchgear, switchboard, or distribution panel to equipment grounding bar terminal on busway.

C. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

D. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

E. Isolated Grounding Receptacle Circuits: Install an insulated equipment grounding conductor connected to the receptacle grounding terminal. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

F. Isolated Equipment Enclosure Circuits: For designated equipment supplied by a branch circuit or feeder, isolate equipment enclosure from supply circuit raceway with a nonmetallic raceway fitting listed for the purpose. Install fitting where raceway enters enclosure, and install a separate insulated equipment grounding conductor. Isolate conductor from raceway and from panelboard grounding terminals. Terminate at equipment grounding conductor terminal of the applicable derived system or service unless otherwise indicated.

G. Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

H. Metallic Fences: Comply with requirements of IEEE C2.

1. Grounding Conductor: Bare copper, not less than #6 AWG.

2. Gates: Shall be bonded to the grounding conductor with a flexible bonding jumper.

3. Barbed Wire: Strands shall be bonded to the grounding conductor.

3.6 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Bonding Common with Lightning Protection System: Comply with NFPA 780 and UL 96 when interconnecting with lightning protection system. Bond electrical power system ground directly to lightning protection system grounding conductor at closest point to electrical service grounding electrode. Use bonding conductor sized same as system grounding electrode conductor, and install in conduit.

C. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. For grounding electrode system, install at least (2) two rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

D. Test Wells: Ground rod driven through drilled hole in bottom of handhole. Handholes are specified in Section 260543 "Underground Ducts and Raceways for Electrical Systems," and shall be at least 12 inches (300 mm) deep, with cover.

1. Test Wells: Install at least one test well for each service unless otherwise indicated. Install at the ground rod electrically closest to service entrance. Set top of test well flush with finished grade or floor.

E. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.

2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.

3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

F. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-

type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.

2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

3. Bond each aboveground portion of gas piping system downstream from equipment shutoff valve.

G. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

H. Ground Ring: Install a grounding conductor, electrically connected to each building structure ground rod and to each steel column, extending around the perimeter of the building or area indicated.

1. Install tinned-copper conductor not less than #2/0 AWG for ground ring and for taps to building steel.

2. Bury ground ring not less than 24 inches (600 mm) from building's foundation.

I. Concrete-Encased Grounding Electrode (UFER Ground): Fabricate according to NFPA 70; use a minimum of 20 feet (6 m) of bare copper conductor not smaller than #4 AWG.

1. If concrete foundation is less than 20 feet (6 m) long, coil excess conductor within base of foundation.

2. Bond grounding conductor to reinforcing steel in at least four locations and to anchor bolts. Extend grounding conductor below grade and connect to building's grounding grid or to grounding electrode external to concrete.

J. Concrete-Encased Grounding Electrode (Ufer Ground): Fabricate according to NFPA 70; using electrically conductive coated steel reinforcing bars or rods, at least 20 feet (6.0 m) long. If reinforcing is in multiple pieces, connect together by the usual steel tie wires or exothermic welding to create the required length.

3.7 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

C. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

D. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

3. Test completed grounding system at each location where a maximum ground-resistance level is specified, at service disconnect enclosure grounding terminal, at ground test wells, and at individual ground rods. Make tests at ground rods before any conductors are connected.

a. Measure ground resistance no fewer than two full days after last trace of precipitation and without soil being moistened by any means other than natural drainage or seepage and without chemical treatment or other artificial means of reducing natural ground resistance.

b. Perform tests by fall-of-potential method according to IEEE 81.

4. Prepare dimensioned Drawings locating each test well, ground rod and ground-rod assembly, and other grounding electrodes. Identify each by letter in alphabetical order, and key to the record of tests and observations. Include the number of rods driven and their depth at each location, and include observations of weather and other phenomena that may affect test results. Describe measures taken to improve test results.

E. Grounding system will be considered defective if it does not pass tests and inspections.

F. Prepare test and inspection reports.

G. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and Less: 5 ohms.

2. Power and Lighting Equipment or System with Capacity of 500 to 1000 kVA: 5 ohms.

3. Power and Lighting Equipment or System with Capacity More Than 1000 kVA: 5 ohms.

4. Power Distribution Units or Panelboards Serving Electronic Equipment: 5 ohm(s).

5. Substations and Pad-Mounted Equipment: **5** ohms.

6. Manhole Grounds: 5 ohms.

H. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance

END OF SECTION

SECTION 26 05 29 - HANGERS AND SUPPORTS FOR ELECTRICAL 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 the following:

1. Hangers and supports for electrical equipment and systems.

2. Construction requirements for concrete bases.

B. Related Sections include the following:

1. Not Applicable

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design supports for multiple raceways, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Design supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

C. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

D. Rated Strength: Adequate in tension, shear, and pullout force to resist maximum loads calculated or imposed for this Project, with a minimum structural safety factor of (5) five times the applied force.

1.5 SUBMITTALS

A. Product Data: For the following:

1. Steel slotted support systems.

2. Nonmetallic slotted support systems.

B. Shop Drawings: Show fabrication and installation details and include calculations for the following:

1. Trapeze hangers. Include Product Data for components.

2. Steel slotted channel systems. Include Product Data for components.

3. Nonmetallic slotted channel systems. Include Product Data for components.

4. Equipment supports.

1.6 COORDINATION

A. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified together with concrete Specifications.

B. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Section 077200 "Roof Accessories."

PART 2 - PRODUCTS

2.1 SUPPORT, ANCHORAGE, AND ATTACHMENT COMPONENTS

A. Steel Slotted Support Systems: Comply with MFMA-4, factory-fabricated components for field assembly.

1. 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:

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

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.

c. ERICO International Corporation.

d. Thomas & Betts Corporation.

e. Unistrut; Atkore International.

3. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.

4. Nonmetallic Coatings: Manufacturer's standard PVC, polyurethane, or polyester coating applied according to MFMA-4.

5. Painted Coatings: Manufacturer's standard painted coating applied according to MFMA-4.

6. Channel Dimensions: Selected for applicable load criteria.

B. Nonmetallic Slotted Support Systems: Structural-grade, factory-formed, glass-fiber-resin channels and angles with 9/16-inch- (14-mm-) diameter holes at a maximum of 8 inches (200 mm) on center, in at least 1 surface.

1. 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:

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

a. Allied Tube & Conduit.

b. Cooper B-Line, Inc.

c. Fabco Plastics Wholesale Limited.

d. Seasafe, Inc.

3. Fittings and Accessories: Products of channel and angle manufacturer and designed for use with those items.

4. Fitting and Accessory Materials: Same as channels and angles, except metal items may be stainless steel.

5. Rated Strength: Selected to suit applicable load criteria.

C. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

D. Conduit and Cable Support Devices: Steel or Steel and malleable-iron hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

E. Support for Conductors in Vertical Conduit: Factory-fabricated assembly consisting of threaded body and insulating wedging plug or plugs for non-armored electrical conductors or cables in riser conduits. Plugs shall have number, size, and shape of conductor gripping pieces as required to suit individual conductors or cables supported. Body shall be malleable iron.

F. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

G. Mounting, Anchoring, and Attachment Components: Items for fastening electrical items or their supports to building surfaces include the following:

1. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened Portland cement concrete, steel, or wood, with tension, shear, and pullout capacities appropriate for supported loads and building materials where used.

    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:

        1) Hilti, Inc.

        2) ITW Ramset/Red Head; Illinois Tool Works, Inc.

        3) MKT Fastening, LLC.

        4) Simpson Strong-Tie Co., Inc.

2. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel, for use in hardened Portland cement concrete with tension, shear, and pullout capacities appropriate for supported loads and building materials in which used.

    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:

        1) Cooper B-Line, Inc.

        2) Empire Tool and Manufacturing Co., Inc.

        3) Hilti, Inc.

        4) ITW Ramset/Red Head; Illinois Tool Works, Inc.

        5) MKT Fastening, LLC.

3. Concrete Inserts: Steel or malleable-iron, slotted support system units similar to MSS Type 18; complying with MFMA-4 or MSS SP-58.

4. Clamps for Attachment to Steel Structural Elements: MSS SP-58, type suitable for attached structural element.

5. Through Bolts: Structural type, hex head, and high strength. Comply with ASTM A 325.

6. Toggle Bolts: All-steel springhead type.

7. Hanger Rods: Threaded steel.

2.2 FABRICATED METAL EQUIPMENT SUPPORT ASSEMBLIES

A. Description: Welded or bolted, structural-steel shapes, shop or field fabricated to fit dimensions of supported equipment.

B. Materials: Comply with requirements in Section 055000 "Metal Fabrications" for steel shapes and plates.

PART 3 - EXECUTION

3.1 APPLICATION

A. Comply with NECA 1 and NECA 101 for application of hangers and supports for electrical equipment and systems except if requirements in this Section are stricter.

B. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by scheduled in NECA 1, where its Table 1 lists maximum spacing's less than stated in NFPA 70. Minimum rod size shall be 1/4 inch (6 mm) in diameter.

C. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted or other support system, sized so capacity can be increased by at least 25 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with single-bolt conduit clamps.

D. Spring-steel clamps designed for supporting single conduits without bolts may be used for 1-1/2-inch (38-mm) and smaller raceways serving branch circuits and communication systems above suspended ceilings and for fastening raceways to trapeze supports.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Raceway Support Methods: In addition to methods described in NECA 1,for EMT, IMC, and RMC may be supported by openings through structure members, as permitted in NFPA 70.

C. Strength of Support Assemblies: Where not indicated, select sizes of components so strength will be adequate to carry present and future static loads within specified loading limits. Minimum static design load used for strength determination shall be weight of supported components plus 200 lb (90 kg).

D. Mounting and Anchorage of Surface-Mounted Equipment and Components: Anchor and fasten electrical items and their supports to building structural elements by the following methods unless otherwise indicated by code:

1. To Wood: Fasten with lag screws or through bolts.

2. To New Concrete: Bolt to concrete inserts.

3. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.

4. To Existing Concrete: Expansion anchor fasteners.

5. Instead of expansion anchors, powder-actuated driven threaded studs provided with lock washers and nuts may be used in existing standard-weight concrete 4 inches (100 mm) thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches (100 mm) thick.

6. To Steel: Beam clamps MSS Type 19, 21, 23, 25, or 27 complying with MSS SP-69 Spring-tension clamps.

7. To Light Steel: Sheet metal screws.

8. Items Mounted on Hollow Walls and Nonstructural Building Surfaces: Mount cabinets, panelboards, disconnect switches, control enclosures, pull and junction boxes, transformers, and other devices on slotted-channel racks attached to substrate by means that meet seismic-restraint strength and anchorage requirements.

E. Drill holes for expansion anchors in concrete at locations and to depths that avoid reinforcing bars.

3.3 INSTALLATION OF FABRICATED METAL SUPPORTS

A. Comply with installation requirements in Section 055000 "Metal Fabrications" for site-fabricated metal supports.

B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

C. Field Welding: Comply with AWS D1.1/D1.1M.

3.4 CONCRETE BASES

A. Construct concrete bases of dimensions indicated but not less than 4 inches (100 mm) larger in both directions than supported unit, and so anchors will be a minimum of 10 bolt diameters from edge of the base.

B. Use 3000-psi , 28-day compressive-strength concrete. Concrete materials, reinforcement, and placement requirements are specified in Section 033000 "Cast-in-Place Concrete." Section 033053 "Miscellaneous Cast-in-Place Concrete."

C. Anchor equipment to concrete base.

1. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

2. Install anchor bolts to elevations required for proper attachment to supported equipment.

3. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

3.5 PAINTING

A. Touchup: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.

1. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils (0.05 mm).

B. Touchup: Comply with requirements in Section 099113 "Exterior Painting" Section 099123 "Interior Painting" and Section 099600 "High Performance Coatings" for cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION

SECTION 26 05 33 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Nonmetal conduits, tubing, and fittings.
3. Metal wireways and auxiliary gutters.
4. Nonmetal wireways and auxiliary gutters.
5. Surface raceways.
6. Boxes, enclosures, and cabinets.
7. Handholes and boxes for exterior underground cabling.

B. Related Requirements:

1. Not Applicable.

1.3 SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

B. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

C. Samples: Provide samples for wireways, nonmetallic wireways and surface raceways and for each color and texture specified upon request from the Architect or Engineer. Sample to be 12 inches (300 mm) long with all components for review and approval.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

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

1. AFC Cable Systems, Inc.
2. Allied Tube & Conduit.
3. O-Z/Gedney.
4. Republic Conduit.
5. Robroy Industries.
6. Southwire Company.
7. Thomas & Betts Corporation.
8. Western Tube and Conduit Corporation.

B. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. GRC: Comply with ANSI C80.1 and UL 6.

D. ARC: Comply with ANSI C80.5 and UL 6A. (Only allowed if noted on drawings)

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. PVC-Coated Steel Conduit: PVC-coated GRC or IMC

1. Comply with NEMA RN 1.
2. Coating Thickness: 0.040 inch (1 mm), minimum.

G. EMT: Comply with ANSI C80.3 and UL 797.

H. FMC: Comply with UL 1; zinc-coated steel or aluminum.

I. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

J. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Conduit Fittings for Hazardous (Classified) Locations: Comply with UL 886 and NFPA 70.
2. Fittings for EMT:

a. Material: Steel.

b. Type: Setscrew for indoor locations

c. Type: Compression for outdoor and weather exposed locations.

3. Expansion Fittings: PVC or steel to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.

4. Coating for Fittings for PVC-Coated Conduit: Minimum thickness of 0.040 inch (1 mm), with overlapping sleeves protecting threaded joints.

K. Joint Compound for IMC, GRC, or ARC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 NONMETALLIC CONDUITS, TUBING, AND FITTINGS

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

1. AFC Cable Systems, Inc.

2. CANTEX Inc.

3. CertainTeed Corporation.

4. Carlon Electrical Products.

5. RACO; Hubbell.

6. Thomas & Betts Corporation.

B. Listing and Labeling: Nonmetallic conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. ENT: Comply with NEMA TC 13 and UL 1653. Not allowed on this project.

D. RNC: Type EPC-40-PVC, complying with NEMA TC 2 and UL 651 unless otherwise indicated.

E. LFNC: Comply with UL 1660.

F. Rigid HDPE: Comply with UL 651A.

G. Continuous HDPE: Comply with UL 651B.

H. Coilable HDPE: Preassembled with conductors or cables, and complying with ASTM D 3485.

I. RTRC: Comply with UL 1684A and NEMA TC 14.

J. Fittings for ENT and RNC: Comply with NEMA TC 3; match to conduit or tubing type and material.

K. Fittings for LFNC: Comply with UL 514B.

L. Solvent cements and adhesive primers shall have a VOC content of 510 and 550 g/L or less, respectively, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

M. Solvent cements and adhesive primers 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."

2.3 METAL WIREWAYS AND AUXILIARY GUTTERS

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. Cooper B-Line, Inc.

2. Hoffman.

3. Mono-Systems, Inc.

4. Square D.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 or Type 3R outdoor unless otherwise indicated, and sized according to NFPA 70.

1. Metal wireways installed outdoors shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Fittings and Accessories: Include covers, couplings, offsets, elbows, expansion joints, adapters, hold-down straps, end caps, and other fittings to match and mate with wireways as required for complete system.

D. Wireway Covers: Hinged type or Screw-cover type or Flanged-and-gasketed type unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish.

2.4 SURFACE RACEWAYS

A. Surface raceways and tele-power poles shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Surface Metal Raceways: Galvanized steel with snap-on covers complying with UL 5. Manufacturer's standard enamel finishes in color selected by Architect.

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. Mono-Systems, Inc.

    b. Panduit Corp.

    c. Wiremold / Legrand.

C. Surface Nonmetallic Raceways: Two- or three-piece construction, complying with UL 5A, and manufactured of rigid PVC with texture and color selected by Architect from manufacturer's standard colors. Product shall comply with UL 94 V-0 requirements for self-extinguishing characteristics.

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

    a. Hubbell Incorporated.

    b. Mono-Systems, Inc.

    c. Panduit Corp.

    d. Wiremold / Legrand.

D. Tele-Power Poles:

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. Mono-Systems, Inc.

    b. Panduit Corp.

    c. Wiremold / Legrand.

2. Material: Aluminum with clear anodized finish.

3. Fittings and Accessories: Dividers, end caps, covers, cutouts, wiring harnesses, devices, mounting materials, and other fittings shall match and mate with tele-power pole as required for complete system.

2.5 BOXES, ENCLOSURES, AND CABINETS

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. Cooper Crouse-Hinds Technologies Company.

2. EGS/Appleton Electric.
3. FSR Inc.
4. Hoffman.
5. Hubbell Incorporated.
6. Milbank Manufacturing Co.
7. Mono-Systems, Inc.
8. O-Z/Gedney.
9. RACO; Hubbell.
10. Robroy Industries.
11. Spring City Electrical Manufacturing Company.
12. Thomas & Betts Corporation.
13. Wiremold / Legrand.

B. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

C. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Metal Floor Boxes:

1. Material: sheet metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

G. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb. (23 kg) shall be listed and marked for the maximum allowable weight.

H. Paddle Fan Outlet Boxes: Nonadjustable, designed for attachment of paddle fan weighing 70 lb. (32 kg).

1. Listing and Labeling: Paddle fan outlet boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

I. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

J. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum or galvanized, cast iron with gasketed cover.

K. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

L. Device Box Dimensions: 4 inches by 2-1/8 inches by 2-1/8 inches deep.

M. Gangable boxes are allowed.

N. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1or Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.

2. Nonmetallic Enclosures: Plastic or Fiberglass.

3. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

O. Cabinets:

1. NEMA 250, Type 1 Type 3R galvanized-steel box with removable interior panel and removable front, finished inside and out with manufacturer's standard enamel.

2. Hinged door in front cover with flush latch and concealed hinge.

3. Key latch to match panelboards.

4. Metal barriers to separate wiring of different systems and voltage.

5. Accessory feet where required for freestanding equipment.

6. Nonmetallic cabinets shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.6 HANDHOLES AND BOXES FOR EXTERIOR UNDERGROUND WIRING

A. General Requirements for Handholes and Boxes:

1. Boxes and handholes for use in underground systems shall be designed and identified as defined in NFPA 70, for intended location and application.

2. Boxes installed in wet areas shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Polymer-Concrete Handholes and Boxes with Polymer-Concrete Cover: Molded of sand and aggregate, bound together with polymer resin, and reinforced with steel, fiberglass, or a combination of the two.

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]:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Armorcast Products Company.

b. Carson Industries LLC.

c. New Basis.

d. Oldcastle Precast, Inc.

e. Quazite: Hubbell Power System, Inc.

f. Synertech Molded Products.

3. Standard: Comply with SCTE 77.

4. Configuration: Designed for flush burial with open closed or integral closed bottom unless otherwise indicated.

5. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

6. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

7. Cover Legend: Molded lettering, "ELECTRIC."

8. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

9. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

C. Fiberglass Handholes and Boxes: Molded of fiberglass-reinforced polyester resin, with frame and covers of fiberglass.

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:

2. Basis-of-Design Product: Subject to compliance with requirements, provide products indicated on Drawings or comparable product by one of the following:

a. Armorcast Products Company.

b. Carson Industries LLC.

c. New Basis.

d. Nordic Fiberglass, Inc.

e. Oldcastle Precast, Inc.; Christy Concrete Products.

f. Quazite: Hubbell Power System, Inc.; Hubbell Power Systems.

g. Synertech Molded Products.

3. Standard: Comply with SCTE 77.

4. Color of Frame and Cover: Gray or Green.

5. Configuration: Designed for flush burial with open, closed or integral closed bottom as per application requirements.

6. Cover: Weatherproof, secured by tamper-resistant locking devices and having structural load rating consistent with enclosure and handhole location.

7. Cover Finish: Nonskid finish shall have a minimum coefficient of friction of 0.50.

8. Cover Legend: Molded lettering, "ELECTRIC."

9. Conduit Entrance Provisions: Conduit-terminating fittings shall mate with entering ducts for secure, fixed installation in enclosure wall.

10. Handholes 12 Inches Wide by 24 Inches Long (300 mm Wide by 600 mm Long) and Larger: Have inserts for cable racks and pulling-in irons installed before concrete is poured.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC, IMC.

2. Concealed Conduit, Aboveground: GRC, IMC, EMT RNC, Type EPC-40-PVC.

3. Underground Conduit: RNC, Type EPC-40-PVCdirect buried or concrete encased.

4. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment: LFMC LFNC.

5. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT

2. Exposed, Not Subject to Severe Physical Damage: EMT identified for such use.

3. Exposed and Subject to Severe Physical Damage: GRC or IMC. Raceway locations include the following:

    a. Loading dock.

    b. Corridors used for traffic of mechanized carts, forklifts, and pallet-handling units.

    c. Mechanical rooms.

    d. Gymnasiums.

4. Concealed in Ceilings and Interior Walls and Partitions: EMT.

5. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.

6. Damp or Wet Locations: GRC, IMC.

7. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel or nonmetallic in institutional and commercial kitchens and damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.

2. PVC Externally Coated, Rigid Steel Conduits: Use only fittings listed for use with this type of conduit. Patch and seal all joints, nicks, and scrapes in PVC coating after installing conduits and fittings. Use sealant recommended by fitting manufacturer and apply in thickness and number of coats recommended by manufacturer.

3. EMT: Use setscrew steel fittings. Comply with NEMA FB 2.10.

4. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

E. Install nonferrous conduit or tubing for circuits operating above 60 Hz. Where aluminum raceways are installed for such circuits and pass through concrete, install in nonmetallic sleeve.

F. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.

G. Install surface raceways only where indicated on Drawings.

H. Do not install nonmetallic conduit except below grade or as indicated on the drawings.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 12 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Comply with requirements in Section 260529 "Hangers and Supports for Electrical Systems" for hangers and supports.

E. Arrange stub-ups so curved portions of bends are not visible above finished slab.

F. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

G. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

H. Support conduit within 12 inches (300 mm) of enclosures to which attached.

I. Raceways Embedded in Slabs: “Not Allowed without submission and approval “

1. Run conduit larger than 1-inch (27-mm) trade size, parallel or at right angles to main reinforcement. Where at right angles to reinforcement, place conduit close to slab support. Secure raceways to reinforcement at maximum 10-foot (3-m) intervals.

2. Arrange raceways to cross building expansion joints at right angles with expansion fittings.

3. Arrange raceways to keep a minimum of 2 inches (50 mm) of concrete cover in all directions.

4. Do not embed threadless fittings in concrete unless specifically approved by Architect for each specific location.

5. Change from PVC conduit to GRC elbows before rising above floor. Wrap GRC elbows with PVC tape where in contact with earth or concrete.

J. Stub-ups to Above Recessed Ceilings:

1. Use EMT, IMC, or RMC for raceways.

2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

K. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

L. Coat field-cut threads on PVC-coated raceway with a corrosion-preventing conductive compound prior to assembly.

M. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

N. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

O. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

P. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

Q. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

R. Install pull wires in all empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

S. Surface Raceways:

1. Install surface raceway with a minimum 2-inch (50-mm) radius control at bend points.

2. Secure surface raceway with screws or other anchor-type devices at intervals not exceeding 48 inches (1200 mm) and with no less than two supports per straight raceway section. Support surface raceway according to manufacturer's written instructions. Tape and glue are not acceptable support methods.

T. Install raceway sealing fittings at accessible locations according to NFPA 70 and fill them with 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 according to NFPA 70.

U. Install devices to seal raceway interiors at accessible locations. Locate seals so no fittings or boxes are between the seal and the following changes of environments. Seal the interior of all raceways at the following points:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.

2. Where an underground service raceway enters a building or structure.

3. Where otherwise required by NFPA 70.

V. Comply with manufacturer's written instructions for solvent welding RNC and fittings.

W. Expansion-Joint Fittings:

1. Install in each run of above ground RMC, IMC or EMT conduits that is located where environmental temperature change may exceed 100 deg F (55 deg C) and that has straight-run length that exceeds 100 feet (30 m).

2. Install type and quantity of fittings that accommodate temperature change listed for each of the following locations:

a. Outdoor Locations Not Exposed to Direct Sunlight: 125 deg F (70 deg C) temperature change.

b. Outdoor Locations Exposed to Direct Sunlight: 155 deg F (86 deg C) temperature change.

c. Indoor Spaces Connected with Outdoors without Physical Separation: 125 deg F (70 deg C) temperature change.

d. Attics: 135 deg F (75 deg C) temperature change.

e. 2" and larger conduits that cross building expansion joints.

3. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F (0.06 mm per meter of length of straight run per deg C) of temperature change for PVC conduits. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F (0.0115 mm per meter of length of straight run per deg C) of temperature change for metal conduits.

4. Install expansion fittings at all locations where conduits cross building or structure expansion joints.

5. Install each expansion-joint fitting with position, mounting, and piston setting selected according to manufacturer's written instructions for conditions at specific location at time of installation. Install conduit supports to allow for expansion movement.

X. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for recessed and semi-recessed luminaires, equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

2. Use LFMC or LFNC in damp or wet locations not subject to severe physical damage.

Y. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

Z. Recessed Boxes in Masonry Walls: Saw-cut opening for box in center of cell of masonry block, and install box flush with surface of wall. Prepare block surfaces to provide a flat surface for a raintight connection between box and cover plate or supported equipment and box.

AA. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

BB. Locate boxes so that cover or plate will not span different building finishes.

CC. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

DD. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

EE. Set metal floor boxes level and flush with finished floor surface.

FF. Set nonmetallic floor boxes level. Trim after installation to fit flush with finished floor surface.

3.3 INSTALLATION OF UNDERGROUND CONDUIT

A. Direct-Buried Conduit:

1. Excavate trench bottom to provide firm and uniform support for conduit. Prepare trench bottom as specified in Section 312000 "Earth Moving" for pipe less than 6 inches (150 mm) in nominal diameter.

2. Install backfill as specified in Section 312000 "Earth Moving."

3. After installing conduit, backfill and compact. Start at tie-in point, and work toward end of conduit run, leaving conduit at end of run free to move with expansion and contraction as temperature changes during this process. Firmly hand tamp backfill around conduit to provide maximum supporting strength. After placing controlled backfill to within 12 inches (300 mm) of finished grade, make final conduit connection at end of run and complete backfilling with normal compaction as specified in Section 312000 "Earth Moving."

4. Install manufactured duct elbows for stub-ups at poles and equipment and at building entrances through floor unless otherwise indicated. Encase elbows for stub-up ducts throughout length of elbow.

5. Install manufactured rigid steel conduit elbows for stub-ups at poles and equipment and at building entrances through floor.

a. Couple steel conduits to ducts with adapters designed for this purpose, and encase coupling with 3 inches (75 mm) of concrete for a minimum of 12 inches (300 mm) on each side of the coupling.

b. For stub-ups at equipment mounted on outdoor concrete bases and where conduits penetrate building foundations, extend steel conduit horizontally a minimum of 60 inches (1500 mm) from edge of foundation or equipment base. Install insulated grounding bushings on terminations at equipment.

6. Underground Warning Tape: Comply with requirements in Section 260553 "Identification for Electrical Systems."

3.4 INSTALLATION OF UNDERGROUND HANDHOLES AND BOXES

A. Install handholes and boxes level and plumb and with orientation and depth coordinated with connecting conduits to minimize bends and deflections required for proper entrances and in accordance with the manufactures written instructions.

B. Unless otherwise indicated, support units on a level bed of crushed stone or gravel, graded from 1/2-inch (12.5-mm) sieve to No. 4 (4.75-mm) sieve and compacted to same density as adjacent undisturbed earth.

C. Elevation: In paved areas, set so cover surface will be flush with finished grade. Set covers of other enclosures 1 inch (25 mm) above finished grade.

D. Install removable hardware, including pulling eyes, cable stanchions, cable arms, and insulators, as required for installation and support of cables and conductors and as indicated. Select arm lengths to be long enough to provide spare space for future cables but short enough to preserve adequate working clearances in enclosure.

E. Field-cut openings for conduits according to enclosure manufacturer's written instructions. Cut wall of enclosure with a tool designed for material to be cut. Size holes for terminating fittings to be used, and seal around penetrations after fittings are installed.

3.5 SLEEVE & SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.6 FIRESTOPPING

A. Install firestopping at penetrations of fire-rated floor and wall assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.7 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

2. Repair damage to PVC coatings or paint finishes with matching touchup coating recommended by manufacturer.

END OF SECTION

SECTION 26 05 44 - SLEEVES AND SLEEVE SEALS FOR ELECTRICAL RACEWAYS AND CABLING

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. Sleeves for raceway and cable penetration of non-fire-rated construction walls and floors.
2. Sleeve-seal systems.
3. Sleeve-seal fittings.
4. Grout.
5. Silicone sealants.

B. Related Requirements:

1. Section 078413 "Penetration Firestopping" for penetration firestopping installed in fire-resistance-rated walls, horizontal assemblies, and smoke barriers, with and without penetrating items.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 SLEEVES

A. Wall Sleeves:

1. Steel Pipe Sleeves: ASTM A 53/A 53M, Type E, Grade B, Schedule 40, zinc coated, plain ends.
2. Cast-Iron Pipe Sleeves: Cast or fabricated "wall pipe," equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop unless otherwise indicated.

B. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies: Galvanized-steel sheet; 0.0239-inch (0.6-mm) minimum thickness; round tube closed with welded longitudinal joint, with tabs for screw-fastening the sleeve to the board.

C. PVC-Pipe Sleeves: ASTM D 1785, Schedule 40.

D. Molded-PVC Sleeves: With nailing flange for attaching to wooden forms.

E. Molded-PE or -PP Sleeves: Removable, tapered-cup shaped, and smooth outer surface with nailing flange for attaching to wooden forms.

F. Sleeves for Rectangular Openings:

1. Material: Galvanized sheet steel.

2. Minimum Metal Thickness:

a. For sleeve cross-section rectangle perimeter less than 50 inches (1270 mm) and with no side larger than 16 inches (400 mm), thickness shall be 0.052 inch (1.3 mm).

b. For sleeve cross-section rectangle perimeter 50 inches (1270 mm) or more and one or more sides larger than 16 inches (400 mm), thickness shall be 0.138 inch (3.5 mm).

2.2 SLEEVE-SEAL SYSTEMS

A. Description: Modular sealing device, designed for field assembly, to fill annular space between sleeve and raceway or cable.

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:

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

a. Advance Products & Systems, Inc.

b. CALPICO, Inc.

c. Metraflex Company (The).

d. Pipeline Seal and Insulator, Inc.

e. Proco Products, Inc.

3. Sealing Elements: EPDM rubber interlocking links shaped to fit surface of pipe. Include type and number required for pipe material and size of pipe.

4. Pressure Plates: Stainless steel.

5. Connecting Bolts and Nuts: Stainless steel of length required to secure pressure plates to sealing elements.

2.3 SLEEVE-SEAL FITTINGS

A. Description: Manufactured plastic, sleeve-type, waterstop assembly made for embedding in concrete slab or wall. Unit shall have plastic or rubber waterstop collar with center opening to match piping OD.

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:

2. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:

a. Pre-sealed Systems.

2.4 GROUT

A. Description: Nonshrink; recommended for interior and exterior sealing openings in non-fire-rated walls or floors.

B. Standard: ASTM C 1107/C 1107M, Grade B, post-hardening and volume-adjusting, dry, hydraulic-cement grout.

C. Design Mix: 5000-psi (34.5-MPa), 28-day compressive strength.

D. Packaging: Premixed and factory packaged.

2.5 SILICONE SEALANTS

A. Silicone Sealants: Single-component, silicone-based, neutral-curing elastomeric sealants of grade indicated below.

1. Grade: Pourable (self-leveling) formulation for openings in floors and other horizontal surfaces that are not fire rated.

2. Sealant shall have VOC content value as calculated according to 40 CFR 59, Subpart D EPA Method 24.

3. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Silicone Foams: Multicomponent, silicone-based liquid elastomers that, when mixed, expand and cure in place to produce a flexible, non-shrinking foam.

PART 3 - EXECUTION

3.1 SLEEVE INSTALLATION FOR NON-FIRE-RATED ELECTRICAL PENETRATIONS

A. Comply with NECA 1.

B. Comply with NEMA VE 2 for cable tray and cable penetrations.

C. Sleeves for Conduits Penetrating Above-Grade Non-Fire-Rated Concrete and Masonry-Unit Floors and Walls:

1. Interior Penetrations of Non-Fire-Rated Walls and Floors:

a. Seal annular space between sleeve and raceway or cable, using joint sealant appropriate for size, depth, and location of joint. Comply with requirements in Section 079200 "Joint Sealants."

b. Seal space outside of sleeves with mortar or grout. Pack sealing material solidly between sleeve and wall so no voids remain. Tool exposed surfaces smooth; protect material while curing.

2. Use pipe sleeves unless penetration arrangement requires rectangular sleeved opening.

3. Size pipe sleeves to provide 1/4-inch (6.4-mm) annular clear space between sleeve and raceway or cable unless sleeve seal is to be installed or unless seismic criteria require different clearance.

4. Install sleeves for wall penetrations unless core-drilled holes or formed openings are used. Install sleeves during erection of walls. Cut sleeves to length for mounting flush with both surfaces of walls. De-burr after cutting.

5. Install sleeves for floor penetrations. Extend sleeves installed in floors 2 inches (50 mm) above finished floor level. Install sleeves during erection of floors.

D. Sleeves for Conduits Penetrating Non-Fire-Rated Gypsum Board Assemblies:

1. Use circular metal sleeves unless penetration arrangement requires rectangular sleeved opening.

2. Seal space outside of sleeves with approved joint compound for gypsum board assemblies.

E. Roof-Penetration Sleeves: Seal penetration of individual raceways and cables with flexible boot-type flashing units applied in coordination with roofing work.

F. Aboveground, Exterior-Wall Penetrations: Seal penetrations using steel pipe sleeves and mechanical sleeve seals. Select sleeve size to allow for 1-inch (25-mm) annular clear space between pipe and sleeve for installing mechanical sleeve seals.

G. Underground, Exterior-Wall and Floor Penetrations: Install cast-iron pipe sleeves. Size sleeves to allow for 1-inch (25-mm) annular clear space between raceway or cable and sleeve for installing sleeve-seal system.

3.2 SLEEVE-SEAL-SYSTEM INSTALLATION

A. Install sleeve-seal systems in sleeves in exterior concrete walls and slabs-on-grade at raceway entries into building.

B. Install type and number of sealing elements recommended by manufacturer for raceway or cable material and size. Position raceway or cable in center of sleeve. Assemble mechanical sleeve seals and install in annular space between raceway or cable and sleeve. Tighten bolts against pressure plates that cause sealing elements to expand and make watertight seal.

3.3 SLEEVE-SEAL-FITTING INSTALLATION

A. Install sleeve-seal fittings in new walls and slabs as they are constructed.

B. Assemble fitting components of length to be flush with both surfaces of concrete slabs and walls. Position waterstop flange to be centered in concrete slab or wall.

C. Secure nailing flanges to concrete forms.

D. Using grout, seal the space around outside of sleeve-seal fittings.

END OF SECTION

SECTION 26 05 53 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

B. Samples: For each type of label and sign to illustrate size, colors, lettering style, mounting provisions, and graphic features of identification products.

C. Identification Schedule: An index of nomenclature of electrical equipment and system components used in identification signs and labels.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1 and IEEE C2.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL 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 600 V or Less:

1. Black letters on an orange field.

2. Legend: Indicate voltage and system.

C. Colors for Raceways Carrying Circuits at More Than 600 V:

1. Black letters on a RED field.

2. Legend: "DANGER CONCEALED HIGH VOLTAGE WIRING."

D. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

E. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers diagonally over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stop stripes at legends.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Colors for Cables Carrying Circuits at 600 V and Less:

1. Black letters on an orange field.

2. Legend: Indicate voltage and system.

C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- (0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

2.4 CONDUCTOR IDENTIFICATION MATERIALS

A. Color-Coding Conductor Tape: Colored, self-adhesive vinyl tapes not less than 3 mils (0.08 mm) thick by 1 to 2 inches (25 to 50 mm) wide.

B. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.5 FLOOR MARKING TAPE

A. 2-inch- (50-mm-) wide, 5-mil (0.125-mm) pressure-sensitive vinyl tape, with yellow and black stripes and clear vinyl overlay.

2.6 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.

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.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.

2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE, HIGH VOLTAGE,.

3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE, OPTICAL FIBER CABLE.

C. Tag: Type I Underground utilities:

1. Pigmented polyolefin, bright-colored, continuous-printed on one side with the inscription of the utility, compounded for direct-burial service.

2. Thickness: 4 mils (0.1 mm).

3. Weight: 18.5 lb./1000 sq. ft. (9.0 kg/100 sq. m).

2.7 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.

2. 1/4-inch (6.4-mm) grommets in corners for mounting.

3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Metal-Backed, Butyrate Warning Signs:

1. Weather-resistant, nonfading, preprinted, cellulose-acetate butyrate signs with 0.0396-inch (1-mm) galvanized-steel backing; and with colors, legend, and size required for application.

2. 1/4-inch (6.4-mm) grommets in corners for mounting.

3. Nominal size, 10 by 14 inches (250 by 360 mm).

E. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."

2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

3. Equipment labels ARC-FLASH Classification Warning and Equipment voltages.

2.8 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.

2. Punched or drilled for mechanical fasteners.

3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

2.9 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.10 CABLE TIES

A. General-Purpose Cable Ties: Fungus inert, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: Black except where used for color-coding.

B. UV-Stabilized Cable Ties: Fungus inert, designed for continuous exposure to exterior sunlight, self-extinguishing, one piece, self-locking, Type 6/6 nylon.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 12,000 psi (82.7 MPa).

3. Temperature Range: Minus 40 to plus 185 deg F (Minus 40 to plus 85 deg C).

4. Color: Black.

C. Plenum-Rated Cable Ties: Self-extinguishing, UV stabilized, one piece, self-locking.

1. Minimum Width: 3/16 inch (5 mm).

2. Tensile Strength at 73 deg F (23 deg C), According to ASTM D 638: 7000 psi (48.2 MPa).

3. UL 94 Flame Rating: 94V-0.

4. Temperature Range: Minus 50 to plus 284 deg F (Minus 46 to plus 140 deg C).

5. Color: Black.

2.11 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

F. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

G. System Identification Color-Coding Bands for Raceways and Cables: Each color-coding band shall completely encircle cable or conduit. Place adjacent bands of two-color markings in contact, side by side. Locate bands at changes in direction, at penetrations of walls and floors, at 50-foot (15-m) maximum intervals in straight runs, and at 25-foot (7.6-m) maximum intervals in congested areas.

H. Cable Ties: For attaching tags. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.

2. In Spaces Handling Environmental Air: Plenum rated.

I. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade and 8 inches above conduit or cable. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.

J. Painted Identification: Comply with requirements in painting Sections for surface preparation and paint application.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 120 V to ground: Identify with self-adhesive colored vinyl label. Install labels at 25foot maximum intervals.

B. Accessible Raceways and Cables within Buildings: Identify the covers of each junction and pull box of the following systems with self-adhesive vinyl labels with the wiring system legend and system voltage. System legends shall be as follows:

1. Emergency Power.

2. Power.

3. UPS.

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase and Voltage Level Identification, 600 V or Less: Use colors listed below for ungrounded service and feeder (100Amps or greater) branch-circuit conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.

b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 3 inches (75 mm) from terminal points and in boxes where splices or taps are made. Apply last two turns of tape with no tension to prevent possible unwinding. Locate bands to avoid obscuring factory cable markings.

D. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

E. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.

3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

F. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Limit use of underground-line warning tape to direct-buried cables.

2. Install underground-line warning tape for both direct-buried cables and cables in raceway.

G. Workspace Indication: Install floor marking tape to show working clearances in the direction of access to live parts. Workspace shall be as required by NFPA 70 and 29 CFR 1926.403 unless otherwise indicated. Do not install at flush-mounted panelboards and similar equipment in finished spaces.

H. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

I. Emergency Operating Instruction Signs: Install instruction signs with white legend on a red background with minimum 3/8-inch- (10-mm-) high letters for emergency instructions at equipment used for power transfer and testing.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

a. Indoor Equipment: engraved, laminated acrylic Unless otherwise indicated, provide a single line of text with 3/8inch- high letters on 1 inch-high label; where two lines of text are required, use labels 2 inches (50 mm) high.

b. Outdoor Equipment: Same as Indoor Equipment.

c. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved laminated acrylic or melamine label.

b. Enclosures and electrical cabinets.

c. Access doors and panels for concealed electrical items.

d. Switchgear.

e. Switchboards.

f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.

g. Emergency system boxes and enclosures.

h. Motor-control centers.

i. Enclosed switches.

j. Enclosed circuit breakers.

k. Enclosed controllers.

l. Variable-speed controllers.

m. Push-button stations.

n. Power transfer equipment.

o. Contactors.

p. Remote-controlled switches, dimmer modules, and control devices.

q. Battery racks.

r. Power-generating units.

s. Monitoring and control equipment.

END OF SECTION

SECTION 26 05 73.19 - ARC-FLASH HAZARD ANALYSIS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes a computer-based, arc-flash study to determine the arc-flash hazard distance and the incident energy to which personnel could be exposed during work on or near electrical equipment.

1.3 DEFINITIONS

A. Existing to Remain: Existing items of construction that are not to be removed and that are not otherwise indicated to be removed, removed and salvaged, or removed and reinstalled.

B. Field Adjusting Agency: An independent electrical testing agency with full-time employees and the capability to adjust devices and conduct testing indicated and that is a member company of NETA.

C. One-Line Diagram: A diagram that shows, by means of single lines and graphic symbols, the course of an electric circuit or system of circuits and the component devices or parts used therein.

D. Power System Analysis Software Developer: An entity that commercially develops, maintains, and distributes computer software used for power system studies.

E. Power Systems Analysis Specialist: Professional engineer in charge of performing the study and documenting recommendations, licensed in the state where Project is located.

F. Protective Device: A device that senses when an abnormal current flow exists and then removes the affected portion from the system.

G. SCCR: Short-circuit current rating.

H. Service: The conductors and equipment for delivering electric energy from the serving utility to the wiring system of the premises served.

I. Single-Line Diagram: See "One-Line Diagram."

1.4 ACTION SUBMITTALS

A. Product Data: For computer software program to be used for studies.

B. Study Submittals: Submit the following submittals after the approval of system protective devices submittals. Submittals may be in digital form:

1. Arc-flash study input data, including completed computer program input data sheets.

2. Arc-flash study report; signed, dated, and sealed by Power Systems Analysis Specialist.

3. Submit study report for action prior to receiving final approval of distribution equipment submittals. If formal completion of studies will cause delay in equipment manufacturing, obtain approval from Architect for preliminary submittal of sufficient study data to ensure that selection of devices and associated characteristics is satisfactory.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data:

1. For Power Systems Analysis Software Developer.

2. For Power System Analysis Specialist.

3. For Field Adjusting Agency.

B. Product Certificates: For arc-flash hazard analysis software, certifying compliance with IEEE 1584 and NFPA 70E.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data:

1. Provide maintenance procedures in equipment manuals according to requirements in NFPA 70E.

2. Operation and Maintenance Procedures: In addition to items specified in Section 017823 "Operation and Maintenance Data," provide maintenance procedures for use by Owner's personnel that comply with requirements in NFPA 70E.

1.7 QUALITY ASSURANCE

A. Study shall be performed using commercially developed and distributed software designed specifically for power system analysis.

B. Software algorithms shall comply with requirements of standards and guides specified in this Section.

C. Manual calculations are unacceptable.

D. Power System Analysis Software Qualifications: An entity that owns and markets computer software used for studies, having performed successful studies of similar magnitude on electrical distribution systems using similar devices.

1. Computer program shall be designed to perform arc-flash analysis or have a function, component, or add-on module designed to perform arc-flash analysis.

2. Computer program shall be developed under the charge of a licensed professional engineer who holds IEEE Computer Society's Certified Software Development Professional certification.

E. Power Systems Analysis Specialist Qualifications: Professional engineer in charge of performing the arc-flash study, analyzing the arc flash, and documenting recommendations, licensed in the state where Project is located. All elements of the study shall be performed under the direct supervision and control of this professional engineer.

F. Arc-Flash Study Certification: Arc-Flash Study Report shall be signed and sealed by Power Systems Analysis Specialist.

G. Field Adjusting Agency Qualifications:

1. Employer of a NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification responsible for all field adjusting of the Work.

2. A member company of NETA.

3. Acceptable to authorities having jurisdiction.

PART 2 - PRODUCTS

2.1 COMPUTER SOFTWARE DEVELOPERS

A. Companies:

1. EasyPower, LLC

2. SKM Systems Analysis, Inc.

3. CGI CYME

4. ETAP

B. Comply with IEEE 1584 and NFPA 70E.

C. Analytical features of device coordination study computer software program shall have the capability to calculate "mandatory," "very desirable," and "desirable" features as listed in IEEE 399.

2.2 ARC-FLASH STUDY REPORT CONTENT

A. Executive summary of study findings.

B. Study descriptions, purpose, basis, and scope. Include case descriptions, definition of terms, and guide for interpretation of results.

C. One-line diagram, showing the following:

1. Protective device designations and ampere ratings.

2. Conductor types, sizes, and lengths.

3. Transformer kilovolt ampere (kVA) and voltage ratings, including derating factors and environmental conditions.

4. Motor and generator designations and kVA ratings.

5. Switchgear, switchboard, motor-control center, panelboard designations, and ratings.

D. Study Input Data: As described in "Power System Data" Article.

E. Short-Circuit Current Output Data.

F. Protective Device Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

G. Arc-Flash Study Output Reports:

1. Interrupting Duty Report: Three-phase and unbalanced fault calculations, showing the following for each equipment location included in the report:

a. Voltage.

b. Calculated symmetrical fault-current magnitude and angle.

c. Fault-point X/R ratio.

d. No AC Decrement (NACD) ratio.

e. Equivalent impedance.

f. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a symmetrical basis.

g. Multiplying factors for 2-, 3-, 5-, and 8-cycle circuit breakers rated on a total basis.

H. Incident Energy and Flash Protection Boundary Calculations:

1. Arcing fault magnitude.
2. Protective device clearing time.
3. Duration of arc.
4. Arc-flash boundary.
5. Restricted approach boundary.
6. Limited approach boundary.
7. Working distance.
8. Incident energy.
9. Hazard risk category.
10. Recommendations for arc-flash energy reduction.

I. Fault study input data, case descriptions, and fault-current calculations including a definition of terms and guide for interpretation of computer printout.

2.3 ARC-FLASH WARNING LABELS

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for self-adhesive equipment labels. Produce a 3.5-by-5-inch (76-by-127-mm) self-adhesive equipment label for each work location included in the analysis.

B. Label shall have an orange header with the wording, "WARNING, ARC-FLASH HAZARD," and shall include the following information taken directly from the arc-flash hazard analysis:

1. Location designation.
2. Nominal voltage.
3. Protection boundaries.
    a. Arc-flash boundary.
    b. Restricted approach boundary.
    c. Limited approach boundary.
4. Arc flash PPE category.
5. Required minimum arc rating of PPE in Cal/cm squared.
6. Available incident energy.

7. Working distance.

8. Engineering report number, revision number, and issue date.

C. Labels shall be machine printed, with no field-applied markings.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine Project overcurrent protective device submittals. Proceed with arc-flash study only after relevant equipment submittals have been assembled. Overcurrent protective devices that have not been submitted and approved prior to arc-flash study may not be used in study.

3.2 ARC-FLASH HAZARD ANALYSIS

A. Comply with NFPA 70E and its Annex D for hazard analysis study.

B. Preparatory Studies: Perform the Protective Device Coordination study prior to starting the Arc-Flash Hazard Analysis or obtain results from another source.

1. Coordination Study Report Contents: As specified in "Coordination Study Report Contents" Article in Section 260573.16 "Coordination Studies."

C. Calculate maximum and minimum contributions of fault-current size.

1. Maximum calculation shall assume a maximum contribution from the utility and shall assume motors to be operating under full-load conditions.

2. Calculate arc-flash energy at 85 percent of maximum short-circuit current according to IEEE 1584 recommendations.

3. Calculate arc-flash energy at 38 percent of maximum short-circuit current according to NFPA 70E recommendations.

4. Calculate arc-flash energy with the utility contribution at a minimum and assume no motor contribution.

D. Calculate the arc-flash protection boundary and incident energy at locations in electrical distribution system where personnel could perform work on energized parts.

E. Include medium- and low-voltage equipment locations, except equipment rated 240 V ac or less fed from transformers less than 125 kVA.

F. Calculate the limited, restricted, and prohibited approach boundaries for each location.

G. Incident energy calculations shall consider the accumulation of energy over time when performing arc-flash calculations on buses with multiple sources. Iterative

calculations shall take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators shall be decremented as follows:

1. Fault contribution from induction motors shall not be considered beyond three to five cycles.

2. Fault contribution from synchronous motors and generators shall be decayed to match the actual decrement of each as closely as possible (for example, contributions from permanent magnet generators will typically decay from 10 per unit to three per unit after 10 cycles).

H. Arc-flash energy shall generally be reported for the maximum of line or load side of a circuit breaker. However, arc-flash computation shall be performed and reported for both line and load side of a circuit breaker as follows:

1. When the circuit breaker is in a separate enclosure.

2. When the line terminals of the circuit breaker are separate from the work location.

I. Base arc-flash calculations on actual overcurrent protective device clearing time. Cap maximum clearing time at two seconds based on IEEE 1584, Section B.1.2.

3.3 POWER SYSTEM DATA

A. Obtain all data necessary for conduct of the arc-flash hazard analysis.

1. Verify completeness of data supplied on one-line diagram on Drawings. Call discrepancies to Project Engineer's attention.
2. For new equipment, use characteristics from approved submittals under provisions of action submittals and information submittals for this Project.

B. Electrical Survey Data: Gather and tabulate the following input data to support study. Comply with recommendations in IEEE 1584 and NFPA 70E as to the amount of detail that is required to be acquired in the field. Field data gathering shall be under the direct supervision and control of the engineer in charge of performing the study, and shall be by the engineer or its representative who holds NETA ETT-Certified Technician Level III or NICET Electrical Power Testing Level III certification. Data include, but are not limited to, the following:

1. Product Data for overcurrent protective devices specified in other Sections and involved in overcurrent protective device coordination studies. Use equipment designation tags that are consistent with electrical distribution system diagrams, overcurrent protective device submittals, input and output data, and recommended device settings.

2. Obtain electrical power utility impedance or available short circuit current at the service.

3. Power sources and ties.

4. Short-circuit current at each system bus (three phase and line to ground).

5. Full-load current of all loads.

6. Voltage level at each bus.

7. For transformers, include kVA, primary and secondary voltages, connection type, impedance, X/R ratio, taps measured in percent, and phase shift.

8. For reactors, provide manufacturer and model designation, voltage rating and impedance.

9. For circuit breakers and fuses, provide manufacturer and model designation. List type of breaker, type of trip and available range of settings, SCCR, current rating, and breaker settings.

10. Generator short-circuit current contribution data, including short-circuit reactance, rated kVA, rated voltage, and X/R ratio.

11. For relays, provide manufacturer and model designation, current transformer ratios, potential transformer ratios, and relay settings.

12. Busway manufacturer and model designation, current rating, impedance, lengths, size, and conductor material.

13. Motor horsepower and NEMA MG 1 code letter designation.

14. Low-voltage conductor sizes, lengths, number, conductor material and conduit material (magnetic or nonmagnetic).

15. Medium-voltage conductor sizes, lengths, conductor material, conductor construction and metallic shield performance parameters, and conduit material (magnetic or nonmagnetic).

3.4 LABELING

A. Apply one arc-flash label on the front cover of each section of the equipment for each equipment included in the study. Base arc-flash label data on highest values calculated at each location.

B. Each piece of equipment listed below shall have an arc-flash label applied to it:

1. Motor-control center.

2. Low-voltage switchboard.

3. Switchgear.

4. Medium-voltage switch.

5. Medium voltage transformers

6. Low voltage transformers. Exclude transformers with high voltage side 240 V or less and less than 125 kVA.

7. Panelboard and safety switch over 250 V.

8. Applicable panelboard and safety switch under 250 V.

9. Control panel.

C. Note on record Drawings the location of equipment where the personnel could be exposed to arc-flash hazard during their work.

1. Indicate arc-flash energy.

2. Indicate protection level required.

3.5 APPLICATION OF WARNING LABELS

A. Install arc-flash warning labels under the direct supervision and control of Power System Analysis Specialist.

3.6 DEMONSTRATION

A. Engage Power Systems Analysis Specialist to train Owner's maintenance personnel in potential arc-flash hazards associated with working on energized equipment and the significance of arc-flash warning labels.

END OF SECTION

SECTION 26 09 23 - LIGHTING CONTROL 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. Section Includes:

1. Time switches.
2. Photoelectric switches.
3. Standalone daylight-harvesting switching controls.
4. Indoor occupancy and vacancy sensors.
5. Outdoor motion sensors.

B. Related Requirements:

1. Section 262726 "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

1.3 SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Show installation details for occupancy and light-level sensors.

1. Interconnection diagrams showing field-installed wiring.
2. Include diagrams for power, signal, and control wiring.

PART 2 - PRODUCTS

2.1 TIME SWITCHES

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

B. Basis-of-Design Product: Subject to compliance with requirements, provide one of the following:

1. Cooper Industries, Inc.

2. Intermatic, Inc.

3. NSI Industries LLC; TORK Products.

C. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Contact Configuration: per application on drawings.

3. Contact Rating: 30-A inductive or resistive 120 or 277V ac.

4. Programs: Two on-off set points on a 24-hour schedule, allowing different set points for each day of the week and an annual holiday schedule that overrides the weekly operation on holidays.

5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program.

6. Astronomic Time: all outdoor channels.

7. Automatic daylight savings time changeover.

8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.

2.2 OUTDOOR PHOTOELECTRIC SWITCHES

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

1. Cooper Industries, Inc.

2. Intermatic, Inc.

3. NSI Industries LLC; TORK Products.

4. Tyco Electronics; ALR Brand.

B. Description: Solid state, with SPST dry contacts rated for 2000-VA tungsten or 1200-VA inductive, to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.

3. Time Delay: Fifteen second minimum, to prevent false operation.

4. Surge Protection: Metal-oxide varistors.

5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

2.3 DAYLIGHT-HARVESTING SWITCHING CONTROLS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Eaton Corporation.

2. Cooper Industries Inc.

3. Leviton Manufacturing Co., Inc.

4. Lithonia Lighting; Acuity Brands Lighting, Inc.

5. NSI Industries LLC; TORK Products.

6. Sensor Switch, Inc.

7. Tyco Electronics; ALR Brand.

8. Watt Stopper.

B. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack, to detect changes in indoor lighting levels that are perceived by the eye.

C. Electrical Components, Devices, and Accessories:

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Sensor Output: Contacts rated to operate the associated power pack, complying with UL 773A. Sensor is powered by the power pack.

3. Power Pack: Dry contacts rated for 20A ballast load at 120- and 277-V ac, for 20A tungsten at 120-V ac, and for 1/2 HP at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.

4. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lux), with an adjustment for turn-on and turn-off levels within that range.

5. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc (1080 to 10 800 lux), with an adjustment for turn-on and turn-off levels within that range.

6. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc (10 800 to 108 000 lux), with an adjustment for turn-on and turn-off levels within that range.

7. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.

8. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.

9. Test Mode: User selectable, overriding programmed time delay to allow settings check.

10. Control Load Status: User selectable to confirm that load wiring is correct.

11. Indicator: Two digital displays to indicate the beginning of on-off cycles.

2.4 DAYLIGHT-HARVESTING DIMMING CONTROLS

A. Manufacturers: Subject in compliance with requirements, provide products by one of the following:

1. Cooper Industries Inc.

2. Leviton Mfg. Company Inc.

3. Lithonia Lighting; Acuity Lighting Group, Inc.

4. Watt Stopper.

B. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.

1. Lighting control set point is based on two lighting conditions:

a. When no daylight is present (target level).

b. When significant daylight is present.

2. System programming is done with two hand-held, remote-control tools.

a. Initial setup tool.

b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.

C. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.

3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.

4. Light-Level Sensor Set-Point Adjustment Range: 20 to 70 fc (120 to 750 lux).

2.5 INDOOR OCCUPANCY AND VACANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cooper Industries, Inc.

2. Leviton Manufacturing Co., Inc.

3. Lightolier Controls.

4. Lithonia Lighting; Acuity Brands Lighting, Inc.

5. Lutron Electronics Co., Inc.

6. NSI Industries LLC; TORK Products.

7. Sensor Switch, Inc.

8. Watt Stopper.

B. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy and vacancy sensors with a 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. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.

c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.

6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.

7. Bypass Switch: Override the "on" function in case of sensor failure.

8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.

C. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR 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: Separate for each sensing technology.

2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).

3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

2.6 SWITCHBOX-MOUNTED OCCUPANCY SENSORS

A. Manufacturers: Subject to compliance with requirements, provide products by the following:

1. Cooper Industries, Inc.

2. Leviton Manufacturing Co., Inc.

3. Lightolier Controls.

4. Lithonia Lighting; Acuity Brands Lighting, Inc.

5. Lutron Electronics Co., Inc.

6. NSI Industries LLC; TORK Products.

7. Sensor Switch, Inc.

8. Watt Stopper.

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, and shall comply with California Title 24.

2. Operating Ambient Conditions: Dry interior conditions, 32 to 120 deg F (0 to 49 deg C).

3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.

C. Wall-Switch Sensor Tag WS1:

1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. (84 sq. m).

2. Sensing Technology: Dual technology - PIR and ultrasonic.

3. Switch Type: as required for application

4. Voltage: Dual voltage, 120 and 277 V.

5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.

6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.

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.

3.2 CONTACTOR INSTALLATION

A. Mount mechanically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

3.3 WIRING INSTALLATION

A. Wiring Method: Comply with Section 260519 "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).

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 lighting control device 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.

3.4 IDENTIFICATION

A. Identify components and power and control wiring according to Section 260553 "Identification for Electrical Systems."

1. Identify controlled circuits in lighting contactors.

2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.

B. Label time switches and contactors with a unique designation.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within the 12-month warranty period from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions.

3.6 DEMONSTRATION

A. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Section 260943.13 "Addressable-Fixture Lighting Controls" and Section 260943.23 "Relay-Based Lighting Controls."

END OF SECTION

SECTION 26 27 26 - WIRING 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. Section Includes:

1. Straight-blade convenience, isolated-ground, and tamper-resistant receptacles.
2. USB charger devices.
3. GFCI receptacles.
4. SPD receptacles, 125 V, 20 A.
5. Hospital-grade receptacles, 125 V, 20 A.
6. Twist-locking receptacles.
7. Cord and plug sets.
8. Occupancy sensors.
9. Toggle switches.
10. Wall switch sensor light switches with dual technology sensors.
11. Wall-box dimmers.
12. Wall plates.
13. Floor service fittings.
14. Poke-through assemblies.
15. Prefabricated multioutlet assemblies.
16. Service poles.

1.3 DEFINITIONS

A. Abbreviations of Manufacturers' Names:

1. Cooper: Cooper Wiring Devices; Division of Cooper Industries, Inc.

2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.

3. Leviton: Leviton Mfg. Company, Inc.

4. Pass & Seymour: Pass& Seymour/Legrand.

B. BAS: Building automation system.

C. EMI: Electromagnetic interference.

D. GFCI: Ground-fault circuit interrupter.

E. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

F. RFI: Radio-frequency interference.

G. SPD: Surge protective device.

H. UTP: Unshielded twisted pair.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: List of legends and description of materials and process used for premarking wall plates.

C. Samples: One for each type of device and wall plate specified, in each color specified.

1.5 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For wiring devices to include in all manufacturers' packing-label warnings and instruction manuals that include labeling conditions.

PART 2 - PRODUCTS

2.1 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.

2. Devices shall comply with the requirements in this Section.

D. Devices for Owner-Furnished Equipment:

1. Receptacles: Match plug configurations.

2. Cord and Plug Sets: Match equipment requirements.

E. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 MANUFACTURERS

A. Manufacturers:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).

2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).

3. Leviton Mfg. Company Inc. (Leviton).

4. Pass & Seymour/Legrand (Pass & Seymour)

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

B. Isolated-Ground, Duplex Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

1. Description: Straight blade; equipment grounding contacts shall be connected only to the green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

C. Tamper-Resistant Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Standards: Comply with UL 498 and FS W-C-596.

4. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.4 USB CHARGER DEVICES

A. USB Charging Receptacles:

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.

2. USB Receptacles: Dual, (1) USB Type A and (1) USB Type C, 5 V dc, and 2.1 A per receptacle (minimum).

3. Standards: Comply with UL 1310 and USB 3.0 devices.

B. Tamper-Resistant, USB Charger Receptacles: 12 V dc, 2.0 A, (1) USB Type A and (1) USB Type C; comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, UL 1310, and FS W-C-596.

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.

2. USB Receptacles: Dual, (1) Type A and (1) Type C.

3. Line Voltage Receptacles: Single, two pole, three wire, and self-grounding.

2.5 GFCI RECEPTACLES

A. Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Type: Feed through.

4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

B. Tamper-Resistant Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Type: Feed through.

4. Standards: Comply with UL 498, UL 943 Class A, and FS W-C-596.

5. Marking: Listed and labeled as complying with NFPA 70, "Tamper-Resistant Receptacles" Article.

2.6 SPD RECEPTACLES, 125 V, 20A

A. Duplex SPD Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral SPD in line to ground, line to neutral, and neutral to ground. LED indicator light.

2. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.

3. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

4. Configuration: NEMA WD 6, Configuration 5-20R.

5. Standards: Comply with NEMA WD 1, UL 498, UL 1449, and FS W-C-596.

B. Isolated-Ground Duplex SPD Receptacles, 125 V, 20A:

1. Description: Two pole, three wire, and self-grounding. Integral SPD in line to ground, line to neutral, and neutral to ground. LED indicator light.

2. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.

3. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

4. Grounding: Equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

5. Configuration: NEMA WD 6, Configuration 5-20R.

6. Standards: Comply with UL 498, UL 1449, and FS W-C-596

2.7 HOSPITAL-GRADE RECEPTACLES, 125 V, 20A

A. Hospital-Grade, Single Receptacles, 125 V, 20A:

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Two pole, three wire, and self-grounding.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Standards: Comply with UL 498 Supplement sd and FS W-C-596.

4. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.

B. Hospital-Grade, Duplex Receptacles, 125 V, 20 A:

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Two pole, three wire, and self-grounding.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Standards: Comply with UL 498 Supplement sd and FS W-C-596.

4. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.

C. Hospital-Grade, Isolated-Ground, Duplex Receptacles, 125 V, 20 A:

1. Description: Straight blade; equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts. Two pole, three wire, and self-grounding.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Standards: Comply with UL 498 Supplement sd and FS W-C-596.

4. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.

D. Hospital-Grade, Tamper-Resistant, Duplex Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, and FS W-C-596.

4. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.

E. Hospital-Grade, Tamper-Resistant, Duplex (125 V, 20 A) and USB Charging Receptacles:

1. Description: Single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Integral shutters that operate only when a plug is inserted in the line voltage receptacle.

2. Line Voltage Receptacles: Two pole, three wire, and self-grounding, NEMA Configuration 5-20R.

3. USB Receptacles: Dual, USB Type A, 5 V dc, and 2.1 A per receptacle (minimum).

4. Standards: Comply with NEMA WD 1, UL 498 Supplement sd, UL 1310, and FS W-C-596.

5. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.

F. Hospital-Grade, Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Single-piece, rivetless, nickel-plated, all-brass grounding system.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Type: Feed through.

4. Standards: Comply with UL 498 supplement sd, UL 943 Class A, and FS W-C-596.

5. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.

G. Hospital-Grade, Tamper-Resistant, Duplex GFCI Receptacles, 125 V, 20 A:

1. Description: Integral GFCI with "Test" and "Reset" buttons and LED indicator light. Two pole, three wire, and self-grounding. Integral shutters that operate only when a plug is inserted in the receptacle. Single-piece, rivetless, nickel-plated, all-brass grounding system.

2. Configuration: NEMA WD 6, Configuration 5-20R.

3. Type: Feed through.

4. Standards: Comply with UL 498 supplement sd, UL 943 Class A, and FS W-C-596.

5. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.

H. Hospital-Grade, Duplex SPD Receptacles, 125 V, 20 A:

1. Description: Two pole, three wire, and self-grounding. Integral SPD in line to ground, line to neutral, and neutral to ground. LED indicator light. With single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap.

2. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.

3. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

4. Configuration: NEMA WD 6, Configuration 5-20R.

5. Standards: Comply with UL 498 supplement sd, UL 1449, and FS W-C-596.

6. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article.

I. Hospital-Grade, Isolated-Ground, Duplex SPD Receptacles, 125 V, 20 A:

1. Description: With single-piece, rivetless, nickel-plated, all-brass grounding system. Nickel-plated, brass mounting strap. Two pole, three wire, and self-grounding.

2. SPD Components: Multiple metal-oxide varistors; with a nominal clamp-level rating of 400 V and minimum single transient pulse energy dissipation of 240 J, according to IEEE C62.41.2 and IEEE C62.45.

3. Active SPD Indication: Visual and audible, with light visible in face of device to indicate device is "active" or "no longer in service."

4. Grounding: Equipment grounding contacts shall be connected only to green grounding screw terminal of the device and with inherent electrical isolation from mounting strap. Isolation shall be integral to receptacle construction and not dependent on removable parts.

5. Configuration: NEMA WD 6, Configuration 5-20R.

6. Standards: Comply with NEMA WD 1, UL 498 supplement sd, UL 1449, and FS W-C-596.

7. Marking: Listed and labeled as complying with NFPA 70, "Health Care Facilities" Article

2.8 TWIST-LOCKING RECEPTACLES

A. Twist-Lock, Single Convenience Receptacles: 125 V, 20 A; comply with NEMA WD 1, NEMA WD 6 Configuration L5-20R, and UL 498.

2.9 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.

2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.

3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.10 TOGGLE SWITCHES

A. Manufacturers:

1. Eaton: Cooper Wiring Devices; Division of Cooper Industries, Inc.

2. Hubbell: Hubbell Incorporated: Wiring Devices-Kellems.

3. Leviton: Leviton Mfg. Company, Inc.

4. Pass & Seymour: Pass& Seymour/Legrand.

B. Single-Pole Switches, 120/277 V, 20 A:

1. Standards: Comply with UL 20 and FS W-S-896.

C. Antimicrobial, Single-Pole Switches, 120/277 V, 20 A:

1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.

2. Standards: Comply with UL 20 and FS W-S-896.

D. Two-Pole Switches, 120/277 V, 20 A:

1. Comply with UL 20 and FS W-S-896.

E. Antimicrobial, Double-Pole Switches, 120/277 V, 20 A:

1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.

2. Standards: Comply with UL 20 and FS W-S-896.

F. Three-Way Switches, 120/277 V, 20 A:

1. Comply with UL 20 and FS W-S-896.

G. Antimicrobial, Three-Way Switches, 120/277 V, 20 A:

1. Description: Contact surfaces treated with a coating that kills 99.9 percent of certain common bacteria within two hours when regularly and properly cleaned.

2. Standards: Comply with UL 20 and FS W-S-896.

H. Four-Way Switches, 120/277 V, 20 A:

1. Standards: Comply with UL 20 and FS W-S-896.

I. Pilot-Light, Single-Pole Switches: 120/277 V, 20 A:

1. Description: Illuminated when switch is off.

2. Standards: Comply with UL 20 and FS W-S-896.

J. Lighted Single-Pole Switches, 120/277 V, 20 A:

1. Description: Handle illuminated when switch is off.

2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

K. Key-Operated, Single-Pole Switches, 120/277 V, 20A:

1. Description: Factory-supplied key in lieu of switch handle.

2. Standards: Comply with UL 20 and FS W-S-896.

L. Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:

1. Description: For use with mechanically held lighting contactors.

2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896.

M. Key-Operated, Single-Pole, Double-Throw, Momentary-Contact, Center-off Switches, 120/277 V, 20 A:

1. Description: For use with mechanically held lighting contactors, with factory-supplied key in lieu of switch handle.

2. Standards: Comply with NEMA WD 1, UL 20, and FS W-S-896

2.11 OCCUPANCY SENSORS

A. Wall Switch Sensor Light Switch, Dual Technology.

1. Description: Switchbox-mounted, combination lighting-control sensor and conventional switch lighting-control unit using dual technology.

2. Connections: Hard wired.

3. Rated 960 W at 120-V ac for tungsten lighting, 10 A at 120-V ac or 10 A at 277-V ac for fluorescent or LED lighting, and 1/4 hp at 120-V ac.

4. Adjustable time delay of 15 minutes.

5. Able to be locked to Automatic-On or Manual-On mode. See drawing for specific configuration.

6. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux).

7. Comply with NEMA WD 1, UL 20, and FS W-S-896.

2.12 WALL-BOX DIMMERS

A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on-off switches, with audible frequency and EMI/RFI suppression filters.

B. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

C. Incandescent Lamp Dimmers: 120 V; control shall follow square-law dimming curve. On-off switch positions shall bypass dimmer module.

1. 600 W; dimmers shall require no derating when ganged with other devices

D. Retain "Fluorescent Lamp Dimmer Switches" Paragraph below with compatible dimming-type ballasts. Coordinate with Section 265116 "Fluorescent Interior Lighting" or Section 265119 "LED Interior Lighting." Use lamp and ballast, if applicable, types to obtain consistent dimming characteristics.

E. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 20 percent of full brightness.

F. LED Lamp Dimmer Switches: Modular; compatible with LED lamps; trim potentiometer to adjust low-end dimming; capable of consistent dimming with low end not greater than 20 percent of full brightness.

2.13 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.

1. Plate-Securing Screws: Metal with head color to match plate finish.

2. Material for Finished Spaces: Smooth, high-impact thermoplastic.

3. Material for Unfinished Spaces: Galvanized steel.

4. Material for Damp Locations: Thermoplastic with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant, die-cast aluminum with lockable cover.

2.14 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Rectangular, Round, or as indicated; die-cast aluminum or solid brass with satin finish, as selected by Architect

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Three modular, keyed, color-coded, RJ-45 jacks for UTP cable. Coordinate with voice/data cabling installer.

2.15 POKE-THROUGH ASSEMBLIES

A. Manufacturers:
1. Legrand; Wiremold

2. Hubbell Wiring Devices

B. Description:
1. Factory-fabricated and -wired assembly of below-floor junction box with multi-channeled, through-floor raceway/firestop unit and detachable matching floor service-outlet assembly.

2. Comply with UL 514 scrub water exclusion requirements.

3. Service-Outlet Assembly: Flush type with four simplex receptacles and space for four RJ45 jacks complying with requirements in Section 271500 "Communications Horizontal Cabling."

4. Size: Selected to fit nominal 4-inch cored holes in floor and matched to floor thickness. See drawing plans for other sizes.

5. Fire Rating: Unit is listed and labeled for fire rating of floor-ceiling assembly.

6. Closure Plug: Arranged to close unused 3-inch cored openings and reestablish fire rating of floor.

7. Wiring Raceways and Compartments: For a minimum of four No. 12 AWG conductors and a minimum of four, four-pair cables

2.16 PREFABRICATED MULTIOUTLET ASSEMBLIES

A. Description: Two-piece surface metal raceway, with factory-wired multioutlet harness.

B. Components shall be products from single manufacturer designed for use as a complete, matching assembly of raceways and receptacles.

C. Raceway Material: Metal, with manufacturer's standard finish.

D. Multioutlet Harness:

1. Receptacles: 15-A, 125-V, NEMA WD 6 Configuration 5-15R receptacles complying with NEMA WD 1, UL 498, and FS W-C-596.

2. Receptacle Spacing: 6 inches (150 mm).

E. Wiring: No. 12 AWG solid, Type THHN copper, two circuit, connecting alternating receptacles.

2.17 SERVICE POLES

A. Dual-Channel Service Poles:

1. Description: Factory-assembled and -wired units to extend power and voice and data communication from distribution wiring concealed in ceiling to devices or outlets in pole near floor.

2. Poles: Nominal 2.5-inch- (65-mm-) square cross-section, with height adequate to extend from floor to at least 6 inches (150 mm) above ceiling, and with separate channels for power wiring and voice and data communication cabling.

3. Mounting: Ceiling trim flange with concealed bracing arranged for positive connection to ceiling supports; with pole foot and carpet pad attachment.

4. Material: Aluminum.

5. Finishes: Manufacturer's standard painted finish and trim combination.

6. Wiring: Sized for minimum of five No. 12 AWG power and ground conductors and a minimum of four, balanced twisted pair data communication cables.

7. Power Receptacles: Two duplex, 20-A, straight-blade receptacles complying with requirements in this Section.

8. Data Communication Outlets: Four RJ-45 jacks.

2.18 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.

2. Wiring Devices Connected to Emergency Power System: Red.

3. SPD Devices: Blue.

4. Isolated-Ground Receptacles: Orange.

B. Wall Plate Color: For plastic covers, match device color.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.

2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.

3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.

4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.

2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.

3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

4. Existing Conductors:

   a. Cut back and pigtail, or replace all damaged conductors.

   b. Straighten conductors that remain and remove corrosion and foreign matter.

   c. Pigtailing existing conductors is permitted, provided the outlet box is large enough.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.

2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.

3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.

4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.

5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.

6. Use a torque screwdriver when a torque is recommended or required by manufacturer.

7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.

8. Tighten unused terminal screws on the device.

9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles up, and on horizontally mounted receptacles to the right.

2. Install hospital-grade receptacles in patient-care areas with the ground pin or neutral blade at the top.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.

2. Verify that dimmers used for fan-speed control are listed for that application.

3. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multi-gang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Test Instruments: Use instruments that comply with UL 1436.

B. Test Instrument for Convenience Receptacles: Digital wiring analyzer with digital readout or illuminated digital-display indicators of measurement.

C. Tests for Convenience Receptacles:

1. Line Voltage: Acceptable range is 105 to 132 V.

2. Percent Voltage Drop under 15-A Load: A value of 6 percent or higher is unacceptable.

3. Ground Impedance: Values of up to 2 ohms are acceptable.

4. GFCI Trip: Test for tripping values specified in UL 1436 and UL 943.

5. Using the test plug, verify that the device and its outlet box are securely mounted.

6. Tests shall be diagnostic, indicating damaged conductors, high resistance at the circuit breaker, poor connections, inadequate fault current path, defective devices, or similar problems. Correct circuit conditions, remove malfunctioning units and replace with new ones, and retest as specified above.

D. Wiring device will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 26 28 13 - FUSES

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. Cartridge fuses rated 600-V ac and less for use in control circuits enclosed switches enclosed controllers and motor-control centers.

2. Plug-fuse adapters for use in Edison-base, plug-fuse sockets.

3. Spare-fuse cabinets.

1.3 SUBMITTALS

A. Product Data: For each type of product indicated. Include construction details, material, dimensions, descriptions of individual components, and finishes for spare-fuse cabinets. Include the following for each fuse type indicated:

1. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.

a. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.

b. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.

2. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.

3. Current-limitation curves for fuses with current-limiting characteristics.

4. Time-current coordination curves average melt and current-limitation curves and instantaneous peak let-through current) for each type and rating of fuse.

5. Coordination charts and tables and related data.

6. Fuse sizes for elevator feeders and elevator disconnect switches.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Ambient temperature adjustment information.

2. Current-limitation curves for fuses with current-limiting characteristics.

3. Time-current coordination curves (average melt) and current-limitation curves (instantaneous peak let-through current) for each type and rating of fuse.

4. Coordination charts and tables and related data.

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. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

1.6 QUALITY ASSURANCE

A. Source Limitations: Obtain fuses, for use within a specific product or circuit, from single source from single manufacturer.

B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

C. Comply with NEMA FU 1 for cartridge fuses.

D. Comply with NFPA 70.

E. Comply with UL 248-11 for plug fuses.

1.7 COORDINATION

A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size and with system short-circuit current levels.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Cooper Bussmann, Inc.

2. Ferraz Shawmut, Inc.

3. Littelfuse, Inc.

2.2 CARTRIDGE FUSES

A. Characteristics: NEMA FU 1, nonrenewable cartridge fuses with voltage ratings consistent with circuit voltages.

2.3 SPARE-FUSE CABINET

A. Characteristics: Wall-mounted steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.

1. Size: Adequate for storage of spare fuses specified with 25 percent spare capacity minimum.

2. Finish: Gray, baked enamel.

3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.

4. Fuse Pullers: For each size of fuse, where applicable and available, from fuse manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine fuses before installation. Reject fuses that are moisture damaged or physically damaged.

B. Examine holders to receive fuses for compliance with installation tolerances and other conditions affecting performance, such as rejection features.

C. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.

D. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.

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

3.2 FUSE APPLICATIONS

A. Cartridge Fuses: Where indicated on the drawings

1. Service Entrance: Class RK1, time delay

2. Feeders: Class RK5, time delay.

3. Motor Branch Circuits: Class RK5, time delay.

4. Other Branch Circuits: Class J, time delay.

5. Control Circuits: Class CC, time delay.

3.3 INSTALLATION

A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.

B. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

A. Install labels complying with requirements for identification specified in Section 260553 "Identification for Electrical Systems" and indicating fuse replacement information on inside door of each fused switch and adjacent to each fuse block, socket, and holder.

END OF SECTION

SECTION 26 28 16 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Fusible switches.

2. Nonfusible switches.

3. Receptacle switches.

4. Shunt trip switches.

5. Molded-case circuit breakers (MCCBs).

6. Molded-case switches.

7. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

C. SPDT: Single pole, double throw.

1.4 SUBMITTALS

A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, accessories, and finishes.

1. Enclosure types and details for types other than NEMA 250, Type 1.

2. Current and voltage ratings.

3. Short-circuit current ratings (interrupting and withstand, as appropriate).

4. Include evidence of NRTL listing for series rating of installed devices.

5. Detail features, characteristics, ratings, and factory settings of individual overcurrent protective devices, accessories, and auxiliary components.

6. Include time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device.

B. Shop Drawings: For enclosed switches and circuit breakers. Include plans, elevations, sections, details, and attachments to other work.

1. Wiring Diagrams: For power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified testing agency.

B. Seismic Qualification Certificates: For enclosed switches and circuit breakers, accessories, and components, from manufacturer.

1. Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

2. Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

3. Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 017823 "Operation and Maintenance Data," include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

2. Time-current coordination curves (average melt) for each type and rating of overcurrent protective device; include selectable ranges for each type of overcurrent protective device

1.7 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Fuses: Equal to 10 percent of quantity installed for each size and type, but no fewer than three of each size and type.

2. Fuse Pullers: Two for each size and type.

1.8 QUALITY ASSURANCE

A. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

B. Product Selection for Restricted Space: Drawings indicate maximum dimensions for enclosed switches and circuit breakers, including clearances between enclosures, and adjacent surfaces and other items. Comply with indicated maximum dimensions.

C. 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.

D. Comply with NFPA 70.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Rate equipment for continuous operation under the following conditions unless otherwise indicated:

1. Ambient Temperature: Not less than minus 22 deg F (minus 30 deg C) and not exceeding 104 deg F (40 deg C).

2. Altitude: Not exceeding 6600 feet (2010 m).

1.10 COORDINATION

A. Coordinate layout and installation of switches, circuit breakers, and components with equipment served and adjacent surfaces. Maintain required workspace clearances and required clearances for equipment access doors and panels.

PART 2 - PRODUCTS

2.1 FUSIBLE SWITCHES

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Type GD, General Duty, Single Throw, 240-V ac, 800 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with cartridge fuse interiors to accommodate specified fuses, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

C. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate specified fuses, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

D. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

4. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.

5. Auxiliary Contact Kit: one NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

6. Hookstick Handle: Allows use of a hookstick to operate the handle.

7. Lugs: Mechanical type, suitable for number, size, and conductor material.

8. Service-Rated Switches: Labeled for use as service equipment.

9. Accessory Control Power Voltage: As noted on drawings.

2.2 NONFUSIBLE SWITCHES

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. Type HD, Heavy Duty, Single Throw, 600-V ac, 1200 A and Smaller: UL 98 and NEMA KS 1, horsepower rated, lockable handle with capability to accept three padlocks, and interlocked with cover in closed position.

C. Accessories:

1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.

2. Neutral Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

3. Isolated Ground Kit: Internally mounted; insulated, capable of being grounded and bonded; labeled for copper and aluminum neutral conductors.

4. Auxiliary Contact Kit: One NO/NC (Form "C") auxiliary contact(s), arranged to activate before switch blades open.

5. Hookstick Handle: Allows use of a hookstick to operate the handle.

6. Lugs: Mechanical type, suitable for number, size, and conductor material.

7. Accessory Control Power Voltage: As noted on drawings

2.3 SHUNT TRIP SWITCHES

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

1. Cooper Bussmann, Inc.

2. Ferraz Shawmut, Inc.

3. Littelfuse, Inc.

B. General Requirements: Comply with ASME A17.1, UL 50, and UL 98, with 200-kA interrupting and short-circuit current rating when fitted with Class J fuses.

C. Switches: Three-pole, horsepower rated, with integral shunt trip mechanism and Class J fuse block; lockable handle with capability to accept three padlocks; interlocked with cover in closed position.

D. Control Circuit: 120-V ac; obtained from integral control power transformer, with primary and secondary fuses, with a control power[transformer of enough capacity to operate shunt trip, connected pilot, and indicating and control devices.

E. Accessories:

1. Oiltight key switch for key-to-test function.

2. Oiltight red ON pilot light.

3. Isolated neutral lug; 100 percent rating.

4. Mechanically interlocked auxiliary contacts that change state when switch is opened and closed.

5. Form C alarm contacts that change state when switch is tripped.

6. Three-pole, double-throw, fire-safety and alarm relay; 120-V ac coil voltage.

7. Three-pole, double-throw, fire-alarm voltage monitoring relay complying with NFPA 72.

2.4 MOLDED-CASE CIRCUIT BREAKERS

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

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.

2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.

3. Siemens Energy & Automation, Inc.

4. Square D; a brand of Schneider Electric.

B. General Requirements: Comply with UL 489, NEMA AB 1, and NEMA AB 3, with interrupting capacity to comply with available fault currents.

C. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit breaker frame sizes 250 A and larger.

D. Adjustable, Instantaneous-Trip Circuit Breakers: Magnetic trip element with front-mounted, field adjustable trip setting.

E. Electronic Trip Circuit Breakers: Field-replaceable rating plug, rms sensing, with the following field-adjustable settings:

1. Instantaneous trip.

2. Long- and short-time pickup levels.

3. Long- and short-time time adjustments.

4. Ground-fault pickup level, time delay, and I^2t response.

F. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller, and let-through ratings less than NEMA FU 1, RK-5.

G. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.

H. Ground-Fault, Circuit-Interrupter (GFCI) Circuit Breakers: Single- and two-pole configurations with Class A ground-fault protection (6-mA trip).

I. Ground-Fault, Equipment-Protection (GFEP) Circuit Breakers: With Class B ground-fault protection (30-mA trip).

J. J. Features and Accessories:

1. Standard frame sizes, trip ratings, and number of poles.

2. Lugs: Mechanical type, suitable for number, size, trip ratings, and conductor material.

3. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HID for feeding fluorescent and high-intensity discharge lighting circuits.

4. Ground-Fault Protection: Comply with UL 1053; integrally mounted, self-powered type with mechanical ground-fault indicator; relay with adjustable pickup and time-delay settings, push-to-test feature, internal memory, and shunt trip unit; and three-phase, zero-sequence current transformer/sensor.

5. Undervoltage Trip: Set to operate at 35 to 75 percent of rated voltage without intentional time delay.

2.5 ENCLOSURES

A. Enclosed Switches and Circuit Breakers: NEMA AB 1, NEMA KS 1, NEMA 250, and UL 50, to comply with environmental conditions at installed location.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.

2. Outdoor Locations: NEMA 250, Type 3R.

3. Other Wet or Damp, Indoor Locations: NEMA 250,Type 4.

4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

5. Hazardous Areas Indicated on Drawings: NEMA 250, Type 7.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance of the Work.

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

3.2 INSTALLATION

A. Install individual wall-mounted switches and circuit breakers with tops at uniform height unless otherwise indicated.

B. Comply with mounting and anchoring requirements specified in Section 260548.16 "Seismic Controls for Electrical Systems."

C. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

D. Install fuses in fusible devices.

E. Comply with NECA 1.

3.3 IDENTIFICATION

A. Comply with requirements in Section 260553 "Identification for Electrical Systems."

1. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs.

2. Label each enclosure with engraved metal or laminated-plastic nameplate.

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust components, assemblies, and equipment installations, including connections.

B. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

C. Acceptance Testing Preparation:

1. Test insulation resistance for each enclosed switch and circuit breaker, component, connecting supply, feeder, and control circuit.

2. Test continuity of each circuit.

D. Tests and Inspections:

1. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

3. Perform the following infrared scan tests and inspections and prepare reports:

a. Initial Infrared Scanning: After Substantial Completion, but not more than 60 days after Final Acceptance, perform an infrared scan of each enclosed switch and circuit breaker. Remove front panels so joints and connections are accessible to portable scanner.

b. Follow-up Infrared Scanning: Perform an additional follow-up infrared scan of each enclosed switch and circuit breaker 11 months after date of Substantial Completion.

c. Instruments and Equipment: Use an infrared scanning device designed to measure temperature or to detect significant deviations from normal values. Provide calibration record for device.

4. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

E. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

F. Prepare test and inspection reports, including a certified report that identifies enclosed switches and circuit breakers and that describes scanning results. Include notation of deficiencies detected, remedial action taken, and observations after remedial action.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

END OF SECTION