XAVIER UNIVERSITY

KUHLMAN HALL RENOVATION/ PHASE II

Project No. 911717

14 March 2014

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PART 2 - GENERAL

2.1 SUMMARY

A. Section includes administrative and procedural requirements for unit prices.

2.2 DEFINITIONS

A. Unit price is a price per unit of measurement for materials, equipment, or services, or a portion of the Work, added to or deducted from the Contract Sum by appropriate modification, if the scope of Work or estimated quantities of Work required by the Contract Documents are increased or decreased.

2.3 PROCEDURES

A. Unit prices include all necessary material, plus cost for delivery, installation, insurance, overhead, and profit.

B. Measurement and Payment: See individual Specification Sections for work that requires establishment of unit prices. Methods of measurement and payment for unit prices are specified in those Sections.

C. Owner reserves the right to reject Contractor's measurement of work-in-place that involves use of established unit prices and to have this work measured, at Owner's expense, by an independent surveyor acceptable to Contractor.

D. List of Unit Prices: A schedule of unit prices is included in Bid Form. Specification Sections referenced in the schedule contain requirements for materials described under each unit price.

END OF SECTION 012200

SECTION 012300 - ALTERNATES

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes administrative and procedural requirements for alternates.

1.2 DEFINITIONS

A. Alternate: An amount proposed by bidders and stated on the Bid Form for certain work defined in the bidding requirements that may be added to or deducted from the base bid amount if Owner decides to accept a corresponding change either in the amount of construction to be completed or in the products, materials, equipment, systems, or installation methods described in the Contract Documents.

1. Alternates described in this Section are part of the Work only if enumerated in the Agreement.
2. The cost or credit for each alternate is the net addition to or deduction from the Contract Sum to incorporate alternate into the Work. No other adjustments are made to the Contract Sum.

1.3 PROCEDURES

A. Coordination: Revise or adjust affected adjacent work as necessary to completely integrate work of the alternate into Project.

1. Include as part of each alternate, miscellaneous devices, accessory objects, and similar items incidental to or required for a complete installation whether or not indicated as part of alternate.

B. Notification: Immediately following award of the Contract, notify each party involved, in writing, of the status of each alternate. Indicate if alternates have been accepted, rejected, or deferred for later consideration. Include a complete description of negotiated revisions to alternates.

C. Execute accepted alternates under the same conditions as other work of the Contract.

D. Schedule: A schedule of alternates is included on the bid form. Specification Sections referenced in schedule contain requirements for materials necessary to achieve the work described under each alternate.

END OF SECTION 012300

SECTION 013546 – ENVIRONMENTAL REQUIREMENTS FOR INDOOR AIR QUALITY CONTROL

PART 1- GENERAL

1.1 SUMMARY

A. This Section includes, but is not limited to, requirements for the following procedures:

1. Selection of products.

1.2 INTENT

A. It is the intent of the Owner to maintain a healthful environment for the present and future occupants of the building. Therefore, the Contractor shall conduct the Work in such a way as to avoid creating indoor air quality problems. Required procedures include:

1. Limiting use of products that may contribute to poor indoor air quality.

PART 2- PRODUCTS

2.1 PRODUCTS

A. Throughout the Work, use products, materials that contribute the m1mmum practicable dust, odors and contaminants to the indoor environment.

B. Products containing Volatile Organic Compounds (VOC's):

1. Comply with the following criteria for VOC limits for the following field-applied products.

a. Adhesives: Refer to Technical Sections that include adhesives, including but not limited to those in Divisions 6 and 9, for specific requirements.

1) Wood Glues: 30 *giL.*
2) Metal to Metal Adhesives: 30 *giL.*
3) Adhesives for Porous Materials (Except Wood): 50 *giL.*
4) Subfloor Adhesives: 50 *giL.*
5) Plastic Foam Adhesives: 50 *giL.*
6) Contact Adhesive: 250 *giL.*
7) Plastic Cement Welding Compounds: 350 giL.
8) ABS Welding Compounds: 400 *giL.*
9) CPVC Welding Compounds: 490 *giL.*
10) PVC Welding Compounds: 510 giL.
11) Adhesive Primer for Plastic: 50 *giL.*
12) Gypsum Board and Panel Adhesives: 50 *giL.*
13) Ceramic Tile Adhesives: 65 giL.
14) VCT and Asphalt Tile Adhesives: 50 *giL.*

15) Cove Base Adhesives: 50 *giL.*
16) Rubber tile and other sheet flooring Flooring Adhesives: 60 giL.
17) Carpet Adhesives: 50 *giL.*
18) Carpet Pad Adhesives: 50 *giL.*
19) Multipurpose Construction Adhesives: 70 giL.
20) Fiberglass Adhesives: 80 *giL.*
21) Structural Glazing Adhesives: 100 *giL.*

b. Sealants: Refer to Division 7 Section "Joint Sealants", and other Technical Sections requiring sealants, for specific requirements.

1) Sealants: 250 giL.
2) Sealant Primers for Nonporous Substrates: 250 *giL.*
3) Sealant Primers for Porous Substrates: 775 *giL.*

END OF SECTION 013546

SECTION 01 73 29
CUTTING AND PATCHING

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. This section includes administrative and procedural requirements for cutting and patching of existing surfaces and previously installed new surfaces, exclusive of what is specified in related sections below.

B. Related Work

1. Division 9 Section “Painting and Coating”: Painting or touch-up painting of surfaces after cutting and patching work is performed.

2. Division 22 - Plumbing: Cutting and patching of plumbing systems (but does not include walls, floors, ceilings, and structures).

3. Division 23 - Heating, Ventilating and Air Conditioning: Cutting and patching of HVAC systems (but does not include walls, floors, ceilings, and structures).

C. Refer to other Sections for specific requirements and limitations applicable to cutting and patching individual parts of the Work.

1. Requirements of this Section apply to mechanical and electrical installations. Refer to Division 21 through 27 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.2 WARRANTY

A. Existing Warranties: Replace, patch, and repair material and surfaces cut or damaged by methods and with materials in such a manner as not to void any warranties required or existing.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible if identical materials are unavailable or cannot be used. Use materials whose installed performance will equal or surpass that of existing materials.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine surfaces to be cut and patched and conditions under which cutting and patching is to be performed before cutting. If unsafe or unsatisfactory conditions are encountered, take corrective action before proceeding.

1. Before proceeding, meet at the Project Site with parties involved in cutting and patching, including mechanical and electrical trades. Review areas of potential interference and conflict. Coordinate procedures and resolve potential conflicts before proceeding.

3.2 PERFORMANCE

A. Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction activities and the subsequent fitting and patching required to restore surfaces to their original condition.

B. Cutting: Cut existing construction using methods least likely to damage elements retained or adjoining construction. Where possible, review proposed procedures with the original Installer; comply with the original Installer's recommendations.

1. In general, where cutting, use hand or small power tools designed for sawing or grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. To avoid marring existing finished surfaces, cut or drill from the exposed or finished side into concealed surfaces.
3. Cut through concrete and masonry using a cutting machine, such as a Carborundum saw or a diamond-core drill.
4. Where services are required to be removed, relocated, or abandoned, bypass utility services, such as pipe or conduit, before cutting. Cut-off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal the remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after by-passing and cutting.

C. Patching: Patch with durable seams that are as invisible as possible. Comply with specified tolerances.

1. Where feasible, inspect and test patched areas to demonstrate integrity of the installation.
2. Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.

3. Where removing walls or partitions extends one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform color and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.

a. Where patching occurs in a smooth painted surface, extend final paint coat over entire unbroken surface containing the patch after the area has received primer and second coat.

4. Patch, repair, or rehang existing ceilings as necessary to provide an even plane surface of uniform appearance.

5. Trim and refinish existing wood doors as necessary to clear new floors.

D. Damaged Surfaces: Patch or replace any portion of an existing finished surface which is found to be damaged, lifted, discolored, or shows other imperfections, with matching material.

1. Provide adequate support of substrate prior to patching the finish.

2. Refinish patched portions of painted or coated surfaces in a manner to produce uniform color and texture over entire surface.

3. When existing surface finish cannot be matched, refinish entire surface to nearest intersections.

E. Plaster Installation: Comply with manufacturer's instructions and install thickness and coats as indicated.

1. Unless otherwise indicated, provide 3-coat work.

2. Finish gypsum plaster to match existing adjacent surfaces. Sand lightly to remove trowel marks and arises.

3. Cut, patch, point-up, and repair plaster to accommodate other construction.

3.3 CLEANING

A. Clean areas and spaces where cutting and patching are performed. Completely remove paint, mortar, oils, putty, and similar items. Thoroughly clean piping, conduit, and similar features before applying paint or other finishing materials. Restore damaged pipe covering to its original condition.

END OF SECTION 01 73 29

SECTION 042200 - CONCRETE UNIT MASONRY

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Concrete masonry units (CMU's).
2. Steel reinforcing bars.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: For reinforcing steel. Detail bending and placement of unit masonry reinforcing bars. Comply with ACI 315, "Details and Detailing of Concrete Reinforcement."

1.3 INFORMATIONAL SUBMITTALS

A. Material Certificates: For each type and size of product indicated. For masonry units include material test reports substantiating compliance with requirements.

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

1. Include test reports for mortar mixes required to comply with property specification. Test according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
2. Include test reports, according to ASTM C 1019, for grout mixes required to comply with compressive strength requirement.

1.4 QUALITY ASSURANCE

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

1.6 PROJECT CONDITIONS

A. Hot-Weather Requirements: Comply with hot-weather construction requirements contained in ACI 530.1/ASCE 6/TMS 602.

PART 2 - PRODUCTS

2.1 MASONRY UNITS, GENERAL

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

where such defects will be exposed in the completed Work.

B. Fire-Resistance Ratings: Where indicated, provide units that comply with requirements for fire-resistance ratings indicated as determined by testing according to ASTM E 119, by equivalent masonry thickness, or by other means, as acceptable to authorities having jurisdiction.

2.2 CONCRETE MASONRY UNITS

A. Shapes: Provide shapes indicated and for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.

D. CMUs: ASTM C 90.

1. Products: Provide 2 hour rated units (bearing the UL classification) by one of the following manufacturers:
   a) ANCHOR CONCRETE PRODUCTS INC

   b) GAGNE & SON CONCRETE BLOCK INC

   c) GLENWOOD MASONRY PRODUCTS
   Allowable compressive stress of 57% of max allowable compressive stress in accordance with the empirical design method.

   d) OLDCASTLE APG SOUTH INC, DBA ADAMS PRODUCTS

   e) WESTBROOK CONCRETE BLOCK CO INC
   Allowable compressive stress of 75.6% of max allowable compressive stress in accordance with the empirical design method.

2.3 CONCRETE MASONRY LINTELS

A. General: Provide one of the following:

B. Concrete Lintels: ASTM C 1623, matching CMUs in color, texture, and density classification; and with reinforcing bars indicated.

C. Concrete Lintels: Precast or formed-in-place concrete lintels complying with requirements in Section 033000 "Cast-in-Place Concrete," and with reinforcing bars indicated.

D. Masonry Lintels: Prefabricated or built-in-place masonry lintels made from bond beam CMUs with reinforcing bars placed as indicated and filled with coarse grout.

2.4 MORTAR AND GROUT MATERIALS

A. Portland Cement: ASTM C 150, Type I or II. Provide natural color. N ot more than 3-1/2 parts of clean sharp sand to 1 part Portland cement (proportioned by volume) and not more than 50 percent hydrated lime (by cement volume).

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

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

D. Mortar Cement: ASTM C 1329.

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

a. Lafarge North America Inc.; Lafarge Mortar Cement or Magnolia Superbond Mortar Cement.

E. Aggregate for Mortar: ASTM C 144.

1. For joints less than 1/4 inch (6 mm) thick, use aggregate graded with 100 percent passing the No. 16 (1.18-mm) sieve.

F. Aggregate for Grout: ASTM C 404.

G. Water: Potable.

2.5 REINFORCEMENT

A. Uncoated Steel Reinforcing Bars: ASTM A 615/A 615M or ASTM A 996/A 996M, Grade 60 (Grade 420).

B. Masonry Joint Reinforcement, General: ASTM A 951/A 951M.

1. Interior Walls: Hot-dip galvanized, carbon steel.
3. Wire Size for Side Rods: 0.148-inch diameter.
4. Wire Size for Cross Rods: 0.148-inch diameter.
6. Spacing of Cross Rods, Tabs, and Cross Ties: Not more than 16 inches o.c.
7. Provide in lengths of not less than 10 feet, with prefabricated corner and tee units.

2.6 TIES AND ANCHORS

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

1. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M; with ASTM A 153/A 153M, Class B-2 coating.
2. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
3. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.

2.10 MORTAR AND GROUT MIXES

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

1. Do not use calcium chloride in mortar or grout.
2. Use portland cement-lime mortar unless otherwise indicated.

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

C. Mortar for Unit Masonry: Comply with ASTM C 270, Proportion Specification.
Provide the following types of mortar for applications stated unless another type is indicated.

1. For interior non-load-bearing partitions; and for other applications where another type is not indicated, use Type N.

F. Grout for Unit Masonry: Comply with ASTM C 476.

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

PART 3 - EXECUTION

3.1 TOLERANCES

A. Dimensions and Locations of Elements:

1. For dimensions in cross section or elevation do not vary by more than plus 1/2 inch (12 mm) or minus 1/4 inch (6 mm).
2. For location of elements in plan do not vary from that indicated by more than plus or minus 1/2 inch (12 mm).
3. For location of elements in elevation do not vary from that indicated by more than plus or minus 1/4 inch (6 mm) in a story height or 1/2 inch (12 mm) total.

B. Lines and Levels:

1. For bed joints and top surfaces of bearing walls do not vary from level by more than 1/4 inch in 10 feet (6 mm in 3 m), or 1/2 inch (12 mm) maximum.
2. For conspicuous horizontal lines, such as lintels, sills, parapets, and reveals, do not vary from level by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.
3. For vertical lines and surfaces do not vary from plumb by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.
4. For conspicuous vertical lines, such as external corners, door jambs, reveals, and

expansion and control joints, do not vary from plumb by more than 1/8 inch in 10 feet (3 mm in 3 m), 1/4 inch in 20 feet (6 mm in 6 m), or 1/2 inch (12 mm) maximum.

5. For lines and surfaces do not vary from straight by more than 1/4 inch in 10 feet (6 mm in 3 m), 3/8 inch in 20 feet (9 mm in 6 m), or 1/2 inch (12 mm) maximum.

C. Joints:

1. For bed joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm), with a maximum thickness limited to 1/2 inch (12 mm).
2. For head and collar joints, do not vary from thickness indicated by more than plus 3/8 inch (9 mm) or minus 1/4 inch (6 mm).
3. For exposed head joints, do not vary from thickness indicated by more than plus or minus 1/8 inch (3 mm).

3.2 LAYING MASONRY WALLS

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

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

C. Bond Pattern for Exposed Masonry: Unless otherwise indicated, lay exposed masonry in running bond; do not use units with less than nominal 4-inch (100-mm) horizontal face dimensions at corners or jambs.

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

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

F. Where built-in items are to be embedded in cores of hollow masonry units, place a layer of metal lath, wire mesh, or plastic mesh in the joint below and rod mortar or grout into core.

G. Fill cores in hollow CMUs with grout 24 inches (600 mm) under bearing plates, beams, lintels, posts, and similar items unless otherwise indicated.

3.3 MORTAR BEDDING AND JOINTING

A. Lay hollow CMUs as follows:

1. With face shells fully bedded in mortar and with head joints of depth equal to bed joints.
2. With webs fully bedded in mortar in grouted masonry, including starting course on footings.
3. With entire units, including areas under cells, fully bedded in mortar at starting course on footings where cells are not grouted.

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

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

D. Cut joints flush for masonry walls to receive plaster or other direct-applied finishes (other than paint) unless otherwise indicated.

3.5 MASONRY JOINT REINFORCEMENT

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

1. Space reinforcement not more than 16 inches o.c.
2. Provide reinforcement not more than 8 inches above and below wall openings and extending 12 inches beyond openings in addition to continuous reinforcement.

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

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

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

3.8 REINFORCED UNIT MASONRY INSTALLATION

A. Temporary Formwork and Shores: Construct formwork and shores as needed to support reinforced masonry elements during construction.

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

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

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

1. Comply with requirements in ACI 530.1/ASCE 6/TMS 602 for cleanouts and for grout placement, including minimum grout space and maximum pour height.

3.11 REPAIRING, POINTING, AND CLEANING

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

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

1. Clean concrete masonry by cleaning method indicated in NCMA TEK 8-2A applicable to type of stain on exposed surfaces.

3.12 MASONRY WASTE DISPOSAL

A. Excess Masonry Waste: Remove excess masonry waste, and legally dispose of off Owner's property.

END OF SECTION 042200

SECTION 06 10 00 – MISCELLANEOUS ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:
1. Wood blocking.

B. Related Work
1. Division 9 Section “Gypsum Board Assemblies”.

PART 2 - PRODUCTS

2.1 LUMBER, GENERAL

A. Lumber Standards: Comply with DOC PS 20, "American Softwood Lumber Standard," and with applicable grading rules of inspection agencies certified by ALSC's Board of Review.

B. Inspection Agencies: Inspection agencies, and the abbreviations used to reference them, include the following:
1. NELMA - Northeastern Lumber Manufacturers Association.
2. NLGA - National Lumber Grades Authority (Canadian).
3. SPIB - Southern Pine Inspection Bureau.
4. WCLIB - West Coast Lumber Inspection Bureau.
5. WWPA - Western Wood Products Association.

C. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

D. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry lumber.
1. Provide dressed lumber, S4S.
2. Provide dry lumber with 19 percent maximum moisture content at time of dressing for 2 inch nominal (38 mm actual) thickness or less.

2.6 FASTENERS

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

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

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

D. Wood Screws: ASME B18.6.1.

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

F. Bolts: Steel bolts complying with ASTM A307, Grade A (ASTM F568, Property Class 4.6); with ASTM A563 (ASTM A563M) hex nuts and, where indicated, flatwashers.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Discard units of material with defects that impair quality of rough carpentry and that are too small to use with minimum number of joints or optimum joint arrangement.

B. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted.

C. Fit rough carpentry to other construction; scribe and cope as required for accurate fit. Correlate location of blocking to allow attachment of other construction.

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

1. CABO NER-272 for power-driven staples, P-nails, and allied fasteners.
2. Published requirements of metal framing anchor manufacturer.

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

3.2 WOOD BLOCKING

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

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

C. Provide blocking as recommended by manufacturers. Where manufacturer's recommendations are not available, submit a list of Contractor's proposal for those areas.

D. Provide concealed wood blocking in partitions for mounting surface mounted equipment, and hardware, regardless of whether the surface mounted equipment or hardware is part of this Contract or is furnished by Owner.

END OF SECTION 06 10 00

SECTION 064000 - ARCHITECTURAL WOODWORK

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Architectural wood WARDROBES AND LAVATORY BASE cabinets.
2 Laminate-clad BASE CABINETS.
3. Plastic-laminate countertops.
4. Solid surfacing material countertops.
5. Wood furring, blocking, shims, and hanging strips for installing architectural wood cabinets unless concealed within other construction before cabinet installation.
6. Shop finishing of architectural wood cabinets.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product, including panel products, cabinet hardware and accessories, and finishing materials and processes.

B. Submit shop drawings showing location of each item, dimensioned plans and elevations, large-scale details, attachment devices, and other components.

1. Show details full size.
2. Show locations and sizes of furring, blocking, and hanging strips, including concealed blocking and reinforcing specified in other Sections.
3. Show locations and sizes of cutouts and holes for plumbing fixtures, faucets, and other items installed in architectural woodwork.
4. Show veneer leaves with dimensions, grain direction, exposed face, and an identification number indicated for each leaf. Identification number shall indicate the flitch and the sequence within the flitch for each leaf.

C. Samples for verification of the following:

1. Lumber with transparent finish, 50 sq. in. (300 sq. cm), for each cut, finished on one side and one edge. STAIN COLOR TO MATCH EXISTING WARDROBES.
2. Veneer leaves representative of and selected from flitches to be used for transparent-finished woodwork.

3. Wood-veneer-faced products, with transparent finish, 8 by 10 inches (200 by 250 mm), for each species and cut. Include at least one face- veneer seam and finish one-half of face as specified.
   a. Step finish materials on sample to show and clearly define each coat. STAIN COLOR TO MATCH EXISTING WARDROBES.
   b. Provide separate samples of un-faced panel product used for core.
4. Solid surfacing materials, 6 inches (150 mm) square.
5. Corner pieces as follows:
   a. Cabinet front frame joints between stiles and rail, as well as exposed end pieces, 18 inches (450 mm) high by 18 inches (450 mm) wide by 6 inches (150 mm) deep.

1.3 INFORMATIONAL SUBMITTALS

A. Woodwork Quality Standard Compliance Certificates: AWI Quality Certification Program certificates.

1.4 QUALITY ASSURANCE

A. Fabricator Qualifications: Firm experienced in producing architectural woodwork similar to that indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units without delaying the Work.

B. Single-Source Responsibility for Fabrication and Installation: Engage a qualified woodworking firm to assume undivided responsibility for fabricating, finishing, and installing woodwork specified in this Section.

C. Quality Standard: Except as otherwise indicated, comply with the following standard:
   1. AWI Quality Standard: Comply with current edition of "Architectural Woodwork Institute Quality Standards" of the Architectural Woodwork Institute for specified grades of woodwork, construction, finishes, and other requirements.

D. Mockup: Prior to fabricating or installing interior architectural woodwork, construct mockup to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mock-up (one end and one center unit), using materials indicated for final unit of work, and complying with the following requirements.
   1. Locate mockup on site in the location indicated by Owner Project Manager.
   2. Notify Owner one week in advance of the date and time when fabrication of mockup will begin.
   3. Notify Owner one week in advance of the date and time when mockup will be installed.

4. Demonstrate the proposed range of aesthetic effects and workmanship.
5. Obtain Owner's acceptance of mockup before start of final unit of Work.
6. Retain and maintain mockup during construction in an undisturbed condition as a standard for judging the completed Work.
    a. When directed, demolish and remove mockup from Project site.
    b. Accepted mock-up in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

E. Preinstallation Conference: Conduct conference at Project site.
1. Meet at project site prior to delivery of woodwork and review coordination and environmental controls required for proper installation and ambient conditioning in areas to receive work. Include in meeting the Contractor, Architect and other Owner Representatives (if any); Installers of woodwork, wet work such as plastering, other finishes, painting, mechanical work and electrical work; and firms or persons responsible for continued operation (whether temporary or permanent) of HVAC system as required to maintain temperature and humidity conditions. Proceed with woodwork installation only when everyone concerned agrees that required ambient conditions can be maintained.

1.5 DELIVERY, STORAGE AND HANDLING

A. Protect woodwork during transit, delivery, storage, and handling to prevent damage, soilage, and deterioration.

B. Do not deliver woodwork until painting and similar operations that could damage, soil, or deteriorate woodwork have been completed in installation areas. If woodwork must be stored in other than installation areas, store only in areas whose environmental conditions meet requirements specified in "Project Conditions."

1.6 PROJECT CONDITIONS

A. Environmental Limitations: Do not deliver or install woodwork until building is enclosed, wet-work is completed, and HVAC system is operating and will maintain temperature and relative humidity at occupancy levels during the remainder of the construction period.

B. Field Measurements: Where woodwork is indicated to be fitted to other construction, check actual dimensions of other construction by accurate field measurements before fabrication, and show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Verify locations of concealed framing, blocking, reinforcements, and furring that support woodwork by accurate field measurements before being enclosed. Record measurements on final shop drawings.

1.7 COORDINATION

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

PART 2 - PRODUCTS

2.1 MATERIALS

A. General: Provide materials that comply with requirements of the AWI quality standard for each type of woodwork and quality grade indicated and, where the specified products are part of woodwork, with requirements of the referenced product standards that apply to product characteristics indicated:

1. Recycled Content of Medium-Density Fiberboard and Particleboard: Provide products with an average recycled content so postconsumer recycled content plus one-half of pre-consumer recycled content is not less than 50 percent.

B. Lumber:

1. Grade Stamps: Provide lumber with each piece factory marked with grade stamp of inspection agency evidencing compliance with grading rule requirements and identifying grading agency, grade, species, moisture content at time of surfacing, and mill.

a. For exposed lumber, furnish pieces with grade stamps applied to ends or back of each piece, or omit grade stamps entirely and provide certificates of grade compliance issued by inspection agency.

C. Softwood Plywood: Comply with DOC PS 1, "U.S. Product Standard for Construction and Industrial Plywood"; manufactured with no added urea formaldehyde resins.

D. Hardwood Plywood and Face Veneers: Comply with HPVA HP-1, "Interim Voluntary Standard for Hardwood and Decorative Plywood"; manufactured with no added urea formaldehyde resins.

E. Hardboard: ANSI/AHA A135.4; manufactured with no added urea formaldehyde resins.

F. Medium-Density Fiberboard: Composite board manufactured with 100 percent recycled wood fiber in a phenol-formaldehyde resin matrix containing no urea formaldehyde resins.

1. Performance Classification: ANSI A208.2, Product Class MD.

2. Product: Subject to compliance with requirements, provide one of the following:
   a. CMI, “Extira Treated Exterior Composite”
   b. Flakeboard, “Vesta MDF”
   c. Panel Source International, “PureKor MDF Plus”.
   d. Sierra Pine, Ltd., "Medite II" or “arreis”.

G. Particleboard: Composite board manufactured with 100 percent recycled wood particles in a phenol-formaldehyde resin matrix containing no urea formaldehyde resins.
   1. Performance Classification: ANSI A208.1, Grade M-2.
   2. Product: Subject to compliance with requirements, provide the following:
      a. Flakeboard, “Vesta Particleboard”
      b. Panel Source International, “PureKor Partticleboard Plus”.
      c. Rosenburg Forest Products, “SkyBlend FSC Particleboard”.
      d. Uniboard, Inc., “Nu Green Particleboard”

H. High Pressure Decorative Plastic Laminate (HPDL): NEMA LD 3, grades as indicated.
   1. Colors and Patterns: Plastic laminate colors and patterns shall be as selected by the Architect:
   2. Manufacturers: Subject to compliance with requirements, provide products manufactured by the following:
   a. Panolam Industries, Nevamar Decorative Surfaces
   b. Pionite Decorative Surfaces.
   c. Wilsonart International.
   3. Adhesive for Bonding Plastic Laminate: Contact cement or aliphatic resin, as recommended by manufacturer. Use resorcinol where needed for fire resistance
   4. Products:
      a. PL-~~1~~: Product for application to plastic laminate countertops, base cabinets and wall cabinets, as selected by Architect from manufacturer’s full range of colors and patterns.

I. Thermoset Decorative Overlay: Decorative surface of thermally fused polyester or melamine-impregnated web, bonded to specified substrate and complying with ALA 1992.
   1. Substrate: Medium-density particleboard or agrifiber board.

J. Solid-Surfacing Material:
   1. Manufacturers: Subject to compliance with requirements, provide product one of the following:
      a. Avonite, Inc.
      b. E. I. du Pont de Nemours and Company.
      c. Formica Corporation.
      d. Wilsonart International.

   2. SS basis of design:

a. SS-1: Wilsonart, **Milk Glass Spectra (9077ST)**
b. SS-2: Wilsonart, **Avalanche Melange (9175ML)**

2.2 FIRE-RETARDANT-TREATED MATERIALS

A. Where indicated, use materials impregnated with fire-retardant chemical formulations indicated by a pressure process or other means acceptable to authorities having jurisdiction to produce products with fire-test-response characteristics specified.

B. Fire-Retardant Chemicals: Use chemical formulations that do not bleed through or otherwise adversely affect finishes. Do not use colorants in solution to distinguish treated material from untreated material.

C. Fire-Retardant-Treated Lumber: Comply with the following:

1. Organic-Resin-Based Formulation: Exterior type per AWPA C20, consisting of organic-resin solution, relatively insoluble in water, thermally set in wood by kiln drying.
2. Low-Hygroscopic Formulation: Interior Type A per AWPA C20.
3. Nonpressure-Treatment Formulation: Nontoxic, water-soluble product applied by dip, spray, roller, curtain coating, vacuum chamber, or soaking.
4. Mill lumber after treatment, within limits set for wood removal that does not affect listed fire-test-response characteristics, using a woodworking plant certified by testing and inspecting agency.
5. Mill lumber before treatment and implement special procedures during treatment and drying processes that prevent lumber from warping and developing discolorations from drying sticks or other causes, marring, and other defects affecting appearance of treated woodwork.
6. Kiln-dry material before and after treatment to levels required for untreated material.
7. Discard treated material that does not comply with requirements of referenced woodworking standard. Do not use twisted, warped, bowed, discolored, or otherwise damaged or defective material.
8. Products: Subject to compliance with requirements, provide one of the following:
   a. Organic-Resin-Based Formulation (Exterior Type):
      1) Exterior Fire-X; American Wood Treaters, Inc.
      2) Exterior Fire-X; Hoover Treated Wood Products, Inc. b.

   Low-Hygroscopic Formulation (Type A):
      1) D-Blaze; J. H. Baxter Co.
      2) D-Blaze; Chemical Specialties, Inc.
      3) Pyro-guard; Continental Wood Preservers, Inc.
      4) Dricon; Hickson Corp.
      5) Pyro-guard; Hoover Treated Wood Products, Inc.
9. Product: Dricon by Hickson Corporation (no substitutions).

2.3 WOOD CABINETS FOR TRANSPARENT FINISH

A. Grade: Premium.

B. Type of Construction:
1 . FRAMELESS FOR WARDROBES
2. FACE FRAME FOR LAVATORY BASE CABINETS.

C. Lumber Trim and Edges: ~~**At panelwork fabricator's option**~~, trim and edges indicated as solid wood ~~**(except moldings**~~) may be ~~**either**~~ lumber or ~~**veneered construction**~~ compatible with grain and color of veneered panels. **Match existing wardrobes to remain.**

D. Cabinet and Door and Drawer Front Interface Style: Full overlay.

E. Reveal Dimension: As needed to operate swing cabinet doors.

F. Wood for Exposed Surfaces:

1. Species: Red oak.
2. Cut: Plain sliced.
3. Grain Direction: Vertically for doors and fixed panels, horizontally for drawer fronts and fixed panel.
4. Matching of Veneer Leaves: Slip match.
5. Veneer Matching within Panel Face: Balance match.
6. Vertical Matching of Adjacent Veneer Leaves: End match.

2.5 FABRICATION GENERAL

A. Interior Woodwork Grade: Provide woodwork complying with the referenced quality standard and of the following grade:
1. Grade: Premium.

B. Wood Moisture Content: Comply with requirements of referenced quality standard for wood moisture content in relation to relative humidity conditions existing during time of fabrication and in installation areas.

D. Fabricate woodwork to dimensions, profiles, and details indicated. Ease edges to radius indicated for the following:
1. Comers of cabinets and edges of solid-wood (lumber) members 3/4 inch (19 mm) thick or less: **1/16** inch (1.5 mm).
2. Edges of rails and similar members more than 3/4 inch (19 mm) thick: **1/8** inch (3 mm).
3. Comers of cabinets and edges of solid-wood (lumber) members and rails: **1/16** inch (1.5 mm).

E. Complete fabrication, including assembly, finishing, and hardware application, before shipment to Project site to maximum extent possible. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

1. Trial fit assemblies at the fabrication shop that cannot be shipped completely assembled. Install dowels, screws, bolted connectors, and other fastening devices that can be removed after trial fitting. Verify that various parts fit as intended and check measurements of assemblies against field measurements indicated on approved shop drawings before disassembling for shipment.

F. Shop-cut openings, to maximum extent possible, to receive hardware, appliances, plumbing fixtures, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Smooth edges of cutouts and, where located in countertops and similar exposures, seal edges with a water-resistant coating.

2.6 LAMINATE-CLAD CABINETS (PLASTIC-COVERED CASEWORK)

A. Quality Standard: Comply with AWI Section 400 requirements for laminate-clad cabinets.

1. Grade: Premium.

B. AWI Type of Cabinet Construction: Flush overlay with reveal.

C. Laminate Cladding for Exposed Surfaces: High-pressure decorative laminate complying with the following requirements:

1. Horizontal Surfaces Other than Tops: HGS (0.048 inch).
2. Vertical Surfaces: HGS (0.048 inch).
3. Edges: HGS (0.048 inch).

D. Materials for Semiexposed Surfaces: Provide surface materials indicated below:

1. Surfaces Other than Drawer Bodies: High-pressure decorative laminate, HGS.
2. **Cabinet &** Drawer Sides, **tops** and Backs: Thermoset decorative overlay **(PL3).**
3. **Cabinet &** Drawer Bottoms: ~~Thermoset decorative overlay~~. **HGS (0.048 inch) (PL4)**
4. Loose (adjustable) Shelves: High pressure decorative plastic laminate, HGS, on both faces and front and rear edges. **HGS (0.048 inch) (PL4)**

E. At all laminate clad door and drawer edges, apply edge laminates prior to application of door and drawer face laminates.

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

1. Provide Architect's selections from laminate manufacturer's full range of colors and finishes in the following categories:

a. Solid colors.
b. Patterns.

G. Provide dust panels of 1/4 inch (6.4 mm) plywood or tempered hardboard above compartments and drawers except where located directly under tops.

H. Substrate: Medium density fiberboard, conforming to ANSI A208.2.
1. Provide 5 mm "Systems" screws for attachment of hardware to case body and nylon inserts for attachment of hardware to doors.

2.6.1 COUNTERTOPS

A. Quality Standard: Comply with AWI Section 400 requirements for countertops.
1. Grade: Premium.

B. Plastic Laminate Countertops: High pressure decorative plastic laminate (HPDL) complying with the following:
1. Grade: HGS (0.048 inch).
2. Colors, Patterns, and Finishes: Provide materials and products that result in colors and textures of exposed laminate surfaces complying with the following requirements:
a. Provide Architect's selections from manufacturer's full range of colors and finishes in the following categories:
~~1) PL-2 Match existing Formica Mink Grafix #513~~
3. Edge Treatment: Same as laminate cladding on horizontal surfaces.
4. Core Material: Particleboard or fiberboard.
a. Thickness: 1 inch, except where indicated otherwise.
b. Density: 45 lbs./cubic foot minimum.
5. Balancing Sheet: Minimum 0.020 inch phenolic backer required all cases.
6. Backsplashes:
a. Edgeband all edges of backsplashes.
b. Apply mildew-resistant silicone sealant to joint and factory assemble backsplash to top with concealed fasteners.

C. Solid Surfacing Countertops:
1. Fabrication: Fabricate tops in one piece with shop-applied backsplashes and edges, unless otherwise indicated. Comply with solid surfacing material manufacturer's recommendations for adhesives, sealers, fabrication, and finishing.
a. Drill holes in countertops for plumbing fittings in the shop.
2. Solid Surfacing Material Thickness:
a. 1/2 inch (13 mm).
b. 1/4 inch

2.7 CABINET HARDWARE AND ACCESSORIES

A. General: Provide cabinet hardware and accessory materials associated with architectural cabinets except for items specified in Section 087111 "Door Hardware (Descriptive Specification)."

B. Frameless Concealed Hinges (European Type): BHMA A156.9, B01602, 170 degrees of opening, heavy duty, fully adjustable and self-closing.

D. Back-Mounted Pulls: BHMA A156.9, B02011.

E. Wire Pulls: Back mounted, solid metal, 4 inches long. EPCO MC-402-4, stainless steel.

F. Adjustable Shelf Standards and Supports: Plug-In Type: Häfele No. 282.11.761, nickel-plated, or equal.

H. Shelf Rests: BHMA A156.9, B04013; metal, two-pin type with shelf hold- down clip.

I. Drawer Slides: BHMA A156.9.

1. Grade 1 and Grade 2: Side mounted and extending under bottom edge of drawer; full-extension type; epoxy-coated steel with polymer rollers.
2. Grade 1HD-100 and Grade 1HD-200: Side mounted; full-extension type; zinc-plated-steel ball-bearing slides.
4. For drawers more than 3 inches high but not more than 6 inches high and not more than 24 inches wide, provide Grade 1HD-100.
5. For drawers more than 6 inches high or more than 24 inches wide, provide Grade 1HD-200.

J. Door and Drawer Silencers: BHMA A156.16, L03011.

K. Exposed Hardware Finishes: For exposed hardware, provide finish that complies with BHMA A156.18 for BHMA finish number indicated.

1. Satin Chromium Plated: BHMA 626 for brass or bronze base; BHMA 652 for steel base.

L. Clothes Hook: Nylon Hook by HEWI No. 477.90.025

M. Clothes Rod: 770-1 CHR bright chrome by Knape & Vogt w/ flanges to match building standard.

2.8 MISCELLANEOUS MATERIALS

A. Furring, Blocking, Shims, and Hanging Strips: Softwood or hardwood lumber dried to less than 15 percent moisture content.

B. Anchors: Select material, type, size, and finish required for each substrate for secure anchorage. Provide metal expansion sleeves or expansion bolts for post-installed anchors. Use nonferrous- metal or hot-dip galvanized anchors and inserts at inside face of exterior walls and at floors.

C. Adhesives: Do not use adhesives that contain urea formaldehyde.

D. Adhesives: Use adhesives that meet 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."

2.9 FABRICATION

A. Complete fabrication, including assembly, finishing, and hardware application, to maximum extent possible before shipment to Project site. Disassemble components only as necessary for shipment and installation. Where necessary for fitting at site, provide ample allowance for scribing, trimming, and fitting.

B. Shop-cut openings to maximum extent possible to receive hardware, appliances, electrical work, and similar items. Locate openings accurately and use templates or roughing-in diagrams to produce accurately sized and shaped openings. Sand edges of cutouts to remove splinters and burrs.

2.10 SHOP FINISHING OF ARCHITECTURAL WOODWORK

A. Quality Standard: Comply with AWI Section 1500, unless otherwise indicated.
   1. Grade: Provide finishes of same grades as items to be finished.

B. General: The entire finish of interior architectural woodwork is specified in this Section, regardless of whether shop applied or applied after installation.
   1. Shop Finishing: To the greatest extent possible, finish architectural woodwork at the fabrication shop. Defer only final touch up, cleaning, and polishing until after installation.

C. Preparations for Finishing: Comply with referenced quality standard for sanding, filling countersunk fasteners, sealing concealed surfaces, and similar preparations for finishing architectural woodwork, as applicable to each unit of work.
   1. Backpriming: Apply one coat of sealer or primer compatible with finish coats to concealed surfaces of woodwork, including backs of cabinets and the underside of countertops. Concealed surfaces of plastic laminate-clad woodwork do not require backpriming when surfaced with plastic laminate or thermoset decorative overlay.

D. Washcoat for Stained Finish: Apply a vinyl washcoat to woodwork made from closed-grain wood before staining and finishing.

E. Filled Finish for Open-Grain Woods: After staining (if any), apply paste wood filler to open-grain woods and wipe off excess. Tint filler to match stained wood.

1. Apply vinyl washcoat sealer after staining and before filling.

F. Transparent Finish: Comply with requirements indicated below for grade, finish system, staining, and sheen, with sheen measured on 60-degree gloss meter per ASTM D523.

1. Grade: Premium.
2. AWI Finish System: Conversion varnish.
3. Staining: Match Architect's sample.
4. Sheen: Satin 30-50 gloss units.
5. Sheen: Semigloss 55-75 gloss units.

PART 3 - EXECUTION

3.1 PREPARATION

A. Before installation, condition cabinets to average prevailing humidity conditions in installation areas.

3.2 INSTALLATION

A. Grade: Install cabinets to comply with same grade as item to be installed.

B. Install wardrobes and cabinets level, plumb, true, and straight. Shim as required with concealed shims. Install level and plumb to a tolerance of 1/8 inch in 96 inches (3 mm in 2400 mm).

C. Scribe and cut cabinets to fit adjoining work, refinish cut surfaces, and repair damaged finish at cuts.

D. Anchor wardrobes and cabinets to anchors or blocking built in or directly attached to substrates. Secure with countersunk, concealed fasteners and blind nailing. Use fine finishing nails for exposed fastening, countersunk and filled flush with woodwork and matching final finish where transparent finish is indicated.

E. Cabinets: Install without distortion so that doors and drawers fit openings properly and are accurately aligned. Adjust hardware to center doors and drawers in openings and to provide unencumbered operation. Complete the installation of hardware and accessory items as indicated.

1. Install cabinets with no more than 1/8 inch in 96 inch (3 mm in 2400 mm) sag, bow, or other variation from a straight line.
2. Maintain veneer sequence matching of cabinets with transparent finish.

F. Tops: Anchor securely to base units and other support systems as indicated.

Caulk space between backsplash and wall with mildew-resistant silicone sealant. Field assembled counters shall have a bead of mildew-resistant silcone sealant installed between the backsplash and the countertop.

1. Install countertops with no more than 1/8 inch in 96 inch (3 mm in 2400 mm) sag, bow, or other variation from a straight line.
2. Align adjacent solid-surfacing-material countertops and form seams to comply with manufacturer's written recommendations using adhesive in color to match countertop. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
3. Secure backsplashes to tops with concealed metal brackets at 16 inches (400 mm) o.c.
4. Caulk space between backsplash and wall with sealant specified in Division 07 Section "Joint Sealants."

3.4 PROTECTION

A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, which will ensure that woodwork will be without damage or deterioration at time of Substantial Completion.

END OF SECTION 064000

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Interior joints in the following vertical surfaces and horizontal nontraffic surfaces:

a. Control and expansion joints on exposed interior surfaces of exterior walls.
b. Perimeter joints of exterior openings where indicated.
c. Tile control and expansion joints.
d. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions.
e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
f. Joints between plumbing fixtures and adjoining walls, floors, and counters.
g. Other joints as indicated.

2. Interior joints in the following horizontal traffic surfaces:

a. Control and expansion joints in tile flooring.

1.2 ACTION SUBMITTALS

A. Product Data: For each joint-sealant product indicated. Include maximum VOC contents specified below.

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

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

1.3 QUALITY ASSURANCE

A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.

B. Preinstallation Conference: Conduct conference at Project site.

1.4 WARRANTY

A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Two years from date of Substantial Completion.

B. Special Manufacturer's Warranty: Manufacturer's standard form in which joint-sealant manufacturer agrees to furnish joint sealants to repair or replace those that do not comply with performance and other requirements specified in this Section within specified warranty period.

1. Warranty Period: Twenty years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS, GENERAL

A. VOC Content of Interior Sealants: Sealants and sealant primers used inside the weatherproofing system shall comply with the following limits for VOC content when calculated according to 40 CFR 59, Subpart D (EPA Method 24):

1. Architectural Sealants: 250 g/L.
2. Sealant Primers for Nonporous Substrates: 250 g/L.
3. Sealant Primers for Porous Substrates: 775 g/L.

2.2 JOINT SEALANT BACKING

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

B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer.

2.3 MISCELLANEOUS MATERIALS

A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.

B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials.

C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 PREPARATION

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions.

1. Remove laitance and form-release agents from concrete.
2. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants.

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

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

3.2 INSTALLATION

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

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

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

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

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

1. Place sealants so they directly contact and fully wet joint substrates.
2. Completely fill recesses in each joint configuration.

3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.

E. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants according to requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.

1. Remove excess sealant from surfaces adjacent to joints.
2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
3. Provide concave joint profile per Figure 8A in ASTM C 1193, unless otherwise indicated.

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

3.3 ELASTOMERIC JOINT-SEALANT SCHEDULE

A. Mildew-Resistant Silicone Sealant: Where joint sealants of this type are indicated, provide products formulated with fungicide that are intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and temperature extremes, and that comply with ASTM C920 and the following:

1. Products: Provide one of the following or equal:
   a. 786 Mildew Resistant; Dow Corning.
   b. Sanitary SCS1700; GE Silicones.
   c. 898 Silicone Sanitary Sealant; Pecora Corporation.
   d. PSI-611; Polymeric Systems, Inc.
   e. Tremsil 600; Tremco.
2. Type and Grade: S (single component) and NS (nonsag).
3. Class: 25.
4. Use Related to Exposure: NT (nontraffic).
5. Uses Related to Joint Substrates: G, A, and, as applicable to joint substrates indicated, O.
   a. Use O Joint Substrates: G a lvanized steel, and ceramic tile.
6. Applications: Interior joints in vertical surfaces in toilet rooms, showers and kitchens/lounges; and where indicated.

3.4 NON-ELASTOMERIC JOINT-SEALANT SCHEDULE

A. Latex Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Provide one of the following or equal:
a. Chem-Calk 600; Bostik Inc.

b. AC-20; Pecora Corporation.
c. PSI-701; Polymeric Systems, Inc.
d. Tremflex 834; Tremco.
2. Applications: Interior exposed joints in field painted vertical and overhead surfaces; at perimeter of hollow metal door frames; in gypsum drywall, plaster, and concrete masonry; and where indicated.

B. Preformed Foam Sealant: Where joint sealants of this type are indicated, provide products complying with the following:

1. Products: Provide one of the following or equal:
a. Emseal 25V; Emseal Joint Systems, Ltd.
b. Polytite Standard; Polytite Manufacturing Corporation.
c. Blocoband HF; Salamander Industrial Products Inc.
d. Wilseal 600; Sealform, Ltd.

END OF SECTION 079200

SECTION 081113 - HOLLOW METAL DOORS AND FRAMES

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes hollow-metal work.

1.2 DEFINITIONS

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

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: Include elevations, door edge details, frame profiles, metal thicknesses, preparations for hardware, and other details.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of exposed finish required.

E. Schedule: Prepared by or under the supervision of supplier, using same reference numbers for details and openings as those on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Product test reports.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

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

1. Steel Doors and Frames:
   a. Ceco Door Products; an Assa Abloy Group company.
   b. Curries Company; an Assa Abloy Group company.
   c. Kewanee Corporation (The).
   d. Pioneer Industries, Inc.
   e. Steelcraft; an Ingersoll-Rand company.
   f. Windsor Republic Doors.

2.1 MATERIALS

A. Hot-Rolled Steel Sheets: ASTM A569/A569M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.

B. Cold-Rolled Steel Sheets: ASTM A366/A366M, Commercial Steel (CS), or ASTM A620/A620M, Drawing Steel (DS), Type B; stretcher-leveled standard of flatness.

C. Electrolytic Zinc-Coated Steel Sheet: ASTM A591/A591M, Commercial Steel (CS), Class B coating; mill phosphatized; suitable for unexposed applications; stretcher-leveled standard of flatness where used for face sheets.

D. Frame Anchors: ASTM A 879/A 879M, Commercial Steel (CS), 04Z (12G) coating designation; mill phosphatized.

E. Inserts, Bolts, and Fasteners: Hot-dip galvanized according to ASTM A 153/A 153M.

F. Power-Actuated Fasteners in Concrete: From corrosion-resistant materials.

G. Grout: ASTM C 476, except with a maximum slump of 4 inches (102 mm), as measured according to ASTM C 143/C 143M.

2.2 REGULATORY REQUIREMENTS

A. Fire-Rated Assemblies: Complying with NFPA 80 and listed and labeled by a qualified testing agency acceptable to authorities having jurisdiction for fire-protection ratings and temperature-rise limits indicated, based on testing at positive pressure according to NFPA 252 or UL 10C. Provide an assembly with gaskets listed and labeled for smoke and draft control by a qualified testing agency acceptable to authorities having jurisdiction, based on testing according to UL 1784 and installed in compliance with NFPA 105.

2.3 INTERIOR DOORS

A. Provide doors of sizes, thicknesses, materials, and designs indicated.

1. Interior Doors: Provide doors complying with requirements indicated below by referencing ANSI 250.8 for level and model and ANSI A250.4 for physical-endurance level:
   a. Level 2 and Physical Performance Level B (Heavy Duty), Model 2 (Seamless); fabricated from 18 gage/0.042 inch (1.0 mm) thick steel sheet.

2.4 FRAMES

A. Provide steel frames for doors with details indicated for type and profile. Conceal fastenings, unless otherwise indicated.

B. Fabricate frames as full profile welded unless otherwise indicated.

C. Frames of minimum 16 gage/0.053 inch (1.3 mm) thick steel sheet for:
1. Level 2 steel doors.
2. Wood doors.

E. Door Silencers: Except on gasketed or weather-stripped frames, fabricate stops to receive three silencers on strike jambs of single-door frames and two silencers on heads of double-door frames.

F. Plaster Guards: Provide 0.016 inch (0.4 mm) thick, steel sheet plaster guards or mortar boxes to close off interior of openings; place at back of hardware cutouts where mortar or other materials might obstruct hardware operation.

G. Supports and Anchors: Fabricated from not less than 18 gage/0.042 inch (1.0 mm) thick, electrolytic zinc-coated or metallic-coated steel sheet.
1. Wall Anchors in Masonry Construction: 0.177 inch (4.5 mm) diameter, steel wire complying with ASTMA510 (ASTMA510M) may be used in place of steel sheet.

H. Inserts, Bolts, and Fasteners: Manufacturer's standard units. Where zinc-coated items are to be built into exterior walls, comply with ASTM A153/A153M, Class C or D as applicable.

2.5 FABRICATION

A. Fabricate steel door and frame units to comply with ANSI A250.8 and to be rigid, neat in appearance, and free from defects including warp and buckle. Where practical, fit and assemble units in manufacturer's plant. Clearly identify work that cannot be permanently factory assembled before shipment, to assure proper assembly at Project site.

B. Interior Door Faces: Fabricate exposed faces of doors and panels, including stiles and rails of nonflush units, from the following material:
1. Cold-rolled steel sheet, unless otherwise indicated.

C. Core Construction: Manufacturer's standard core construction that produces a door complying with SDI standards.

E. Clearances for Non-Fire-Rated Doors: Not more than 1/8 inch (3.2 mm) at jambs and heads, except not more than 114 inch (6.4 mm) between pairs of doors. Not more than 3/4 inch (19 mm) at bottom.

F. Clearances for Fire-Rated Doors: As required by NFPA 80.

2.6 FRAME ANCHORS

A. Jamb Anchors:

1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (51 mm) wide by 10 inches (254 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
2. Compression Type for Drywall Slip-on Frames: Adjustable compression anchors.

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

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

C. Hollow-Metal Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.

2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
3. Grout Guards: Weld guards to frame at back of hardware mortises in frames to be grouted.
4. Floor Anchors: Weld anchors to bottoms of jambs with at least four spot welds per anchor; however, for slip-on drywall frames, provide anchor clips or countersunk holes at bottoms of jambs.
5. Jamb Anchors: Provide number and spacing of anchors as follows:

a. Masonry Type: Locate anchors not more than 16 inches (406 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) o.c., to match coursing, and as follows:

1) Two anchors per jamb up to 60 inches (1524 mm) high.
2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) high.
3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) high.
4) Four anchors per jamb plus one additional anchor per jamb for each 24 inches (610 mm) or fraction thereof above 120 inches (3048 mm) high.

b. Compression Type: Not less than two anchors in each frame.
c. Postinstalled Expansion Type: Locate anchors not more than 6 inches (152 mm) from top and bottom of frame. Space anchors not more than 26 inches (660 mm) o.c.

6. Door Silencers: Except on weather-stripped frames/gasketed, drill stops to receive door silencers.

a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.

D. Hardware Preparation: Factory prepare hollow-metal work to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping according to SDI A250.6, the Door Hardware Schedule, and templates.

1. Reinforce doors and frames to receive nontemplated, mortised, and surface-mounted door hardware.
2. Comply with applicable requirements in SDI A250.6 and BHMA A156.115 for preparation of hollow-metal work for hardware.

2.7 STEEL FINISHES

A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.

1. Shop Primer: SDI A250.10.

2.8 ACCESSORIES

A. Grout Guards: Formed from same material as frames, not less than 0.016 inch (0.4 mm) thick.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Hollow-Metal Frames: Install hollow-metal frames of size and profile indicated. Comply with SDI A250.11 or NAAMM-HMMA 840 as required by standards specified.

1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.

a. At fire-rated openings, install frames according to NFPA 80.
b. Where frames are fabricated in sections because of shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
c. Install frames with removable stops located on secure side of opening.
d. Install door silencers in frames before grouting.
e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
f. Check plumb, square, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.

2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor, and secure with postinstalled expansion anchors.

a. Floor anchors may be set with power-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on Shop Drawings.

3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with grout.
4. In-Place Concrete or Masonry Construction: Secure frames in place with postinstalled expansion anchors. Countersink anchors, and fill and make smooth, flush, and invisible on exposed faces.
5. Installation Tolerances: Adjust hollow-metal door frames for squareness, alignment, twist, and plumb to the following tolerances:

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

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

1. Fire-Rated Doors: Install doors and gaskets with clearances according to NFPA 80 & NFPA 105 .

3.2 ADJUSTING AND CLEANING

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

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

C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.

D. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

E. Touchup Painting: Cleaning and touchup painting of abraded areas of paint are specified in painting Sections.

END OF SECTION 081113

SECTION 081416 - FLUSH WOOD DOORS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Solid-core doors with wood-veneer faces .

2. Factory finishing flush wood doors.

1.2 ACTION SUBMITTALS

A. Product data for each type of wood door, including details of core and edge construction, trim for openings.
   1. Include factory-finishing specifications.
   2. Low-Emitting Materials: Fabricate doors with adhesives and composite wood products that do not contain urea formaldehyde.

B. Shop Drawings: Submit shop drawings that indicate location, size, and hand of each door; elevation of each kind of door; construction details not covered in product data; location and extent of hardware blocking; and other pertinent data.
   1. Indicate dimensions and locations of mortises and holes for hardware.
   2. Indicate dimensions and locations of cutouts.
   3. Indicate requirements for veneer matching.
   4. Indicate doors to be factory finished and finish requirements.
   5. Indicate fire ratings for fire doors.

C. Samples for Verification: Submit samples as follows:
   1. Corner sections of doors approximately 8 by 10 inches (200 by 250 mm) with door faces and edgings representing the typical range of color and grain for each species of veneer and solid lumber required. Finish sample with same materials proposed for factory-finished doors. COLOR TO MATCH EXISTING ADJACENT DOORS. Provide manufacturer's full range of stain samples to choose from.

   2. Frames for light openings, 6 inches (150 mm) long, for each material, type, and finish required.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide flush faced wood doors as

manufactured by one of the following:

1. Algoma Hardwoods, Inc.
2. Eggers Industries, Architectural Door Division.
3. Marshfield Dom·Systems, Inc.
4. VT Architectural Wood Doors.

B. Regional Materials: Flush wood doors shall be manufactured within 500 miles (800 km) of Project site.

2.2 DOOR CONSTRUCTION, GENERAL

A. Doors for Transparent Finish: Comply with the following requirements:
   1. Grade: Premium, with Grade AA faces.
   2. Faces: Red Oak, plain sliced.
   3. Match between Veneer Leaves: Slip match.
   4. Match within Door Faces: Balance match.
   5. Pair and Set Match: Provide for pairs of doors and for doors hung in adjacent sets.

2.3 SOLID-CORE DOORS

A. Particleboard Cores: Comply with the following requirements:
   1. Particleboard: ANSI A208.1, Grade LD-2.
   2. Blocking: Provide wood blocking at particleboard-core doors as follows:
      a. 5 inch (125 mm) top-rail blocking, at doors indicated to have closers.
      b. 5 inch (125 mm) bottom-rail blocking, at exterior doors and doors indicated to have kick, mop, or armor plates.
      c. 5 inch (125 mm) midrail blocking, at doors indicated to have exit devices.

B. Interior Veneer-Faced Doors: Comply with the following requirements:
   1. Core: Particleboard core.
   2. Construction: Five plies with stiles and rails bonded to core, then entire unit abrasive planed before veneering.

C. Fire-Rated Doors: Comply with the following requirements:
   1. Construction: Construction and core specified above for type of face indicated or manufacturer's standard mineral-core construction as required to provide fire rating indicated.
   2. Blocking: For mineral-core doors, provide composite blocking with improved screw-holding capability approved for use in doors of fire ratings indicated and as follows:
      a. 5 inch (125 mm) top-rail blocking.
      b. 5 inch (125 mm) bottom-rail blocking, at doors indicated to have kick, mop, or armor plates.
      c. 4-1/2 by I0 inch (114 by 250 mm) lock blocks.
      d. 5 inch (125 mm) midrail blocking, at doors indicated to have exit devices.

3. Edge Construction: At hinge stiles, provide manufacturer's standard laminated-edge construction with improved screw-holding capability and split resistance and with outer stile matching face veneer.

4. Pairs: Furnish formed-steel edges and astragals for pairs of fire-rated doors, unless otherwise indicated.

5. Pairs: Provide fire-rated pairs with fire-retardant stiles that are labeled and listed for kinds of applications indicated without formed-steel edges and astragals.

2.4 FLUSH WOOD DOORS

A. Flush Faced Wood Doors (Non-Fire-Rated): 1-3/4 inches thick, solid particleboard core, flush wood doors conforming to AWI Quality Standards, Premium Grade, Type PC-5.

1. Stiles: Laminated-edge construction for improved screw-holding capability, laminated to core with Type IT water-resistant glue; outer stile species to match face veneer.

2. Rails: Mill-option hardwoods; 5 inch wide top rail (after trimming), suitable for attaching surface applied closer with steel screws.

3. Lock Blocks: 4-1/2 inch by 10 inch lock blocks. Provide lock blocks at each stile for doors scheduled to have exit devices.

4. Cross Bands: Oven-dried hardwoods (natural or engineered fiber), 1/16 inch minimum thickness, extending full width of door and laid with grain at right angles to face veneers.

5. Face Veneers: Slip-match, center balance match, plain sliced Red Oak, HPMA/AWl Grade AA, no sapwood allowed, not less than 1/50 inch thick.

6. Bond cross bands and face veneers to core with Type I exterior resin glue.

7. Where twenty (20) minute fire rated door is indicated, provide PC-5 construction door as specified above, bearing UL label.

B. Flush Faced Wood Doors (Fire-Rated): 1-3/4 inches thick, solid mineral core, flush wood doors conforming to AWI Quality Standards, Premium Grade, Type FD, 5-ply construction. Provide fire rated doors bearing appropriate UL Label.

1. Stiles: 9/16 inch thick untreated, multi-ply maple. Provide veneer banding on stiles to match face veneers. On pairs of doors with both leaves active, provide matching veneer covered metal edge guards on meeting edges (so overlapping astragals or coordinators are not required) or provide manufacturer's concealed system approved for tire rated doors.

2. Top Rails: 5 inch wide fire retardant treated plywood, suitable for attaching surface applied closer with steel screws.

3. Lock Blocks: 4-1/2 inch by 10 inch minimum, fire retardant treated plywood. Provide lock blocks at each stile for doors scheduled to have exit devices. Provide reinforcement blocking at bottom comer at strike edge for attachment of vertical rod guide for doors scheduled to have surface mounted vertical rod exit devices.

4. Face Veneers: Slip-match, center balance match, plain sliced Red Oak, HPMA/AWI Grade AA, no sapwood allowed, not less than 1/50 inch thick.

5. Bond hardwood cross bands and face veneers to core with Type I exterior resin glue.

2.5 FABRICATTON

A. Factory fit doors to suit frame-opening sizes indicated, with the following uniform clearances and bevels, unless otherwise indicated:

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/4 inch (6.4 mm) from bottom of door to top of threshold.
2. Comply with requirements of NFPA 80 for fire-rated doors.

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

1. Coordinate measurements of hardware mortises in metal frames to verify dimensions and alignment before factory machining.
2. Pairs of Fire-Rated Doors: Provide fire rated pairs of doors with manufacturer's fire rated non-metal edges for applications using listed hardware in rated openings without using steel edges and astragals.
3. Metal Astragals: Premachine astragals and formed-steel edges for hardware for pairs of fire-rated doors.

2.6 FACTORY FINISHING

A. Comply with referenced AWI quality standard including Section 1500 "Factory Finishing."

B. Finish wood doors at factory that are indicated to receive transparent finish.

C. Transparent Finishing: Comply with requirements indicated for finish system, grade, stain, sheen, and effect.

1. Grade: Premium.
2. Finish: AWl System conversion varnish.
3. Staining: As selected by Architect from manufacturer's standard range.
4. Effect: Open-grain finish.
5. Sheen: Semigloss.

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine installed door frames before hanging doors.

1. Verify that frames comply with indicated requirements for type, size, location, and swing characteristics and have been installed with plumb jambs and level heads.
2. Reject doors with defects.

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

3.2 INSTALLATION

A. Hardware: For installation, see Division 08 Section, "Door Hardware."

B. Manufacturer's Written Instructions: Install wood doors to comply with manufacturer's written instructions, referenced quality standard, and as indicated.

1. Install fire-rated doors in corresponding fire-rated frames according to NFPA 80.

C. Job-Fit Doors: Align and fit doors in frames with uniform clearances and bevels as indicated below; do not trim stiles and rails in excess of limits set by manufacturer or permitted with fire-rated doors. Machine doors for hardware. Seal cut surfaces after fitting and machining.

1. Clearances: Provide 1/8 inch (3.2 mm) at heads, jambs, and between pairs of doors. Provide 1/8 inch (3.2 mm) from bottom of door to top of decorative floor finish or covering. Where threshold is shown or scheduled, provide 1/ 4 inch (6.4 mm) from bottom of door to top of threshold.
    a. Comply with NFPA 80 for fire-rated doors.
2. Bevel non-fire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) at lock and hinge edges.
3. Bevel tire-rated doors 1/8 inch in 2 inches (3-1/2 degrees) on lock edge; trim stiles and rails only to extent permitted by labeling agency.

D. Factory-Fitted Doors: Align in frames for uniform clearance at each edge.

E. Factory-Finished Doors: Restore finish before installation, if fitting or machining is required at Project site.

3.3 ADJUSTING AND PROTECTING

A. Operation: Rehang or replace doors that do not swing or operate freely.

B. Finished Doors: Refinish or replace doors damaged during installation.

C. Protect doors as recommended by door manufacturer to ensure that wood doors are without damage or deterioration at the time of Substantial Completion.

END OF SECTION 081416

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes:

1. Mechanical door hardware for the following:

a. Swinging doors.

2. Self-Contained Electronic Locks and Readers.

1.2 ACTION SUBMITTALS

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

B. Other Action Submittals:

1. Door Hardware Schedule: Prepared by or under the supervision of Installer, detailing fabrication and assembly of door hardware, as well as installation procedures and diagrams. Coordinate final door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.

a. Format: Use same scheduling sequence and format and use same door numbers as in the Contract Documents.
b. Content: Include the following information:

1) Identification number, location, hand, fire rating, size, and material of each door and frame.
2) Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
3) Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
4) Description of electrified door hardware sequences of operation and interfaces with other building control systems.

2. Keying Schedule: Prepared by or under the supervision of Installer, detailing Owner's final keying instructions for locks.

1.4 QUALITY ASSURANCE

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

B. Door Hardware Supplier Qualifications: An experienced door hardware supplier

with warehousing facility in Project's vicinity and who has on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying. Supplier recognized as an authorized distributor in good standing by the manufacturers of the primary materials.

1. Scheduling Responsibility: Preparation of door hardware and keying schedules.

C. Source Limitations: Provide electrified door hardware from same manufacturer as mechanical door hardware, unless otherwise indicated. Manufacturers that perform electrical modifications and that are listed by a testing and inspecting agency acceptable to authorities having jurisdiction are acceptable.

D. Fire-Rated Door Assemblies: Where fire-rated door assemblies are indicated, provide door hardware rated for use in assemblies complying with NFPA 80 that are listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure according to NFPA 252 or UL 10C, unless otherwise indicated. Provide door hardware that meet requirements of assemblies tested according to UL 1784 and installed in compliance with NFPA 105.

1. Air Leakage Rate: Maximum air leakage of 0.3 cfm/sq. ft. (3 cu. m per minute/sq. m) at the tested pressure differential of 0.3-inch wg (75 Pa) of water.

E. Electrified Door Hardware: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction.

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

G. Accessibility Requirements: For door hardware on doors in an accessible route, comply with the U.S. Architectural & Transportation Barriers Compliance Board's ADA Accessibility Guidelines and ICC/ANSI A117.1.

1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf (22.2 N).
2. Comply with the following maximum opening-force requirements:

   a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf (22.2 N) applied perpendicular to door.
   b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.

3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch (13 mm) high.
4. Adjust door closer sweep periods so that, from an open position of 70 degrees, the door will take at least 3 seconds to move to a point 3 inches (75 mm) from the latch, measured to the leading edge of the door.

I. Keying Conference: Conduct conference in compliance with requirements in Division **0**1 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:

1. Function of building, purpose of each area and degree of security required.
2. Plans for existing and future key system expansion.
3. Requirements for key control system and software.
4. Installation of permanent keys and cylinder cores.
5. Address and requirements for delivery of keys.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Inventory door hardware on receipt and note any discrepencies to the Construction Manager. Store the delivered hardware m the designated secure location provided by the Construction Manager.

1. Access control hardware: Where approved and directed, inventory upon receipt and store electronic access control equipment in a secure, temperature and humidity controlled environment in original manufacturer's sealed containers.

B. Tag each item or package separately with identification related to the final Door Hardware Schedule, and include basic installation instructions with each item or package.

C. Deliver permanent keys, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner established at the "Keying Conference".

1.6 COORDINATION

A. Coordinate quantity and arrangement of assemblies with ceiling space configuration and with components occupying ceiling space, including structural members, pipes, air-distribution components, raceways, cable trays, recessed lighting fixtures, and other items.

B. Access Control System Roughing-In: Coordinate the layout and installation of scheduled electrified door hardware and access control equipment with required connections to source power junction boxes, power supplies, detection and monitoring hardware and fire alarm system.

1. Door Hardware Interface: The card key access control system to interface and be connected to electronic door control hardware (electromechanical locks, electric strikes, magnetic locks, door position switches, other monitoring contacts, and related auxiliary control devices) as described in this section. Coordinate the installation and configuration of specified door hardware being

monitored or controlled with the controls, software and access control hardware specified in this Section.

C. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard, electrified and access control system hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.

D. Door and Frame Preparation: Related Division 08 (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and wired to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.6 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.

B. Special and Extended Warranty Period (Access Control System): The entire installed access control system, covering all related parts and labor, to be warranted for a minimum period of 12 months after Opening Commissioning.

1. Maintenance Service Contract: Submit for Owner's consideration optional maintenance and extended warranty contract for the installed access control system. Version upgrades and "fix" releases to the access control system software, beyond the general warranty time period, are available at no extra charge only if the Owner is under a valid extended warranty and **maintenance contract.**

2. A published copy of this agreement to be included with the submittal package.

3. Support for the installed access control system components is provided through the vendor under a 24 hour technical assistance program.

4. Access control and management system components are to be available on a one-day tum around time frame from the manufacturer.

5. Primary systems manufacturer to offer and provide remote modem or internet access for direct factory support to the vendor. The factory level support to include

diagnostics and troubleshooting support on systems related issues at no additional cost to the owner.

1.7 MAINTENANCE SERVICE

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

B. Maintenance Service: Beginning at Substantial Completion, provide continuous 6 months full maintenance by skilled employees of door hardware and integrated access control systems suppliers and installers. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 - PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

A. Provide door hardware for each door **as scheduled in Part 3 below and on Drawings** to comply with requirements in this Section.

1. Door Hardware: Provide quantity, item, size, finish or color indicated, and products equivalent in function and comparable in quality to named products.
2. Sequence of Operation: Provide electrified door hardware function, sequence of operation, and interface with other building control systems indicated.

B. Designations: Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of door hardware are indicated in Part 3 "Door Hardware Schedule" Article. Products are identified by using door hardware designations, as follows:

1. Named Manufacturers' Products: Manufacturer and product designation are listed for each door hardware type required for the purpose of establishing minimum requirements. Manufacturers' names are abbreviated in Part 3 "Door Hardware Schedule" Article.

2.2 HINGES

A. Hinges: BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:

a. Baldwin Hardware Corporation.
b. Bommer Industries, Inc.

c. Cal-Royal Products, Inc.
d. Hager Companies.
e. IVES Hardware; an Ingersoll-Rand company.
f. Lawrence Hardware Inc.
g. McKinney Products Company; an ASSA ABLOY Group company.
h. PBB, Inc.
i. Stanley Commercial Hardware; Div. of The Stanley Works.

2.6 MECHANICAL LOCKS AND LATCHES

A. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.

1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.

2. Lock Throw: Comply with testing requirements for length of bolts to comply with labeled fire door requirements, and as follows:

a. Mortise Locks: Minimum 3/4-inch latchbolt throw.
b. Bored Locks: Minimum 1/2-inch latchbolt throw.

B. Bored Locks: BHMA A156.2; Grade 1; Series 4000.

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:

~~a. Arrow USA; an ASSA ABLOY Group company.~~
~~b. Best Access Systems; Div. of Stanley Security Solutions, Inc.~~
~~c. Cal-Royal Products, Inc.~~
~~d. Corbin Russwin Architectural Hardware; n ASSA ABLOY Group Company.~~
~~e. Falcon Lock; An Ingersoll-Rand Company.~~
~~f. K2 Commercial Hardware; a Black & Decker Corp. company.~~
~~g. Marks USA.~~
~~h. Medeco Security Locks, Inc.; an ASSA ABLOY Group company.~~
~~i. PDQ Manufacturing.~~
j. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
k. Schlage Commercial Lock Division; an Ingersoll-Rand company. ~~l. Weiser Lock Corp.; a Black & Decker Corp. company.~~
~~m. Yale Security Inc.; an ASSA ABLOY Group company.~~

C. Mortise Locks: BHMA A156.13; Grade 1; stamped steel case with steel or brass parts; Series 1000.

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:

~~a. Accurate Lock & Hardware Co.~~
~~b. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.~~
~~c. Arrow USA; an ASSA ABLOY Group company.~~
~~d. Best Access Systems; Div. of Stanley Security Solutions, Inc.~~
~~e. Cal-Royal Products, Inc.~~
~~f. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.~~
~~g. Falcon Lock; an Ingersoll-Rand company.~~
~~h. Marks USA.~~
~~i. PDQ Manufacturing.~~
j. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
k. Schlage Commercial Lock Division; an Ingersoll-Rand company.
~~l. Yale Security Inc.; an ASSA ABLOY Group company.~~

2.10 SELF-CONTAINED ELECTRONIC LOCKS (OFF-LINE)

A. Self-Contained Electronic Locks and Readers: Internal, battery-powered, self-contained ANSI Grade I mortise or cylindrical lock consisting of electronically motor driven locking mechanism, integrated proximity card reader with keypad and specified accessories. Provide key override, low- battery detection and warning, LED status indicators, and ability to program at the lock for the functions indicated.

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or (APPROVED as comparable BEFORE BID DUE DATE) product by one of the following:

    a. Best Access Systems; Div. of Stanley Security Solutions, Inc.
    b. Kaba Ilco Corp.; a Kaba Group company.
    c. Marks USA.
    d. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
    e. Schlage Commercial Lock Division; an Ingersoll-Rand company.
    f. Yale Security Inc.; an ASSA ABLOY Group company.

2. PROVIDE accessories:

    a. Pocket PC Locklink Programmer / Method to configure or reconfigure locks
    b. Network Card Encoder / device to program XU cards with access control data

2.13 MANUAL FLUSH BOLTS

A. Manual Flush Bolts: BHMA A156.16; minimum 3/4-inch (19-mm) throw; designed for mortising into door edge.

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:

a. Adams Rite Manufacturing Co.; an ASSA ABLOY Group company.
b. Burns Manufacturing Incorporated.
c. Don-Jo Mfg., Inc.
d. Door Controls International, Inc.
e. Hiawatha, Inc.
f. IVES Hardware; an Ingersoll-Rand company.
g. Trimco.

2.16 LOCK CYLINDERS

A. CYLINDERS AND KEYING

1. Provide patented and restricted, security cylinders utilizing a unique factory code pattern that is both geographically and time zoned protected. Manufacturers of cylinders to allow for the ability of the patented and restricted security keys to operate both security and conventional cylinders that are used together under the same facility master or grandmaster key system. End User is required to have the ability for on-site cylinder pinning and original key cutting. A letter of authorization by the End User is required to accompany purchases of any products which involve patented and restricted cylinders, keys and accessories.

2. Cylinders:
   a. KABA (NO Substitution)

3. Standards: BHMA certified products complying with the following:

   a. Cylinders: BHMA A156.5, Grade 1.

2.17 KEYING

A. Keying System: Factory registered, complying with guidelines in BHMA A156.28, Appendix A. Incorporate decisions made in keying conference. Provide for a keying system that matches the existing system.

2.21 SURFACE CLOSERS

A. Surface Closers: BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written recommendations for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:

   a. Arrow USA; an ASSA ABLOY Group company.

b. Corbin Russwin Architectural Hardware; an ASSA ABLOY Group company.
c. DORMA Architectural Hardware; Member of The DORMA Group North America.
d. Dor-O-Matic; an Ingersoll-Rand company.
e. K2 Commercial Hardware; a Black & Decker Corp. company.
f. LCN Closers; an Ingersoll-Rand company.
g. Norton Door Controls; an ASSA ABLOY Group company.
h. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
i. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
j. Yale Security Inc.; an ASSA ABLOY Group company.

2.24 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: BHMA A156.16; aluminum base metal.

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:

a. Architectural Builders Hardware Mfg., Inc.
b. Baldwin Hardware Corporation.
c. Burns Manufacturing Incorporated.
d. Cal-Royal Products, Inc.
e. Don-Jo Mfg., Inc.
f. Door Controls International, Inc .
g. Hager Companies.
h. Hiawatha, Inc.
i. IVES Hardware; an Ingersoll-Rand company.
j. Rockwood Manufacturing Company.
k. Stanley Commercial Hardware; Div. of The Stanley Works.
l. Trimco.

2.25 ELECTROMAGNETIC STOPS AND HOLDERS

A. Electromagnetic Door Holders: BHMA A156.15, Grade 1; wall-mounted electromagnetic single unit with strike plate attached to swinging door; coordinated with fire detectors and interface with fire alarm system for labeled fire-rated door assemblies.

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:

a. Architectural Builders Hardware Mfg., Inc.
b. DORMA Architectural Hardware; Member of The DORMA Group North America.
c. SARGENT Manufacturing Company; an ASSA ABLOY Group company.
d. LCN

2.27 DOOR GASKETING

B. Door Gasketing: BHMA A156.22; air leakage not to exceed 0.50 cfm per foot (0.000774 cu. m/s per m) of crack length for gasketing other than for smoke control, as tested according to ASTM E 283; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:

a. Hager Companies.
b. M-D Building Products, Inc.
c. National Guard Products.
d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
e. Reese Enterprises, Inc.
f. Sealeze; a unit of Jason Incorporated.
g. Zero International.

2.28 THRESHOLDS

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

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:

a. Hager Companies.
b. M-D Building Products, Inc.
c. National Guard Products.
d. Pemko Manufacturing Co.; an ASSA ABLOY Group company.
e. Reese Enterprises, Inc.
f. Rixson Specialty Door Controls; an ASSA ABLOY Group company.
g. Sealeze; a unit of Jason Incorporated.
h. Zero International.

2.31 METAL PROTECTIVE TRIM UNITS

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

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:

a. Baldwin Hardware Corporation.
b. Burns Manufacturing Incorporated.
c. Don-Jo Mfg., Inc.
d. Hiawatha, Inc.

e. IPC Door and Wall Protection Systems, Inc.; Div. of InPro Corporation.
f. IVES Hardware; an Ingersoll-Rand company.
g. Pawling Corporation.
h. Rockwood Manufacturing Company.
i. Trimco.

2.33 AUXILIARY DOOR HARDWARE

A. Auxiliary Hardware: BHMA A156.16.

1. Basis-of-Design Product: Subject to compliance with requirements, **provide product indicated in Part 3** or comparable product by one of the following:
   a. Baldwin Hardware Corporation.
   b. Cal-Royal Products, Inc.
   c. Don-Jo Mfg., Inc.
   d. Hager Companies.
   e. Rockwood Manufacturing Company.
   f. Stanley Commercial Hardware; Div. of The Stanley Works.
   g. Trimco.

2.35 FABRICATION

A. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended, except aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware, unless otherwise indicated.

1. Concealed Fasteners: For door hardware units that are exposed when door is closed, except for units already specified with concealed fasteners. Do not use through bolts for installation where bolt head or nut on opposite face is exposed unless it is the only means of securely attaching the door hardware. Where through bolts are used on hollow door and frame construction, provide sleeves for each through bolt.
2. Fire-Rated Applications:
   a. Wood or Machine Screws: For the following:
      1) Hinges mortised to doors or frames**;** use threaded-to-the-head wood screws for wood doors.
      2) Strike plates to frames.
      3) Closers to doors and frames.
3. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
4. Fasteners for Wood Doors: Comply with requirements in DHI WDHS.2, "Recommended Fasteners for Wood Doors."

2.36 FINISHES

A. Provide finishes complying with BHMA A156.18 as indicated in door hardware schedule.

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

PART 3 - EXECUTION

3.1 INSTALLATION

A. Steel Doors and Frames: For surface applied door hardware, drill and tap doors and frames according to ANSI/SDI A250.6.

B. Wood Doors: Comply with DHI WDHS.5 "Recommended Hardware Reinforcement Locations for Mineral Core Wood Flush Doors."

C. Mounting Heights: Mount door hardware units at heights THAT COORDINATE W/ EXISTING DOOR FRAME STRIKES unless otherwise indicated or required to comply with governing regulations.

1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
2. Custom Steel Doors and Frames: HMMA 831.
3. Wood Doors: DHI WDHS.3, "Recommended Locations for Architectural Hardware for Wood Flush Doors."

D. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.

1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.

2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors according to industry standards.

E. Hinges: Install types and in quantities indicated in door hardware schedule but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches (750 mm) of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.

G. Lock Cylinders:

1. Furnish permanent cores to Owner for installation.

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

K. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

O. Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

3.3 HARDWARE SCHEDULE (see door schedule on drawings for assignments)

MK – McKinney
PE – Pemko
RF - Rixson
RO - Rockwood
YA - Yale

Closers (always mount on room side unless existing conditions create physical conflict)

Closer (for regular arm mount)	351 O	EN	SA
Closer (for parallel arm mount)	351 P10	EN	SA
Closer (for parallel with stop arm mount)	351 PS	EN	SA
Track Closer (pull side mount)	351 OTB	EN	SA

Electromagnetic hold open

Install door armature with screws to the door (do not through bolt).

For concealed conduit at Rec Room only

Electromagnetic hold open	998	689	RF

For surface conduit (Typical UNO)

Electromagnetic hold open	996	689	RF

Hinges

ST ST, BB	TA2314	32D	MK
BB	TA2714	26D	MK
ST ST, BB, HD	T4A3386	32D	MK

BB, HD	T4A3786	26D	MK
FULL SURFACE CONTINUOUS	22 HD	CL/BZ	MK
CONTINUOUS	12HD	CL/BZ	MK

Locks, push/pull plates, exit devices

Mortise Card Key Lock with Pin Pad	KP-PG-82276-LNJ	26D	SA
Cylindrical Card Key Lock with Pin Pad	PG-82276-LNJ	26D	SA
Passage (bored latch)	28 10U15 LJ	26D	SA
Passage (mortise latch)	8215 LNJ	26D	SA
Privacy (bored lock)	28 10U65 LJ	26D	SA
Storeroom (bored lock)	28 10G04 LJ	26D	SA
Push/Pull	70E/126x70C	US32D	RO
SVR panic with lever trim (less bottom rod)	NB8713 ETJ	32D	SA

Replace Add Stop

Wall Stop	401	US26D	RO
Wall Stop (for inswing privacy latchsets)	404	US26D	RO
Door Stop	474	US26D	RO
Floor stop	445	US26D	RO

Kick plate

Kick plate	K1050 series 2” LDW BE CSK	US32D	RO

Threshold

Typical UNO	170AK FHSL14		PE
040B, 140B	254AK FHSL14		PE
At each elevator (Flrs 0-6)	252 AK FHSL14		PE

Sweep

Door sweep	345 ANB		PE

Offset Pulls

Offset Pulls	BF157A	US32D	RO

Gasket

For fire rated openings, existing, 20 minute and 45 minute **AND 90 MINUTE**

Smoke seal (frame mount)	S88D		PE

For pair of door fire rated openings, existing, 20 minute, 45 minute, **AND 90 MINUTE**

Astragal seal (door edge mount)	S772D		PE

Astragal & Manual Flush-Bolts

Astragal seal (door edge mount)	S772D		PE
Manual Flush Bolts (one set)	557 with 570 dust proof strike	US26D	RO

END OF SECTION 087100

SECTION 09 21 16
GYPSUM BOARD ASSEMBLIES

PART 1 – GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Interior gypsum wallboard and horizontal shaft-liner.
2. Cementitious (tile) backing units
3. Non-load-bearing steel framing.

1.2 SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide products of the following:

1. Steel Framing and Furring:
   a. Clark Steel Framing Systems.
   b. Dale Industries, Inc.; Dale/Incor.
   c. Dietrich Industries, Inc.
   d. MarinoWare; Division of Ware Ind.
   e. National Gypsum Company.
   f. Unimast, Inc.

2. Gypsum Board and Related Products:
   a. American Gypsum Co.
   b. CertainTeed Corporation.
   c. G-P Gypsum Corp.
   d. National Gypsum Company.
   e. United States Gypsum Co.

2.2 STEEL PARTITION FRAMING

A. Components: As follows:

1. Comply with ASTM C 754 for conditions indicated.
2. Steel Sheet Components: Complying with ASTM C 645 requirements for metal and with manufacturer's standard corrosion-resistant zinc coating.

2.3 INTERIOR GYPSUM WALLBOARD

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

B. Gypsum Wallboard: ASTM C 36.

1. Regular Type:
   a. Thickness: 5/8 inch thick, unless noted otherwise.
   b. Long Edges: Tapered and featured (rounded or beveled) for prefilling.
   c. Location: As indicated.

C. Proprietary, Special Fire-Resistive Type: ASTM C 36, having improved fire resistance over standard Type X.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. American Gypsum Co.; FireBloc Type C.
   b. G-P Gypsum Corp.; Firestop Type C.
   c. National Gypsum Company; Gold Bond Fire-Shield G.
   d. United States Gypsum Co.; SHEETROCK Brand Gypsum Panels, FIRECODE C Core or ULTRACODE Core.

2. Thickness: As indicated.

3. Long Edges: Tapered and featured (rounded or beveled) for prefilling.

4. Location: Where required for specific fire-resistance-rated assembly indicated.

D. Cementitious Backer Units: ANSI A118.9 and ASTM C 1288 or 1325, with manufacturer's standard edges.

1. Products: Subject to compliance with requirements, provide one of the following:
   a. C-Cure; C-Cure Board 990.
   b. CertainTeed Corp.; FiberCement BackerBoard.
   c. Custom Building Products Wonderboard.
   d. FinPan, Inc. Util-A-Crete Concrete Backer Board.
   e. National Gypsum Company, Permabase Cement Board.
   f. USG Corporation; DUROCK Cement Board.

2. Thickness: 1/2 inch.
3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274.

E. Flexible Gypsum Wallboard: ASTM C 36, manufactured to bend to fit tight radii and to be more flexible than standard regular-type panels of the same thickness.

1. Thickness: 1/4 inch (6.4 mm).

2. Long Edges: Tapered.

F. Gypsum Liner Panels: Manufacturer's proprietary liner panels 1 inch thickness and with moisture-resistant paper faces.

G. Sag-Resistant Gypsum Wallboard: ASTM C 36, manufactured to have more sag resistance than regular-type gypsum board.
1. Thickness: 1/2 inch (12.7 mm).
2. Long Edges: Tapered.
3. Location: Ceiling surfaces.
4. Moisture resistant for Dorm Room Bathroom Ceiling surfaces, and supports spaced no more than 12" on center.

2.7 TRIM ACCESSORIES

A. Interior Trim: ASTM C 1047.
1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized steel sheet.
2. Shapes:
a. Cornerbead: Use at outside corners.
b. J-Bead: Use where indicated.

2.8 JOINT TREATMENT MATERIALS

A. Comply with ASTM C 475.

B. Joint Tape:
1. Interior Gypsum Wallboard: Paper.
2. Tile Backing Panels: 2" alkali-resistant glass fiber mesh tape as recommended by panel manufacturer.

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

2.10 AUXILIARY MATERIALS

A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

B. Laminating Adhesive: Adhesive or joint compound recommended for directly adhering gypsum panels to continuous substrate.

C. Steel Drill Screws: ASTM C 1002, unless otherwise indicated.
1. Use zinc coated screws complying with ASTM F2329-13 for fastening panels to steel members from 0.033 to 0.112 inch (0.84 to 2.84 mm) thick.

PART 3 – EXECUTION

3.1 INSTALLING STEEL FRAMING, GENERAL

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

B. Install supplementary framing, blocking, and bracing at terminations in gypsum board assemblies to support equipment. Comply with details indicated and with gypsum board manufacturer's written recommendations or, if none available, with United States Gypsum's "Gypsum Construction Handbook."

3.5 APPLYING AND FINISHING PANELS, GENERAL

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

B. Cementitious Backer Units:
1. Cementitious Backer Units: ANSI A108.11. Provide metal stud back-up at all horizontal and vertical joints in cementitious backer board units.

3.6 INSTALLING TRIM ACCESSORIES

A. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

B. Control Joints: Install control joints according to ASTM C 840 and in specific locations approved by Architect for visual effect.

3.7 FINISHING GYPSUM BOARD ASSEMBLIES

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

B. Prefill open joints, rounded or beveled edges, and damaged surface areas.

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

D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire resistance- rated assemblies and sound-rated assemblies.
2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile.

3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view, unless otherwise indicated.
4. Level 5: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges, and apply skim coat of joint compound over entire surface. Provide Level 5 finish at the following areas:
a. Wall surfaces that are lit with raking light or washed with lights.
b. Walls that are perpendicular to an exterior wall that have a window coming right up to the intersection of the interior and exterior walls.

END OF SECTION 09 21 16

SECTION 093000 TILING

PART 1– GENERAL

1.1 SUMMARY

A. This section includes the following:
1. Ceramic mosaic floor tile.
2. Glazed wall tile.
3. Porcelain floor tile with matching cove base.
4.
5. Stone thresholds installed as part of tile installations.
6. Waterproof membrane for thin-set tile installations.

B. Related Work
1. Division 7 Section Joint Sealants: Sealing of expansion, contraction, control, and isolation joints in tile surfaces.
2. Division 9 Section Gypsum Board Assemblies: Cementitious and gypsum backer units specified for tile substrates.
3. Division 10 Section Toilet, Bath and Laundry Accessories: Accessories mounted on ceramic wall tile.
4. Division 22 Section Plumbing: Plumbing Fixtures.

1.2 REFERENCES

A. Provide tiling in accordance with the following references:
1. ANSI A108.10: Installation of Grout in Tilework.
2. ANSI A118.4: Specifications for Latex Portland Cement Mortar.
3. ANSI A118.6: Specifications for Ceramic Tile Grouts.
4. ANSI A137.1: Specifications for Ceramic Tile.

1.3 DEFINITIONS

A. Module Size: Actual tile size (minor facial dimension as measured per ASTM C499) plus joint width indicated.

B. Facial Dimension: Nominal tile size as defined in ANSI A137.1.

1.4 SYSTEM DESCRIPTION

A. Ceramic wall tile, installed over gypsum backer board using organic adhesive and over concrete block or cementitious backer units using Latex-Portland cement mortar, with Latex-Portland cement grouted joints.

B. Ceramic mosaic floor tile, installed over concrete floor slabs using Latex-Portland cement mortar, with Latex-Portland cement grouted joints.

1.5 PERFORMANCE REQUIREMENTS

A. Static Coefficient of Friction: For tile installed on walkway surfaces, provide products with the following values as determined by testing identical products per ASTM Cl028:

1. Level Surfaces: Minimum 0.6.
2. Step Treads: Minimum 0.6.
3. Ramp Surfaces: Minimum 0.8.

B. Load-Bearing Performance: For ceramic tile installed on walkway surfaces, provide installations rated for the following load-bearing performance level based on testing assemblies according to ASTM C627 that are representative of those indicated for this Project:

1. Extra Heavy: Passes cycles 1 through 14.
2. Heavy: Passes cycles 1 through 12.
3. Moderate: Passes cycles 1through 10.
4. Light: Passes cycles 1 through 6.
5. Residential: Passes cycles 1 through 3.

1.6 SUBMITTALS

A. Submit product data for each type of tile, mortar, grout, and other products specified.

B. Shop Drawings: Submit shop drawings for the following:

1. Tile patterns and locations.
2. Widths, details, and locations of expansion, contraction, control, and isolation joints in tile substrates and finished tile surfaces.

C. Tile Samples for Initial Selection: Submit manufacturer's color charts consisting of actual tiles or sections of tiles showing the full range of colors, textures, and patterns available for each type and composition of tile indicated. Include samples of accessories involving color selection.

D. Grout Samples for Initial Selection: Submit manufacturer's color charts consisting of actual sections of grout showing the full range of colors available for each type of grout indicated.

E. Samples for Verification: Submit each item listed below, prepared on samples of size and construction indicated. Where products involve normal color and texture variations, include sample sets showing the full range of variations expected.

1. Each type and composition of tile and for each color and texture required, in color or colors selected by Architect.
2. Full-size units of each type of trim and accessory for each color required.
3. Stone thresholds in 6 inch (150 mm) lengths.
4. Metal edge strips in 6 inch (150 mm) lengths.

F. Product Certificates: Signed by manufacturers certifying that the products furnished comply with requirements.

G. Qualification Data: For firms and persons specified in the "Quality Assurance" Article to demonstrate their capabilities and experience. Include lists of completed projects with project names and addresses, names of architects and owners, and other information specified.

H. Setting Material Test Reports: Indicate and interpret test results for compliance of tile-setting and grouting products with specified requirements.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer who has completed tile installations similar in material, design, and extent to that indicated for this Project and with a record of successful in-service performance.

B. Source Limitations for Tile: Obtain each color, grade, finish, type, composition, and variety of tile from one source with resources to provide products from the same production run for each contiguous area of consistent quality in appearance and physical properties without delaying the Work.

C. Source Limitations for Setting and Grouting Materials: Obtain ingredients of a uniform quality for each mortar, adhesive, and grout component from a single manufacturer and each aggregate from one source or producer.

D. Source Limitations for Other Products: Obtain each of the following products specified in this Section from one source and by a single manufacturer for each product:

1. Stone thresholds.

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

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver and store packaged materials in original containers with seals unbroken and labels intact until time of use. Comply with requirement of ANSI Al37.1 for labeling sealed tile packages.

B. Prevent damage or contamination to materials by water, freezing, foreign matter, and other causes.

C. Handle tile with temporary protective coating on exposed surfaces to prevent coated surfaces from contacting backs or edges of other units. If coating does contact bonding surfaces of tile, remove coating from bonding surfaces before setting tile.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not install tile until construction in spaces is completed and ambient temperature and humidity conditions are being maintained to comply with referenced standards and manufacturer's written instructions.

1.10 EXTRA MATERIALS

A. Deliver extra materials to Owner. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Tile and Trim Units: Furnish quantity of full-size units equal to 3 percent of amount installed, for each type, composition, color, pattern, and size indicated.

PART 2- PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide EQUAL (if approved during bidding) to basis of design products by one of the following:

1. Tile:
   a. American Olean; Div. of Dal-Tile International Corp.
   b. Daltile; Div. of Dal-Tile International Inc.
   c. United States Ceramic Tile Company.
2. Tile-Setting and Grouting Materials:
   a. LATTCRETE International Inc.
   b. MAPEl Corporation.
   c. TEC Specialty Products Inc.

2.2 PRODUCTS, GENERAL

A. ANSI Ceramic Tile Standard: Provide tile that complies with ANSI A137.1, "Specifications for Ceramic Tile," for types, compositions, and other characteristics indicated.

1. Provide tile complying with Standard Grade requirements, unless otherwise indicated.
2. For facial dimensions of tile, comply with requirements relating to tile sizes specified in Part 1 "Definitions" Article.

B. ANSI Standards for Tile Installation Materials: Provide materials complying with ANSI standards referenced in "Setting Materials" and "Grouting Materials" articles.

C. Colors, Textures, and Patterns: Where manufacturer's standard products are indicated for tile, grout, and other products requiring selection of colors, surface textures, patterns, and other appearance characteristics, provide specific products or materials complying with the following requirements:

1. Provide Architect's selections from manufacturer's full range of colors, textures, and patterns for products of type indicated.
2. Provide tile trim and accessories that match color and finish of adjoining flat tile.

D. Factory Blending: For tile exhibiting color variations within the ranges selected during sample submittals, blend tile in the factory and package so tile units taken from one package show the same range in colors as those taken from other packages and match approved samples.

E. Mounting: Where factory-mounted tile is required, provide back- or edge- mounted tile assemblies as standard with manufacturer, unless another mounting method is indicated.

1. Where tile is indicated for installation in wet areas, do not use back- or edge-mounted tile assemblies unless tile manufacturer specifies in writing that this type of mounting is suitable for these kinds of installations and has a record of successful in-service performance.

F. Factory-Applied Temporary Protective Coating: Where indicated under tile type, protect exposed surfaces of tile against adherence of mortar and grout by pre-coating them with a continuous film of petroleum paraffin wax, applied hot. Do not coat unexposed tile surfaces.

2.3 FLOOR TILE

A. CTM-1: Unglazed Ceramic Mosaic Tile: Provide factory-mounted flat tile complying with the following requirements:

1. Composition: Porcelain.
2. Module Size: 2 by 2 inches.
3. Nominal Thickness: 1/4 inch. Field verify. Match existing.
4. Colors: Match existing existing shower floor in 018A.

B. PT-1: Porcelain Tile:

1. Product: Daltile, "Continental Slate"
   a. Colors and Sizes: 18x18 /**Egyptian Beige CS50**
2. Composition: Impervious natural clay.
3. Nominal Thickness: 5/16 inch.
4. Pattern: As indicated on Drawings.
5. Finish: Matte

C. PTB-1: 6X12 Porcelain Tile Cove Base and Outside Cove Corners: Match properties of PT-1.

2.4 WALL TILE

~~A. CWT-1: Glazed Wall Tile:~~ **NOT USED.**

B. CWT-2: Glazed Wall Tile: Provide flat tile complying with the following requirements:

1. Module Size: 4-1/4 by 4-1/4 inches.
2. Thickness: 5/16 inch. Field verify thickness. Match existing.
3. Face: Plain with cushion edges.
4. Colors: Match existing “white” of shower walls in room 018A. Cove trim at base.

C. PTM-1 : Unglazed Ceramic PORCELAIN Mosaic Tile: Provide factory-mounted flat tile complying with the following requirements:

1. Product: Daltile, "City View” Random Linear brick joint.
   Color: District Gold CY03
2. Module Size: varies. 9X18 sheets.
3. Nominal Thickness: 3/8 inch.

2.5 TILE TRIM AND ACCESSORIES

A. Trim Units: Provide tile trim units to match characteristics of adjoining flat tile and to comply with the following requirements:

1. Size: As indicated, coordinated with sizes and coursing of adjoining flat tile where applicable.
2. Shapes: As follows, selected from manufacturer's standard shapes:
   a. Base for Thin-Set Mortar Installations: Straight.
   b. Wainscot Cap for Thin-Set Mortar Installations: Surface bullnose.
   c. Wainscot Cap for Flush Conditions: Regular flat tile for conditions where tile wainscot is shown flush with wall surface above.
   d. External Corners for Thin-Set Mortar Installations: Surface bullnose.
   e. Internal Corners: Field-butted square corners, except with coved base and cap angle pieces designed to member with stretcher shapes.
   f. Tapered Transition Tile: Shape designed to effect transition between thickness of tile floor and adjoining floor finishes of different thickness, tapered to provide a reduction in thickness from 1/2 to 1/4 inch (12.7 to 6.35 mm) across nominal 4 inch (100-mm) dimension.

2.6 STONE THRESHOLDS

A. Provide stone thresholds that are uniform in color and finish, fabricated to sizes and profiles indicated to provide transition between tile surfaces and adjoining finished floor surfaces.

1. Fabricate thresholds to heights not more than 1/2 inch (12.7 mm) above adjoining finished floor surfaces, with transition edges beveled on a slope of no greater than 1:2.
2. Fabricate threshold width to be equal to width of door frame.

B. Marble Thresholds: Provide marble thresholds complying with ASTM C503 requirements for exterior use and with a minimum abrasive-hardness value of l 0 per ASTM C241.
1. Provide white, honed marble complying with the Marble Institute of America's Group A requirements for soundness.

2.7 WATERPROOFING FOR THIN-SET TILE INSTALLATIONS

A. Provide products that comply with ANSI A118.10 and the descriptions in this Article.

B. Latex-Rubber Waterproofing: Manufacturer's factory-packaged, job-mixed, proprietary, 2-part formulation consisting of liquid-latex rubber and powder for trowel application and glass-fiber-fabric reinforcing.

C. Products: Subject to compliance with requirements, provide one of the following:
1. Latex-Rubber Waterproofing:
a. Laticrete 9235 Waterproof Membrane; Laticrete International, Inc.

2.8 SETTING MATERIALS

A. Portland Cement Mortar Installation Materials: Provide materials complying with ANSI Al08.1A and as specified below:
1. Cleavage Membrane: Asphalt felt, ASTM D226, Type I (No. 15), or polyethylene sheeting ASTM D4397, 4.0 mils (0.1 mm) thick.
2. Latex additive (water emulsion) described below, serving as replacement for part or all of gaging water, of type specifically recommended by latex additive manufacturer for use with job-mixed portland cement and aggregate mortar bed.
a. Latex Additive: Styrene butadiene rubber.

B. Latex-Portland Cement Mortar: ANSI All8.4. Provide one of the following:
1. Laticrete 4237 with 211 Crete Filler Powder; Laticrete International.
2. Keralastic/Kerabond; Mapei Corporation.
3. Super Flex Latex Mortar; TEC Incorporated.

C. Organic Adhesive: ANSI Al36.1, Type I. Provide one of the following:
1. Laticrete 15 Mastic; Laticrete International.
2. Ultra/Mastic 1; Mapei Corporation.
3. Double Duty Adhesive; TEC Incorporated.

2.9 GROUTING MATERIALS

A. Latex-Portland Cement Grout: ANSI All8.6 for materials described in Section H-2.4, composed as follows:

1. Mixture of Dry-Grout Mix and Latex Additive: Mixture of factory- prepared, dry-grout mix and latex additive complying with the following requirements:
   a. Unsanded Dry-Grout Mix: Dry-set grout complying with ANSI All8.6 for materials described in Section H-2.3, for joints 1/8 inch (3.2 mm) and narrower.
   b. Sanded Dry-Grout Mix: Commercial portland cement grout complying with ANSI All8.6 for materials described in Section H-2.1, for joints 1/8 inch (3.2 mm) and wider.
   c. Latex Additive: Styrene butadiene rubber.
2. Provide one of the following or equal:
   a. P1astijoints with Keraco1or; by Mapei Corporation.
   b. Hydroment Ceramic Tile Grout with Hydroment 425 Flexible Grout Admixture; by Bostik Construction Products Division.
   c. Laticrete Sanded (1500 Series) or Unsanded (1600 Series) Grout and Joint Filler with Laticrete 1776 Grout Admix Plus; by Laticrete International.

B. URETHANE GROUT ALTERNATE: Provide Alternate price to use: Bostik TruColor pre-mixed urethane grout (or identified Equal) in lieu of Latex-Portland Cement Grout in Lobbies. **Approved equal: QuartzLock 2 Urethane Grout by Bostik. Color = 240 Linen**

2.10 MISCELLANEOUS MATERIALS

A. Trowelable Underlayments and Patching Compounds: Latex-modified, portland- cement-based formulation provided or approved by manufacturer of tile-setting materials for installations indicated.

B. Metal Edge Strips: White-zinc-alloy terrazzo strips, 1/8 inch (3.2 mm) wide at top edge with integral provision for anchorage to mortar bed or substrate, unless otherwise indicated.

C. Temporary Protective Coating: Provide product indicated below that is formulated to protect exposed surfaces of tile against adherence of mortar and grout; is compatible with tile, mortar, and grout products; and is easily removable after grouting is completed without damaging grout or tile.

1. Petroleum paraffin wax, fully refined and odorless, containing at least 0.5 percent oil with a melting point of 120 to 140 deg F (49 to 60 deg C) per ASTMD87.

2. Grout release in form of manufacturer's standard proprietary liquid coating that is specially formulated and recommended for use as a temporary protective coating for tile.

D. Tile Cleaner: A neutral cleaner capable of removing soil and residue without harming tile and grout surfaces, specifically approved for materials and installations indicated by tile and grout manufacturers.

E. Self Leveling Underlayment: Bostik's Universal Primer SL-150 Self Leveler or equal.

2.11 MIXING MORTARS AND GROUT

A. Mix mortars and grouts to comply with referenced standards and mortar and grout manufacturers' written instructions.

B. Add materials, water, and additives in accurate proportions.

C. Obtain and use type of mixing equipment, mixer speeds, mixing containers, mixing time, and other procedures to produce mortars and grouts of uniform quality with optimum performance characteristics for installations indicated.

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where tile will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

1. Verify that substrates for setting tile are firm; dry; clean; free from oil, waxy films, and curing compounds; and within flatness tolerances required by referenced ANSI A108 series of tile installation standards for installations indicated.
2. Verify that installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind tile has been completed before installing tile.
3. Verify that joints and cracks in tile substrates are coordinated with tile joint locations; if not coordinated, adjust latter in consultation with Architect.

B. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Remove coatings, including curing compounds, and other substances that contain soap, wax, oil, or silicone and are incompatible with tile-setting materials by using a terrazzo or concrete grinder, a drum sander, or a polishing machine equipped with a heavy-duty wire brush.

B. Provide concrete substrates for tile floors installed with dry-set or latex-portland cement mortars that comply with flatness tolerances specified in referenced ANSI A108 series of tile installation standards for installations indicated.

1. Use trowelable leveling and patching compounds per tile-setting material manufacturer's written instructions to fill cracks, holes, and depressions.
2. Remove protrusions, bumps, and ridges by sanding or grinding.

C. Blending: For tile exhibiting color variations within the ranges selected during sample submittals, verify that tile has been blended in the factory and packaged so tile units taken from one package show the same range in colors as those taken from other packages and match approved samples. If not factory blended, either return to manufacturer or blend tiles at Project site before installing.

D. Field-Applied Temporary Protective Coating: Where indicated under tile type or needed to prevent adhesion or staining of exposed tile surfaces by grout, protect exposed surfaces of tile against adherence of mortar and grout by precoating them with a continuous film of temporary protective coating indicated below, taking care not to coat unexposed tile surfaces:

1. Petroleum paraffin wax, applied hot.
2. Grout release.
3. Petroleum paraffin wax or grout release.

E. Waterproofing for Ceramic Tile Applications:

1. Prepare concrete and install waterproofing in compliance with waterproofing manufacturer's instructions to produce a waterproof membrane of uniform thickness bonded securely to substrate.

3.3 I NSTALLATION

A. Thinset Methods:

1. Install ceramic floor tile over the following floor substrates in accordance with ANSI A108.5 using Latex Portland cement mortar.
   a. Concrete: TCA Method F113.

2. Install ceramic wall tile over the following wall substrates in accordance with ANSI AI08.5 using Latex Portland cement mortar.
   a. Concrete Block: TCA Method W202.
   b. Cementitious Backer Board: TCA Method W244.
      1) Treat joints of cementitious backer board units to comply with manufacturer's instructions.

4. Install ceramic wall tile over gypsum board in accordance with ANSI Al08.4 (TCA Method W223) using water-resistant organic adhesives.

5. Install porcelain mosaic tile over gypsum board in accordance with ANSI A118.4 (TCA Method W243) using cementitious bond coat and latex Portland cement mortar.

6. Mix and proportion bond coat and grout materials in accordance with manufacturer's recommendations.

B. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile.

C. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood or other flooring which finishes flush with top of tile.

D. Center and balance areas of tile, if possible.

1. An excessive amount of cuts shall not be made. Usually, no cuts smaller than half size should be made. Make all cuts on the outer edges of the field.
2. Smooth cut edges. Install tile without jagged or flaked edges.
3. Fit tile closely where edges will be covered by trim, escutcheons or other similar devices.
4. The splitting of tile is expressly prohibited except where no alternative is possible.

E. Maintain the heights of tile work in full courses to the nearest obtainable dimension where the heights are given in feet and inches and are not required to fill vertical spaces exactly.

F. Make comers of all tile flush and level with comers of adjacent tile, with due allowance to tolerances for tile. Form internal wall corners square and external comers bullnosed. Keep all joint lines straight and of even width, including miters.

G. Thoroughly back-up with thin-set bonding material all thin-set trim units, molded or shaped pieces and secure firmly in place.

H. Finish floor and wall areas level and plumb with no variations exceeding 1/8 inch in 8 feet from the required plane.

1. Sound tile after setting. Remove and replace hollow sounding units.

I. Allow tile to set for a minimum of 48 hours prior to grouting.

1. Grout ceramic tiles and ceramic mosaic tiles with Latex-Portland grout in accordance with grout manufacturer's instructions and ANSI Al08.10.

J. Refer to Division 07 Section "Joint Sealants" for mildew resistant sealant applied between ceramic tile and plumbing fixtures.

3.4 INSTALLATION, GENERAL

A. ANSI Tile Installation Standards: Comply with parts of ANSI A108 series of tile installation standards in "Specifications for Installation of Ceramic Tile" that apply

to types of setting and grouting materials and to methods indicated in ceramic tile installation schedules.

B. TCA Installation Guidelines: TCA's "Handbook for Ceramic Tile Installation." Comply with TCA installation methods indicated in ceramic tile installation schedules.

C. Extend tile work into recesses and under or behind equipment and fixtures to form a complete covering without interruptions, unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.

D. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.

E. Jointing Pattern: Lay tile in grid pattern, unless otherwise indicated. Align joints when adjoining tiles on floor, base, walls, and trim are the same size. Lay out tile work and center tile fields in both directions in each space or on each wall area. Adjust to minimize tile cutting. Provide uniform joint widths, unless otherwise indicated.

1. For tile mounted in sheets, make joints between tile sheets the same width as joints within tile sheets so joints between sheets are not apparent in finished work.

F. Expansion Joints: Locate expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.

1. Locate joints in tile surfaces directly above joints in concrete substrates.
2. Prepare joints and apply sealants to comply with requirements of Division 7 Section "Joint Sealants"

G. Grout tile to comply with the requirements of the following tile installation standards:

1. For ceramic tile grouts (sand-portland cement, dry-set, commercial portland cement, and latex-portland cement grouts), comply with ANSI Al08.10.

3.5 WATERPROOFING INSTALLATION

A. Install waterproofing to comply with waterproofing manufacturer's written instructions to produce a waterproof membrane of uniform thickness bonded securely to substrate.

B. Do not install tile over waterproofing until waterproofing has cured and been tested to determine that it is watertight.

3.6 FLOOR TILE INSTALLATION

A. Install tile to comply with requirements in the Ceramic Tile Floor Installation Schedule, including those referencing TCA installation methods and ANSI A108 series of tile installation standards.

B. Joint Widths: Install tile on floors with the following joint widths:
1. Ceramic Mosaic Tile: 1/16 inch.
2. Porcelain ~~Paver~~ Tile: 3/16 inch.

C. Back Buttering: For installations indicated, obtain 100 percent mortar coverage by complying with applicable special requirements for back buttering of tile in referenced ANSI A108 series of tile installation standards:
1. Tile floors composed of rib-backed tiles.

D. Stone Thresholds: Install stone thresholds at locations indicated; set in same type of setting bed as abutting field tile, unless otherwise indicated.
1. Set thresholds in latex-portland cement mortar for locations where mortar bed would otherwise be exposed above adjacent nontile floor finish.

E. Metal Edge Strips: Install at locations indicated or where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile.

3.7 WALL TILE INSTALLATION

A. Install types of tile designated for wall installations to comply with requirements in the Ceramic Tile Wall Installation Schedule, including those referencing TCA installation methods and ANSI setting-bed standards.

B. Joint Widths: Install tile on walls with the following joint widths:
1. **Porcelain** Mosaic Tile: 3/16 inch.
2. Wall Tile: 1/16 inch.

3.8 CLEANING AND PROTECTING

A. Cleaning: On completion of placement and grouting, clean all ceramic tile surfaces so they are free of foreign matter.
1. Remove latex-portland cement grout residue from tile as soon as possible.
2. Unglazed tile may be cleaned with acid solutions only when permitted by tile and grout manufacturer's written instructions, but no sooner than 10 days after installation. Protect metal surfaces, cast iron, and vitreous plumbing fixtures from effects of acid cleaning. Flush surface with clean water before and after cleaning.
3. Remove temporary protective coating by method recommended by coating manufacturer that is acceptable to brick and grout manufacturer. Trap and remove coating to prevent it from clogging drains.

B. Finished Tile Work: Leave finished installation clean and free of cracked, chipped, broken, unbonded, and otherwise defective tile work.

C. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and Installer, that ensure tile is without damage or deterioration at the time of Substantial Completion.

1. When recommended by tile manufacturer, apply a protective coat of neutral protective cleaner to completed tile walls and floors. Protect installed tile work with kraft paper or other heavy covering during construction period to prevent staining, damage, and wear.
2. Prohibit foot and wheel traffic from tiled floors for at least 7 days after grouting is completed.

D. Before final inspection, remove protective coverings and rinse neutral cleaner from tile surfaces.

END OF SECTION 09 30 00

SECTION 09 51 00
ACOUSTICAL CEILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following:

1. Acoustical lay-in panel ceilings with exposed suspension systems.

1.2 SUBMITTALS

A. Submit product data for each type of product specified.

1.3 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

1. Acoustical Ceiling Units: Furnish quantity of full size units equal to 2 percent of amount installed.
2. Exposed Suspension System Components: Furnish quantity of each exposed component equal to 2 percent of amount installed.

PART 2 - PRODUCTS

2.1 ACOUSTICAL PANELS

A. ACT: Mineral Fiber Acoustical Panel

1. Basis of Design Product: Armstrong World Industries Cortega angled tegular edge – 704
2. Classification: ASTM E 1264 Type III; Form 2; Pattern C,D
3. Size: 24 by 24 inches by 15/16 inch.
4. Edge Detail: Square
5. Composition: wet formed mineral fiber with low formaldehyde content.
6. Surface coating: Factory applied latex paint
    a. Color: White
    b. Light Reflectance: 0.82 minimum
7. Acoustical Performance:
    a. CAC: 33
8. Recycled content: 41%

2.2 METAL SUSPENSION SYSTEMS

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

a. Armstrong World Industries, Inc.

B. Basis of Design Product: Armstrong Prelude XL 15/16”

C. Standard for Metal Suspension Systems: Provide metal suspension systems of type, structural classification and finish indicated which comply with applicable ASTM C635 requirements.

D. Finish: Baked polyester paint.

E. Color: White

F. Attachment Devices: Size for 5 times design load indicated in ASTM C635, Table 1, Direct Hung.

1. Concrete Inserts: Inserts formed from hot-dipped galvanized sheet steel and designed for attachment to concrete forms and for embedment in concrete, with holes or loops for attachment at hanger wires.

G. Hanger Wire: Galvanized carbon steel wire, ASTM A641, soft temper, prestretched, Class 1 coating, sized so that stress at 3 times hanger design load (ASTM C635, Table 1, Direct Hung), will be less than yield stress of wire, but provide not less than 12 gage.

1. Provide stainless steel hanger wire when aluminum suspension systems are indicated.

H. Edge Moldings and Trim: Metal or extruded plastic of types and profiles indicated or, if not indicated, provide manufacturer's standard molding for edges and penetrations of ceiling which fits with type of edge detail and suspension system indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install acoustical tile ceilings to comply with ASTM C 636/C 636M and seismic design requirements indicated, according to manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."

END OF SECTION 09 51 00

SECTION 09 65 19 - RESILIENT TILE FLOORING

PART 1- GENERAL

1.1 SUMMARY

A. This section includes the following:
1. Vinyl composition floor tile.
2. Resilient wall base and accessories.

1.2 SUBMITTALS

A. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors and patterns available for each type of product indicated.

B. Samples for Verification: Submit full-size tiles of each different color and pattern of resilient floor tile specified, showing the full range of variations expected in these characteristics.
1. For resilient accessories, manufacturer's standard-size samples, but not less than 12 inches (300 mm) long, of each resilient accessory color and pattern specified.

C. Product Certificates: Submit product certificates signed by manufacturers of resilient products certifying that each product furnished complies with requirements.
1. Submit certification by tile manufacturer that products supplied for tile installation comply with local regulations controlling use of volatile organic compounds (VOC's).

2. Certification that flooring material falls within ATBCB guidelines for slip- resistance. Static coefficient of friction be equal or greater than the following:
a. Level surfaces: 0.6 b.
Ramps: 0.8

E. Maintenance Data: Submit maintenance data for resilient floor tile..

1.3 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced installer to perform work of this section who has specialized in installing resilient products similar to those required for this Project and with a record of successful in-service performance.

B. Source Limitations: Obtain each type, color, and pattern of product specified from one source with resources to provide products of consistent quality in appearance and physical properties without delaying the Work.

C. Fire-Test-Response Characteristics: Provide products with the following fire-test- response characteristics as determined by testing identical products per test method indicated below by a testing and inspecting agency acceptable to authorities having jurisdiction.

1. Critical Radiant Flux: 0.45 W/sq. cm or greater when tested per ASTM E648.
2. Smoke Density: Maximum specific optical density of 450 or less when tested per ASTM E662.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to Project site in manufacturer's original, unopened cartons and containers, each bearing names of product and manufacturer, Project identification, and shipping and handling instructions.

B. Store products in dry spaces protected from the weather, with ambient temperatures maintained between 50 and 90 degrees F (10 and 32 degrees C).

C. Store tiles on flat surfaces.

D. Move products into spaces where they will be installed at least 48 hours before installation, unless longer conditioning period is recommended in writing by manufacturer.

1.5 PROJECT CONDITIONS

A. Maintain a temperature of not less than 70 degrees F (21 degrees C) or more than 95 degrees F (35 degrees C) in spaces to receive products for at least 48 hours before installation, during installation, and for at least 48 hours after installation, unless manufacturer's written recommendations specify longer time periods. After post-installation period, maintain a temperature of not less than 55 degrees F (13 degrees C) or more than 95 degrees F (35 degrees C).

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

C. Close spaces to traffic during flooring installation and for time period after installation recommended in writing by manufacturer.

D. Install tiles and accessories after other finishing operations, including painting, have been completed.

E. Where items are indicated for installation on top of resilient tile flooring, install tile before these items are installed.

F. Do not install flooring over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive, as determined by and moisture test.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels describing contents.

1. Furnish not less than one box for each 50 boxes or fraction thereof, of each type, color, pattern, class, wearing surface, and size of resilient tile flooring installed.
2. Furnish not less than 10 linear feet (3 linear m) for each 500 linear feet (150 linear m) or fraction thereof, of each type, color, pattern, and size of resilient accessory installed.
3. Deliver extra materials to Owner.

PART 2- PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer:

1. Vinyl composition tile:
   a. Armstrong World Industries, Inc.

2. Rubber base and flooring accessories:
   a. Roppe
   b. Armstrong Floor Division, Armstrong World Industries.
   c. BurkeMercer Flooring Products.
   d. Johnsonite.

B. VCT 1: Vinyl Composition Floor Tile: Products complying with ASTM F1066, Composition l (nonasbestos formulated),

1. Size: 12 inch by 12 inch
2. Thickness: l/8 inch
3. Basis of Design Product: Provide the following or equivalent:
   a. VCT 1: Armstrong Standard Excelon Imperial Texture. Match existing VCT in dorm rooms.

2.3 INSTALLATION ACCESSORIES

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

B. Adhesives: Type recommended by manufacturer to suit resilient products and substrate conditions indicated. See section 013546 - ENVIRONMENTAL REQUIREMENTS FOR INDOOR AIR QUALITY CONTROL for requirements.

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions where installation of resilient products will occur, with Installer present, for compliance with manufacturer's requirements. Verify that substrates and conditions are satisfactory for resilient product installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F71 0 and the following:

1. Test concrete in accordance with ASTM Standard F-2170-02. Perform three (3) tests for each area under 2000 sq. ft., with one additional test for every additional 1000 sq. ft. Test locations shall be selected less than 5 feet from building perimeter, near window and door openings wherever possible. Pass threshold: less than 85% ERH (Equilibrium Relative Humidity).
2. Subfloor finishes comply with requirements specified in Division 3 Section "Cast-in-Place Concrete" for slabs receiving resilient flooring.
3. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

C. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Comply with resilient product manufacturer's written installation instructions for preparing substrates indicated to receive resilient products.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

C. Use stair-tread-nose filler, according to resilient tread manufacturer's written instructions, to fill nosing substrates that do not conform to tread contours.

D. Remove coatings, including curing compounds, and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by manufacturer. Do not use solvents.

E. Broom and vacuum clean substrates to be covered immediately before product installation. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.3 TILE INSTALLATION

A. Comply with tile manufacturer's written installation instructions.

B. Lay out tiles from center marks established with principal walls, discounting minor offsets, so tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half of a tile at perimeter.

1. Lay tiles square with room axis, unless otherwise indicated.

C. Match tiles for color and pattern by selecting tiles from cartons in the same sequence as manufactured and packaged, if so numbered. Cut tiles neatly around all fixtures. Discard broken, cracked, chipped, or deformed tiles.

1. Lay tiles with grain running in one direction.
2. Lay tiles in basket-weave pattern with grain direction alternating in adjacent tiles.
3. Lay tiles in pattern of colors and sizes indicated on Drawings.

D. Scribe, cut, and fit tiles to butt neatly and tightly to vertical surfaces and permanent fixtures, including built-in furniture, cabinets, pipes, outlets, edgings, door frames, thresholds, and nosings.

E. Extend tiles into toe spaces, door reveals, closets, and similar openings.

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use chalk or other nonpermanent, nonstaining marking device.

G. Install tiles on covers for telephone and electrical ducts, and similar items in finished floor areas. Maintain overall continuity of color and pattern with pieces of flooring insta11ed on covers. Tightly adhere edges to perimeter of floor around covers and to covers.

H. Adhere tiles to flooring substrates using a fu11 spread of adhesive applied to substrate to comply with tile manufacturer's written instructions, including those for trowel notching, adhesive mixing, and adhesive open and working times.

1. Provide completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

I. Hand roll tiles according to tile manufacturer's written instructions.

3.4 RESILIENT ACCESSORY INSTALLATION

A. Install resilient accessories according to manufacturer's written installation instructions.

B. Apply resilient wall base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.

1. Install wall base in lengths as long as practicable without gaps at seams and with tops of adjacent pieces aligned.
2. Tightly adhere wall base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.
3. Do not stretch base during installation.
4. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient wall base with manufacturer's recommended adhesive filler material.
5. Install premolded outside corners before installing straight pieces.
6. Install premolded outside and inside comers before installing straight pieces.
7. Form outside corners on job from straight pieces of maximum lengths possible, without whitening at bends. Shave back of base at points where bends occur and remove strips perpendicular to length of base that are only deep enough to produce a snug tit without removing more than half the wall base thickness.
8. Form inside corners on job, from straight pieces of maximum lengths possible, by cutting an inverted V-shaped notch in toe of wall base at the point where corner is formed. Shave back of base where necessary to produce a snug fit to substrate.

C. Place resilient accessories so they are butted to adjacent materials and bond to substrates with adhesive. Install reducer strips at edges of flooring that would otherwise be exposed.

D. Apply resilient products to stairs as indicated and according to manufacturer's written installation instructions.

3.5 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing resilient products:
1. Remove adhesive and other surface blemishes using cleaner recommended by resilient product manufacturers.
2. Sweep or vacuum floor thoroughly.
3. Do not wash floor until after time period recommended by flooring manufacturer.
4. Damp-mop floor to remove marks and soil.

B. Protect flooring against mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by flooring manufacturer.
1. Apply protective floor polish to floor surfaces that are free from soil, visible adhesive, and surface blemishes, if recommended in writing by manufacturer.
a. Use commercially available product acceptable to flooring manufacturer.

b. Coordinate selection of floor polish with Owner's maintenance service.

2. Cover products installed on floor surfaces with undyed, untreated building paper until inspection for Substantial Completion.

3. Do not move heavy and sharp objects directly over floor surfaces. Place plywood or hardboard panels over flooring and under objects while they are being moved. Slide or roll objects over panels without moving panels.

C. Clean floor surfaces not more than 4 days before dates scheduled for inspections intended to establish date of Substantial Completion in each area of Project. Clean products according to manufacturer's written recommendations.

1. Before cleaning, strip protective floor polish that was applied after completing installation only if required to restore polish finish and if recommended by flooring manufacturer.

2. After cleaning, reapply polish to floor surfaces to restore protective floor finish according to flooring manufacturer's written recommendations. Coordinate with Owner's maintenance program.

END OF SECTION 096519

SECTION 096543 - LINOLEUM FLOORING

PART 1 - GENERAL

1.1 SUMMARY

A. Section includes linoleum floor tile and sheet flooring.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Shop Drawings: For each type of linoleum flooring. Include flooring layouts, locations of seams, edges, columns, doorways, enclosing partitions, built-in furniture, cabinets, and cutouts.

1. Show details of special patterns.

C. Samples: For each exposed product and for each color and pattern specified in manufacturer's standard size, but not less than 13-by-13-inch (152-by-230-mm)] sections.

D. Pre-installation Conference: Conduct conference at Project site with Manufacturer’s representative present.

1.3 CLOSEOUT SUBMITTALS

A. Maintenance data.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Test-Response Characteristics: For linoleum flooring, as determined by testing identical products according to ASTM E 648 or NFPA 253 by a qualified testing agency.

1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

B. Low-Emitting Materials: Flooring system shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers."

2.2 LINOLEUM FLOOR TILE

A. Manufacturers: Subject to compliance with requirements, provide products by the following] [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]:

B. Basis-of-Design Product: Subject to compliance with requirements, provide
1. LIN-1 **NOT USED**
2. LIN-2 **NOT USED**
3. LIN-3 Forbo MCT 13X13 **color: Himalaya**
4. LIN-4 Forbo MCT 13X13 **color: Cotswold**

or comparable product APPROVED AS EQUAL DURING BIDDING by one of the following:

1. Forbo Industries, Inc.
2. Johnsonite; A Tarkett Company.

2.4 INSTALLATION MATERIALS

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

B. Adhesives: Water-resistant type recommended by flooring and adhesive manufacturers to suit products and substrate conditions indicated.

1. Adhesives shall have a VOC content of 50g/L or less.

~~**C. Floor Polish: Provide protective, liquid floor polish products recommended by linoleum flooring manufacturer.**~~

PART 3 - EXECUTION

3.1 PREPARATION

A. Prepare substrates according to linoleum flooring manufacturer's written instructions to ensure adhesion of flooring.

B. Concrete Substrates: Prepare according to ASTM F 710.

1. Verify that substrates are dry and free of curing compounds, sealers, and hardeners.
2. Remove substrate coatings and other substances that are incompatible with flooring adhesives and that contain soap, wax, oil, or silicone, using mechanical methods recommended by linoleum flooring manufacturer. Do not use solvents.
3. Alkalinity and Adhesion Testing: Perform tests recommended by linoleum flooring manufacturer. Proceed with installation only after substrate alkalinity falls within range on pH scale recommended by manufacturer in writing, but not less than 5 or more than 9 pH.
4. Moisture Testing: Perform tests recommended by linoleum flooring manufacturer.

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

D. Do not install flooring until it is the same temperature as space where it is to be installed.

E. Immediately before installation, sweep and vacuum clean substrates to be covered by flooring.

3.2 INSTALLATION, GENERAL

A. Comply with manufacturer's written instructions for installing flooring.

B. Scribe and cut flooring to butt neatly and tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings.

C. Extend flooring into toe spaces, door reveals, closets, and similar openings.

D. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on flooring as marked on substrates. Use chalk or other nonpermanent marking device.

E. Install flooring on covers for telephone and electrical ducts and similar items in finished floor areas. Maintain overall continuity of color and pattern between pieces of flooring installed on covers and adjoining flooring. Tightly adhere flooring edges to substrates that abut covers and to cover perimeters.

F. Adhere flooring to substrates using a full spread of adhesive applied to substrate to produce a completed installation without open cracks, voids, raising and puckering at joints, telegraphing of adhesive spreader marks, and other surface imperfections.

~~**G. Heat-Welded Seams: For seamless installation, comply with ASTM F 1516. Rout joints and heat weld with welding bead to permanently fuse sections into a seamless flooring. Prepare, weld, and finish seams to produce surfaces flush with adjoining flooring surfaces.**~~

3.3 LINOLEUM FLOOR TILE INSTALLATION

A. Lay out linoleum floor tiles from center marks established with principal walls, discounting minor offsets, so floor tiles at opposite edges of room are of equal width. Adjust as necessary to avoid using cut widths that equal less than one-half tile at perimeter.

1. Lay floor tiles square with room axis.

B. Match linoleum floor tiles for color and pattern by selecting tiles from cartons in same sequence as manufactured and packaged, if so numbered. Discard broken, cracked, chipped, or deformed floor tiles.

1. Lay floor tiles with grain running in one direction and in pattern of colors and sizes indicated.

3.5 CLEANING AND PROTECTION

A. Comply with manufacturer's written instructions for cleaning and protecting linoleum flooring.

B. After allowing drying room film (yellow film caused by linseed oil oxidation) to disappear, cover linoleum flooring until Substantial Completion.

END OF SECTION 096543

SECTION 096813 – TILE CARPETING

PART I– GENERAL

1.1 SUMMARY

A. This Section includes carpet tile products, accessories and installation.

B. Related Work

I. Division 09, Section "Resilient Tile Flooring": Resilient wall base and accessories installed with carpet tile.

1.2 SUBMITTALS

A. Submit in accordance with Division 01, Section "Submittal Procedures", product data for each type of product indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance. Include installation methods.

B. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet tiles.
2. Existing flooring materials to be removed.
3. Existing flooring materials to remain.
4. Carpet tile type, color, and dye lot.
5. Type of subfloor.
6. Type of installation.
7. Pattern of installation.
8. Pattern type, location, and direction.
9. Pile direction.
10. Type, color, and location of insets and borders.
11. Type, color, and location of edge, transition, and other accessory strips.
12. Transition details to other flooring materials.

C. Samples: Submit samples for each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

1. Carpet Tile: Full-size sample.
2. Exposed Edge Stripping and Accessory: 12 inch (300 mm) long samples.

D. Product Schedule: Submit schedule of carpet tile using same room and product designations indicated on Drawings and in schedules.

E. Certification: Submit manufacturer's certification stating that carpet materials furnished comply with specified requirements.

1. Include listing of mill register numbers for carpet furnished.

2. Include supporting certified laboratory test data indicating that carpet meets or exceeds specified test requirements.
3. Certification that flooring material falls within ATBCB guidelines for slip-resistance (static coefficient of friction greater than 0.6 for level surfaces, greater than 0.8 for ramps.)

F. Maintenance Data: Submit maintenance data for carpet tile to include in maintenance manuals specified in Division 01. Include the following:
1. Methods for maintaining carpet tile, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet tile.

G. Contractor's Option for concrete curing or Moisture Vapor Transmission Reduction System: Submit the following;
1. Plans showing the proposed moisture test and bond test locations, approved by the flooring manufacturer. Identify each location by a unique designation.
2. Test results for all moisture and bond tests.

H. Certification that all concrete substrate surfaces have been inspected and are free of coatings, curing agents, alkali, have the required texture and are in conformance with ASTM F710 and the flooring and underlayment manufacturers' requirements.

1.3 QUALITY ASSURANCE

1. Installer Qualifications: An experienced installer who is certified by the Floor Covering Installation Board or who can demonstrate compliance with its certification program requirements.

A. Fire-Test-Response Ratings: Where indicated, provide carpet tile identical to those of assemblies tested for fire response according to NFPA 253 by a qualified testing agency.

B. Product Options: Products and manufacturers named in Part 2 establish requirements for product quality in terms of appearance, construction, and performance. Other manufacturers' products comparable in quality to named products and complying with requirements may be considered. Refer to Division 01, Section "Substitution Procedures".

C. Single-Source Responsibility: Obtain each type of carpet from one source and by a single manufacturer.
1. Dye Lot: Provide each carpet type beginning from the start of a full dye lot.

D. Mockups: Before installing carpet tile, install mockups for each type of carpet tile installation required to demonstrate aesthetic effects and qualities of materials and

execution. Install mockups to comply with the following requirements, using materials indicated for the completed Work:

1. Install mockups in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Notify Architect seven days in advance of dates and times when mockups will be installed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Owner and Architect's approval of mockups before starting work.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Approved mockups may become part of the completed Work if undamaged at time of Substantial Completion.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRT 104, Section 5, "Storage and Handling".

B. Remove wrapping from carpet 24 hours prior to installation to allow "off-gassing" of carpet.

1.5 PROJECT CONDITIONS

A. Comply with CRI 104, Section 6.1, "Site Conditions; Temperature and Humidity".

B. Environmental Limitations: Do not install carpet tile until wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.

C. Do not install carpet tile over concrete slabs until slabs have cured and are sufficiently dry to bond with adhesive and concrete slabs have pH range recommended by carpet tile manufacturer.

D. Where items are indicated for installation on top of carpet tile, install carpet tile before installing these items.

1.6 EXTRA MATERIALS

A. Furnish extra materials described below, before installation begins, that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Carpet Tile: Full-size units equal to 5 percent of amount installed for each type indicated, but not less than 10 sq. yd. (8.3 sq. m).

PART 2- PRODUCTS

2.1 CARPET CPT-1, CPT-3, **CPT-4** GENERAL

A. Cost Comparison-Type Alternates: Submit alternate pricing for the three 24" X 24" carpet tile products designated as **Base Bid**, Alternates A-7a, A-7b, ~~**and A-7c.**~~

1. CARPET CPT-1, ~~**CPT-3**~~ ALTERNATE A-7a
   a. Manufacturer: J&J Commercial, Division of J&J Industries
   b. Style: "In Theory Collection" Conspiracy, Style 7014, Modular
   c. Color: As selected by Architect from manufacturer's full range available for specified style.
   d. Backing: "Nexus Modular."
   e. Installation Layout: Quarterturn

2. CARPET CPT-1, ~~**CPT-3**~~ ALTERNATE A-7b
   a. Manufacturer: Tandus
   b. Style: Restoration Collection, Link 04222
   c. Color: As selected by Architect from manufacturer's full range available for specified style.
   d. Backing: ER3 Modular
   e. Installation Layout: Quarterturn

3. CARPET CPT-1, ~~**CPT-3**~~ **BASE BID.**
   a. Manufacturer: Shaw Contract Group
   b. Style: diffuse, No. 59575
   c. Color: **Color A= Flyaway 75400**
      Corridors: Installation Layout = Monolithic with arrows pointing toward side wall

      Color B= Routes 75500
      Lounge (Floor 3, Floor 4): Installation Layout = Quarterturn

      Color C= Movement 75481
      Lounge (Floor 2, Floor 5, Floor 6): Installation Layout = Quarterturn
   d. Backing: ecoworx tile
   e. **Installation Layout: See colors above.**

B. CARPET CPT-3,
   a. Manufacturer: Shaw Contract Group
   a. Style: tempt tile, No. 5T019
   b. Color: wave 18761
   c. Backing: ecoworx tile
   d. Installation Layout: Quarterturn

C. CARPET CPT-4,
   a. Manufacturer: J&J Invision
   e. Style: energy modular (7997)
   f. Color: 1560 variable
   g. Backing: Nexus modular

h. Installation Layout: Quarterturn

2.2 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic-cement-based formulation provided by or recommended by carpet tile manufacturer.

B. Adhesives: Water-resistant, mildew-resistant, nonstaining type to suit products and subfloor conditions indicated, that complies with flammability requirements for installed carpet tile and that is recommended by carpet tile manufacturer.

PART 3- EXECUTION

3.1 EXAMINATION

A. Examine substrates, areas, and conditions for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet tile performance. Verify that substrates and conditions are satisfactory for carpet tile installation and comply with requirements specified.

B. Concrete Subfloors: Verify that concrete slabs comply with ASTM F710 and the following:

1. Slab substrates are dry and free of curing compounds, sealers, hardeners, and other materials that may interfere with adhesive bond. Determine adhesion and dryness characteristics by performing bond and moisture tests. a. Test concrete in accordance with ASTM Standard F-2170-02. Perform three (3) tests for each area under 2000 sq. ft., with one additional test for every additional 1000 sq. ft. Test locations shall be selected less than 5 feet from building perimeter, near window and door openings wherever possible. Pass threshold: Less than 85 percent ERH (Equilibrium Relative Humidity).
2. Subfloors are free of cracks, ridges, depressions, scale, and foreign deposits.

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

3.2 PREPARATION

A. Comply with CRT 104, Section 6.2, "Site Conditions; Floor Preparation," and carpet tile manufacturer's written installation instructions for preparing substrates indicated to receive carpet tile installation.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, and depressions in substrates.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using

solvents. Use mechanical methods recommended in writing by carpet tile manufacturer.

D. Concrete-Subfloor Preparation: Apply concrete-slab primer, according to manufacturer's directions, where recommended by the carpet manufacturer.

1. Test concrete in accordance with ASTM Standard F-2170-02. Perform three (3) tests for each area under 2000 sq. ft., with one additional test for every additional l000 sq. ft. Test locations shall be selected less than 5 feet from building perimeter, near window and door openings wherever possible. Pass threshold: less than 85% ERH (Equilibrium Relative Humidity).

E. Broom and vacuum clean substrates to be covered immediately before installing carpet tile. After cleaning, examine substrates for moisture, alkaline salts, carbonation, or dust. Proceed with installation only after unsatisfactory conditions have been corrected.

3.3 INSTALLATION

A. Comply with CRT 104, Section 13, "Carpet Modules (Tiles)".

B. Installation Method: Glue-down; install every tile with releasable adhesive.

C. Cut and fit carpet tile to butt tightly to vertical surfaces, permanent fixtures, and built-in furniture including cabinets, pipes, outlets, edgings, thresholds, and nosings. Bind or seal cut edges as recommended by carpet tile manufacturer.

D. Extend carpet tile into toe spaces, door reveals, closets, open-bottomed obstructions, removable flanges, alcoves, and similar openings.

E. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

F. Install pattern parallel to walls and borders.

3.4 CLEANING AND PROTECTION

A. Perform the following operations immediately after installing carpet tile:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet tile manufacturer.
2. Remove yarns that protrude from carpet tile surface.
3. Vacuum carpet tile using commercial machine with face-beater element.

B. Protect installed carpet tile to comply with CRT l04, Section 15, "Protection of Indoor Installations".

C. Protect carpet tile against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use

protection methods indicated or recommended in writing by carpet tile manufacturer.

END OF SECTION 09 68 13

SECTION 09 68 16
SHEET CARPETING

1.1 SUMMARY

A. Section Includes:

~~1. Tufted carpet.~~
2. Walk-Off Mat

1.2 PREINSTALLATION MEETINGS

A. Preinstallation Conference: Conduct conference at Project site.

1. Review methods and procedures related to carpet installation including, but not limited to, the following:

a. Review delivery, storage, and handling procedures.
b. Review ambient conditions and ventilation procedures.
c. Review subfloor preparation procedures.

1.3 ACTION SUBMITTALS

A. Product Data: For the following, including installation recommendations for each type of substrate:

1. Carpet: For each type indicated. Include manufacturer's written data on physical characteristics, durability, and fade resistance.

B. Shop Drawings: Show the following:

1. Columns, doorways, enclosing walls or partitions, built-in cabinets, and locations where cutouts are required in carpet.
2. Carpet type, color, and dye lot.
3. Locations where dye lot changes occur.
4. Seam locations, types, and methods.
5. Type of subfloor.
6. Type of installation.
7. Pattern type, repeat size, location, direction, and starting point.
8. Pile direction.
9. Type, color, and location of insets and borders.
10. Type, color, and location of edge, transition, and other accessory strips.
11. Transition details to other flooring materials.

C. Samples: For each of the following products and for each color and texture required. Label each Sample with manufacturer's name, material description, color, pattern, and designation indicated on Drawings and in schedules.

D. Carpet: 12-inch- (300-mm-) square Sample.

2. Exposed Edge, Transition, and Other Accessory Stripping: 12-inch- (300-mm-) long Samples.

E. Product Schedule: For carpet and ~~carpet cushion.~~ Use same designations indicated on Drawings.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance Data: For carpet to include in maintenance manuals. Include the following:

1. Methods for maintaining carpet, including cleaning and stain-removal products and procedures and manufacturer's recommended maintenance schedule.
2. Precautions for cleaning materials and methods that could be detrimental to carpet ~~and carpet cushion.~~

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced Installer who is certified by the International Certified Floorcovering Installers Association at the Commercial II Master II certification level.

B. Fire-Test-Response Ratings: Where indicated, provide carpet and carpet cushion identical to those of assemblies tested for fire response per NFPA 253 by a qualified testing agency.

1.8 DELIVERY, STORAGE, AND HANDLING

A. Comply with CRI 104.

1.9 FIELD CONDITIONS

A. Comply with CRI I04 for temperature, humidity, and ventilation limitations.

B. Environmental Limitations: Do not deliver or install carpet and carpet cushion until spaces are enclosed and weathertight, wet work in spaces is complete and dry, and ambient temperature and humidity conditions are maintained at occupancy levels during the remainder of the construction period.

PART 2- PRODUCTS

2.1 MANUFACTURERS

2.4 WALK-OFF MATS

1. Shaw Contract Group Bon jour II
2. Style 60746
3. Color 31481 Multi-color
4. Removable

2.5 INSTALLATION ACCESSORIES

A. Trowelable Leveling and Patching Compounds: Latex-modified, hydraulic- cement-based formulation provided or recommended by carpet cushion manufacturer.

E. Metal Edge/Transition Strips: Extruded aluminum with mill finish of profile and width shown, of height required to protect exposed edge of carpet, and of maximum lengths to minimize running joints.

PART 3- EXECUTION

3.1 EXAMINATTON

A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for maximum moisture content, alkalinity range, installation tolerances, and other conditions affecting carpet performance. Examine carpet for type, color, pattern, and potential defects.

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

3.2 PREPARATION

A. General: Comply with CRT 104, Section 7.3, "Site Conditions; Floor Preparation," and with carpet manufacturer's written installation instructions for preparing substrates.

B. Use trowelable leveling and patching compounds, according to manufacturer's written instructions, to fill cracks, holes, depressions, and protrusions in substrates. Fill or level cracks, holes and depressions 1/8 inch (3 mm) wide or wider, and protrusions more than 1/32 inch (0.8 mm), unless more stringent requirements are required by manufacturer's written instructions.

C. Remove coatings, including curing compounds, and other substances that are incompatible with adhesives and that contain soap, wax, oil, or silicone, without using solvents. Use mechanical methods recommended in writing by carpet cushion manufacturer.

D. Broom and vacuum clean substrates to be covered immediately before installing carpet.

3.3 INSTALLATION

F. Maintain reference markers, holes, and openings that are in place or marked for future cutting by repeating on finish flooring as marked on subfloor. Use nonpermanent, nonstaining marking device.

3.4 CLEANING AND PROTECTING

A. Perform the following operations immediately after installing carpet:

1. Remove excess adhesive, seam sealer, and other surface blemishes using cleaner recommended by carpet manufacturer.
2. Remove yarns that protrude from carpet surface.
3. Vacuum carpet using commercial machine with face-beater element.

B. Protect installed carpet to comply with CRT 104, Section 16, "Protecting Indoor Installations."

C. Protect carpet against damage from construction operations and placement of equipment and fixtures during the remainder of construction period. Use protection methods indicated or recommended in writing by carpet manufacturer.

END OF SECTION 096816

SECTION 099123 – INTERIOR PAINTING

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes surface preparation and field painting of the following:

1. Exposed interior items and surfaces.
2. Surface preparation, priming, and finish coats specified in this section are in addition to shop priming and surface treatment specified in other sections.

B. Paint exposed surfaces whether or not colors are designated in "schedules," except where a surface or material is specifically indicated not to be painted or is to remain natural. Where an item or surface is not specifically mentioned, paint the same as similar adjacent materials or surfaces. If color or finish is not designated, the Architect will select from colors or finishes available.

1. Painting includes field painting exposed bare and covered pipes and ducts (including color coding), hangers, exposed steel and iron work, and primed metal surfaces of mechanical and electrical equipment.

C. Painting is not required on prefinished items, finished metal surfaces, concealed surfaces, operating parts and labels.

1.2 SUBMITTALS

A. Submit samples of manufacturers' latest color chips for selection by the Architect. Colors shall be selected by Architect prior to commencement of the painting work.
B. Samples for Verification Purposes: Provide samples of each color and material to be applied, with texture to simulate actual conditions, on representative samples of the actual substrate. Define each separate coat, including block fillers and primers. Use representative colors when preparing samples for review. Resubmit until required sheen, color, and texture are achieved.

1. Provide a list of material and application for each coat of each sample. Label each sample as to location and application.
2. Submit samples for the Architect's review of color.

1.3 QUALITY ASSURANCE

A. Applicator Qualifications: Engage an experienced applicator who has completed painting system applications similar in material and extent to those indicated for the Project that have resulted in a construction record of successful in-service performance.
B. Single Source Responsibility: Provide primers and other undercoat paint produced by same manufacturer as finish coats. Use thinners approved by paint manufacturer, and use within recommended limits.
C. Coordination of Work: Review other sections in which primers are provided to ensure compatibility of the total systems for various substrates. On request, furnish information on characteristics of finish materials to ensure use of
compatible primers.

1. Notify the Architect of problems anticipated using the materials specified.

D. Material Quality: Provide the manufacturer's best quality trade sale paint material of the various coating types specified. Paint material containers not displaying manufacturer's product identification will not be acceptable.

E. Provide products which comply with all state and local regulations controlling use of volatile organic compounds (VOCs).

1.4 MOCK-UPS

A. Before proceeding with the work, a representative room with permanent lighting shall be designated for the mockup and the walls finish painted in a white color. Samples of the various wall color schemes shall be prepared on 4 foot by 8 foot sheets of gypsum board (one color to each sheet) and exhibited in the mock-up room for Architect's approval.

1. If requested by Architect, prepare a new mock-up for each color as many as two more times, with minor tint adjustments, for final color approval.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Architectural Coating Products: Subject to compliance with requirements, provide architectural coating products as scheduled and where indicated, as manufactured by one of the following (no substitutions):

1. Benjamin Moore & Company (Moore)
2. Pittsburgh Paints, PPG Architectural Finishes, Inc. (PPG)
3. Pratt & Lambert, Inc. (P&L)
4. Sherwin-Williams (S-W)

2.2 MATERIALS

A. Provide paint products listed in schedules at end of this section for the various paint systems and substrates indicated.

B. Sealers and primers: As recommended by the finish paint manufacturer.

C. Spackle: An approved plaster filler.

D. Gypsum board joint compound finish system shall be as approved by gypsum board manufacturer.

E. Tinting material shall be of the best quality, universal colorants ground in propylene glycol, alkali proof, non-fading, lead-free colorants.

1. Tint all primers and undercoats to the approximate shade (lighter or darker, depending on color selected) of the finish coat. Where the color schedule calls for the use of "deeptones" it is the responsibility of the painting subcontractor to utilize the appropriate deep base primers for use on the surfaces for which they are intended.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions under which painting will be performed for compliance with requirements for application of paint. Do not begin paint application until unsatisfactory conditions have been corrected.

1. Start of painting will be construed as the Applicator's acceptance of surfaces and conditions within a particular area.

3.2 PREPARATION

A. General Procedures: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items in place that are not to be painted, or provide surface-applied protection prior to surface preparation and painting. Remove these items if necessary for complete painting of the items and adjacent surfaces. Following completion of painting operations in each space or area, have items reinstalled by workers skilled in the trades involved.

1. Clean surfaces before applying paint or surface treatments. Remove oil and grease prior to cleaning. Schedule cleaning and painting so that dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

B. Surface Preparation: Clean and prepare surfaces to be painted in accordance with the manufacturer's instructions for each particular substrate condition and as specified.

1. Provide barrier coats over incompatible primers or remove and re-prime. Notify Architect in writing of problems anticipated with using the specified finish coat material with substrates primed by others.

2. Cementitious Materials: Prepare concrete masonry block surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.

a. Use abrasive blast-cleaning methods if recommended by the paint manufacturer.

b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause blistering and burning of finish paint, correct this condition before application. Do not paint surfaces where moisture content exceeds that permitted in manufacturer's printed directions.

3. Ferrous Metals: Clean non-galvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale and other foreign substances. Use solvent or mechanical cleaning methods that comply with recommendations of the Steel Structures Painting Council.

a. Blast steel surfaces clean as recommended by the paint system manufacturer and in accordance with requirements of SSPC specification SSPS-SP 10.

b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.

c. Materials Preparation: Carefully mix and prepare paint materials in accordance with manufacturer's directions.

1. Maintain containers used in mixing and application of paint in a clean condition, free of foreign materials and residue.

2. Stir material before application to produce a mixture of uniform density; stir as required during application. Do not stir surface film into material. Remove film and, if necessary, strain material before using.

3. Use thinners approved by the paint manufacturer, and within recommended limits.

3.3 APPLICATION

A. Apply paint in accordance with manufacturer's directions. Use applicators and techniques best suited for substrate and type of material being applied.

B. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.

C. Paint colors, surface treatments, and finishes are indicated in "schedules."

D. Provide finish coats that are compatible with primers used.

E. The number of coats and film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the manufacturer. Sand between applications where sanding is required to produce an even smooth surface in accordance with the manufacturer's directions.

F. Apply additional coats when undercoats, stains, or other conditions show through final coat of paint until paint film is of uniform finish, color, and appearance. Give special attention to ensure that surfaces, including edges, corners, crevices, welds, and exposed fasteners, receive a dry film thickness equivalent to that of flat surfaces.

G. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place. Extend coatings in these areas as required to maintain the system integrity and provide desired protection.

H. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Paint surfaces behind permanently fixed equipment or furniture with prime coat only before final installation of equipment.

I. Paint interior surfaces or cuts, where visible through registers or grilles, with a flat, non-specular black paint.

J. Omit primer on metal surfaces that have been shop-primed and touch up painted.

K. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.

1. Allow sufficient time between successive coats to permit proper drying. Do not recoat until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure and where application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.

L. Minimum Coating Thickness: Apply materials at not less than the manufacturer's recommend spreading rate. Provide a total dry film thickness of the entire system as recommended by the manufacturer.

M. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.

N. Prime Coats: Before application of finish coats, apply a prime coat of material as recommended by the manufacturer to materials that are required to be painted or finished and have not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to assure a finish coat with no burn through or other defects due to insufficient sealing.

O. Pigmented (Opaque) Finishes: Completely cover to provide an opaque, smooth surface of uniform finish, color, appearance and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.

P Completed Work: Match approved samples for color, texture and coverage. Remove, refinish, or repaint work not in compliance with specified requirements.

3.5 CLEANING AND PROTECTION

A. Cleanup: At the end of each work day, remove empty cans, rags, rubbish, and other discarded paint materials from the site.

B. Protect work of other trades, whether to be painted or not, against damage by painting. Correct damage by cleaning, repairing or replacing, and repainting, as acceptable to Architect.

C. Provide "Wet Paint" signs to protect newly painted finishes. Remove temporary protective wrappings provided by others for protection of their work after completion of painting operations.

D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.7 INTERIOR PAINTING SCHEDULE

A Gypsum Board **(Vestibules, Elevator Lobbies)**

1. First Coat (primer):
   a. P&L Suprime 1 Primer, Z1001.
   b. Moore Moorcraft Super Spec Latex Undercoater & Primer Sealer 253.
   c. PPG Quick Drying Interior Latex Primer, Series 6-2.
   d. S-W PrepRite 200 Latex Wall Primer, B28W200.
2. First Coat (vapor barrier primer):
   a. Moore Super Spec Latex Vapor Barrier Primer Sealer 260.

3. Second and Third Coats (eggshell finish):
    a. P&L Prohide Latex Eggshell, Z8200.
    b. Moore Moorcraft Super Spec Latex Eggshell Enamel 274.
    c. PPG Speedhide Latex Eggshell Enamel, Series 6-411.
    d. S-W ProMar 200 Latex Eg-Shel Enamel, B20W200 Series.

B Gypsum Board Ceilings
1. First Coat (primer):
    a. P&L Suprime 1 Primer, Z1001.
    b. Moore Moorcraft Super Spec Latex Undercoater & Primer Sealer 253.
    c. PPG Quick Drying Interior Latex Primer, Series 6-2.
    d. S-W PrepRite 200 Latex Wall Primer, B28W200.
2. Second and Third Coats (flat finish):
    a. P&L Prohide Latex Flat, Z8100.
    b. Moore Moorcraft Super Spec Vinyl Latex Flat 275.
    c. PPG Speedhide Interior Flat Wall Paint, Series 6-70.
    d. S-W ProMar 200 Latex Flat Paint, B30W200.

C. **CMU (Corridors and Bathrooms in dorm room)** (Epoxy Finish)
1. First Coat (**tinted** primer):
    a. P&L Suprime 1 Primer, Z1001.
    b. Moore Moorcraft Super Spec Latex Undercoater & Primer Sealer 253.
    c. PPG Quick Drying Interior Latex Primer, Series 6-2.
    d. S-W PrepRite 200 Latex Wall Primer, B28W200.
2. Second Coat (2.0 to 2.5 mils DFT, semi-gloss finish):
    a. P&L Tech-Gard Water-Borne Epoxy, Z5300.
    b. Moore Acrylic Epoxy Gloss Coating M43/M44
    c. PPG Pitt-Glaze Acrylic-Epoxy Water Based, Series 16-551.
    d. S-W Water Based Catalyzed Epoxy, B70/B60V25.

D. Ferrous Metal (not shop-primed)
1. First Coat (primer):
    a. P&L Tech-Gard Acrylic Metal Primer, Z190.
    b. Moore Acrylic Metal Primer M04.
    c. PPG Pitt-Tech High Performance Primer/Finish, Series 90-709/712.
    d. S-W DTM Primer/Finish B66W1.
2. Second and Third Coats (semi-gloss finish):
    a. P&L Prohide Latex Semi-Gloss, Z8300.
    b. Moore DTM Acrylic Semi-Gloss M29.
    c. PPG Pitt-Tech Satin DTM Enamel, Series 90-474.
    d. S-W DTM Acrylic Semi-Gloss Coating, B66-200 Series.

G. Grilles, Uncovered Runout, Housings and Accessories of Mechanical Equipment and Apparatus
1. First Coat (primer):
    a. P&L Tech-Gard Acrylic Metal Primer, Z190.

b. Moore Acrylic Metal Primer M04.
c. PPG Pitt-Tech High Performance Primer/Finish, Series 90-709/712.
d. S-W PrepRite Classic Interior Latex Primer, B28W101.

2. Second and Third Coats (semi-gloss finish):
a. P&L Enducryl Acrylic Maintenance Enamel, Z2900.
b. Moore DTM Acrylic Semi-Gloss M29.
c. PPG Pitt-Tech Satin DTM Enamel, Series 90-474.
d. S-W DTM Acrylic Semi-Gloss Coating, B66-200 Series.

H. Existing Painted Metal Surfaces (i.e. doors, frames, trim)
1. First and Second Coats (semi-gloss finish):
a. P&L Prohide Latex Semi-Gloss, Z8300.
b. Moore Moorcraft Super Spec Latex Semi-Gloss Enamel 276.
c. PPG Speedhide Acrylic Latex Semi-Gloss Enamel, Series 6-510.
d. S-W ProMar 200 Interior Latex Semi-Gloss Enamel, B31W200 Series.

I. Concrete Masonry Units (Rec Room)
1. First Coat (primer):
a. P&L Pro-Hide Silver Latex Block Filler
b. Benjamin Moore Primer: Super Spec Latex Block Filler (160)
c. PPG Speedhide Int/Ext Acrylic Masonry Block Filler, Series 6-15.
2. Second and Third Coats (eggshell finish):
a. P&L Prohide Latex Eggshell, Z8200.
b. Moore Moorcraft Super Spec Latex Eggshell Enamel 274.
c. PPG Speedhide Latex Eggshell Enamel, Series 6-411.

J. Existing Previously Painted Concrete Masonry Units
Existing Previously Painted Gypsum Board
(Dorm rooms, Rec Room, Kitchenette and Lounges)
1. Second and Third Coats (eggshell finish):
a. P&L Prohide Latex Eggshell, Z8200.
b. Moore Moorcraft Super Spec Latex Eggshell Enamel 274.
c. PPG Speedhide Latex Eggshell Enamel, Series 6-411.

K. Metal (shop-primed)
1. First and Second Coats (semi-gloss finish):
a. P&L Prohide Latex Semi-Gloss, Z8300.
b. Moore DTM Acrylic Semi-Gloss M29.
c. PPG Pitt-Tech Satin DTM Enamel, Series 90-474.
d. S-W DTM Acrylic Semi-Gloss Coating, B66-200 Series.

L. Wood Transparent Finish
1. First Coat: Paste Wood Filler.
2. Second Coat: Stain.
3. Third And Fourth Coats (transparent satin finish):

a. Aquanamel No. 945134 by Seagrave Coatings Corporation, Carlstadt, NJ.
b. Varathane Elite Diamond Finish No. 2002, Satin, by The Flecto Company, Inc., Oakland, CA.
c. Crystal Aire by Pace Chem Industries, Newbury Park, CA.
d. Polyureseal BP by American Formulative and M anufacturing, San Diego, CA.

3.8 SAFETY COLOR CODE

A. Markings shall be as designated by the University Standards.

1. All exposed pipe lines, ducts, plenums, conduits, and hangers shall be stenciled and marked with flow arrows at entrance and exit of all pipes within such areas, and at not more than 20 foot intervals between.

2. All concealed pipe lines which are accessible by access doors and ceiling removal, shall be banded at each point of entry, junction, or exit to the concealed space and banding shall be repeated at distances not to exceed 20 feet between identifying bands, and shall be repeated at each valve. Exception to the preceding: all condenser water (tower) lines shall receive two coats of primer their entire length.

END OF SECTION 09 90 00

SECTION 10 14 00 SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. This section includes the following types of signs:

1. Panel signs.

1.2 SUBMITTALS

A. Submit in accordance with Division 01 Section “Submittal Procedures”, product data for each type of sign specified, including details of construction relative to materials, dimensions of individual components, profiles, and finishes.

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.

B. 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.

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

1. Manufacturers of Panel Signs:
    a. ASI Sign Systems, Inc.
    b. Best Manufacturing Co.
    c. Mohawk Sign Systems.

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 (80deg C), 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 by Architect from the manufacturer's standards.

B. Colored Coatings for Acrylic Plastic Sheet: Use colored coatings, including inks and paints for copy and background colors, that are recommended by acrylic manufacturers for optimum adherence to acrylic surface and are nonfading for the application intended.

2.3 PANEL SIGNS

A. Locations: Provide one room identification sign for each ~~classroom~~ and for each ~~workroom,~~ and ~~one maximum occupant load sign per classroom (mounted inside as directed by owner.)~~

B. 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.

C. Unframed Panel Signs: Fabricate signs with edges mechanically and smoothly finished to conform with the following requirements:

1. Room Identification Sign Dimensions: SEE DRAWINGS.
   a. Match Fenwick Hall Standard.

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.

E. 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.

2.4 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.

PART 3 - EXECUTION

3.1 INSTALLATION

A. 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. Silicone-Adhesive Mounting: Use liquid silicone adhesive recommended by the sign manufacturer to attach sign units surfaces.

3.2 INTERIOR SIGN SCHEDULE

~~A. Type 01 - Room Identification and Number Sign: Locate 1 sign per interior room entry door .~~

B. See drawings.

1. Graphics shall conform to ADA requirements including tactile and Braille text. Coordinate w/ owner for graphic content & style.

END OF SECTION 10 14 00

SECTION 102600 - WALL AND DOOR PROTECTION

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Corner guards.

1.3 ACTION SUBMITTALS

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

C. Shop Drawings: For each impact-resistant wall protection unit. Include sections, details, and attachments to other work.

1. For installed products indicated to comply with design loads, include structural analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

D. Samples: For each exposed product and for each color and texture specified, 12 inches long.

1.5 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.6 QUALITY ASSURANCE

A. Installer Qualifications: An employer of workers trained and approved by manufacturer.

B. Surface-Burning Characteristics: As determined by testing identical products per ASTM E 84, NFPA 255, or UL 723 by UL or another qualified testing agency.

PART 2 - PRODUCTS

2.1 MATERIALS

A. PVC Plastic: ASTM D 1784, Class 1, textured, chemical- and stain-resistant, high-impact-resistant PVC or acrylic-modified vinyl plastic with integral color throughout.

1. Impact Resistance: Minimum 25.4 ft-lbf/in. of notch when tested according to ASTM D 256, Test Method A.
2. Chemical and Stain Resistance: Tested according to ASTM D 543 or ASTM D 1308.
3. Self-extinguishing when tested according to ASTM D 635.
4. Flame-Spread Index: 25 or less.
5. Smoke-Developed Index: 450 or less.

B. Aluminum Extrusions: Alloy and temper recommended by manufacturer for type of use and finish indicated, but with not less than strength and durability properties specified in ASTM B 221 (ASTM B 221M) for Alloy 6063-T5.

C. Fasteners: Aluminum, nonmagnetic stainless-steel, or other noncorrosive metal screws, bolts, and other fasteners compatible with items being fastened. Use security-type fasteners where exposed to view.

2.4 CORNER GUARDS

A. Surface-Mounted, Resilient, Plastic Corner Guards : Assembly consisting of snap-on plastic cover installed over continuous retainer; including mounting hardware; fabricated with 90- or 135-degree turn to match wall condition.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
   a. American Floor Products Co., Inc.
   b. Arden Architectural Specialties, Inc.
   c. Balco, Inc.
   d. Construction Specialties, Inc.
   e. IPC Door and Wall Protection Systems; Division of InPro Corporation.
   f. Korogard Wall Protection Systems; a division of RJF International Corporation.
   g. Musson Rubber Company.
   h. Pawling Corporation.
   i. Tepromark International, Inc.
   j. WallGuard.com.

3. Cover: Extruded rigid plastic, minimum 0.078-inch wall thickness.

   a. Color and Texture: As selected by Architect from manufacturer's full range.
   b. Profile: nominal 3” long legs.
   c. Height: from top of wall base to ceiling.

4. Retainer: Minimum 0.060-inch- thick, one-piece, extruded aluminum.
5. Retainer Clips: Manufacturer's standard impact-absorbing clips.
6. Top and Bottom Caps: Prefabricated, injection-molded plastic; color matching cover; field adjustable for close alignment with snap-on cover.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General: Install impact-resistant wall protection units level, plumb, and true to line without distortions. Do not use materials with chips, cracks, voids, stains, or other defects that might be visible in the finished Work.

1. Install impact-resistant wall protection units in locations and at mounting heights indicated on Drawings.
2. Provide splices, mounting hardware, anchors, and other accessories required for a complete installation.

B. Immediately after completion of installation, clean plastic covers and accessories using a standard, ammonia-based, household cleaning agent.

C. Remove excess adhesive using methods and materials recommended in writing by manufacturer.

END OF SECTION 102600

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Private-use bathroom accessories.

B. Owner-Furnished Material to be installed by contractor: Paper towel and soap dispensers in custodial breakrooms, existing accessories in corridor toilet rooms.

1.2 ACTION SUBMITTALS

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

B. Product Schedule: Indicating types, quantities, sizes, and installation locations by room of each accessory required.

1. Identify locations using room designations indicated.
2. Identify products using designations indicated.

1.3 INFORMATIONAL SUBMITTALS

A. Warranty: Sample of special warranty.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance data.

1.5 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

A. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings and listed below or APPROVED EQUAL by one of the following:

1. A & J Washroom Accessories, Inc.

2. American Specialties, Inc.
3. Bobrick Washroom Equipment, Inc.
4. Bradley Corporation.
5. GAMCO Specialty Accessories; a division of Bobrick Washroom Equipment, Inc.
6. Tubular Specialties Manufacturing, Inc.

C. Toilet Tissue Dispenser TTD :

1. Basis-of-Design Product: Bradley 5085 Toilet Tissue Dispenser.
2. Description: Single-roll dispenser.
3. Mounting: Surface mounted.
4. Capacity: Designed for 4-1/2 through 5-1/2 inch diameter tissue rolls.
5. Material and Finish: Stainless steel, No. 7 finish (polished).

D. Shower Curtain Rod SCR:

1. Basis-of-Design Product: Bradley 9531 Shower Curtain Rod
2. Outside Diameter: 1-1/4 inches.
3. Mounting: Flanges with exposed fasteners.
4. Rod Material and Finish: Stainless steel, No. 4 finish (satin).
5. Flange Material and Finish: Stainless steel, No. 4 finish (satin.)

E. Robe Hook RH:

1. Basis-of-Design Product: Bradley 9119 Heavy-Duty Robe Hook
2. Description: Single-prong unit.
3. Material and Finish: Polished chrome-plated brass.

F. Towel Bar TB:

1. Basis-of-Design Product: Bradley 908 Heavy Duty Towel Bar.
2. Description: 1 inch-round tube with circular end brackets.
3. Mounting: Flanges with exposed fasteners.
4. Length: 24 inches.
5. Material and Finish: Stainless steel, No. 4 finish (satin) towel bar. Heavy cast brass, chrome-plated and polished to a satin finish support posts.

G. Mirror Unit MR-1:

1. Basis-of-Design Product: Bradley 780-1836 Angle-Frame Mirror.
2. Frame: Stainless-steel angle.
   a. Corners: Welded and ground smooth.
2 . Size: 1 8 ” x 3 6 ”

H. Mirror Unit MR-2:

1. Basis-of-Design Product: Bradley 780-1830 Angle-Frame Mirror .
2. Frame: Stainless-steel angle.

a. Corners: Welded and ground smooth.
3. Size: 18" x 30"

I. Folding Shower Seat SS-1:

1. Basis-of-Design Product: Bradley 9558 Phenolic Bench-Style Shower Seat
2. Configuration: Rectangular seat.
3. Seat: Phenolic or polymeric composite of slat-type or one-piece construction in color as selected by Architect.
4. Mounting Mechanism: Stainless steel, No. 4 finish (satin).
5. Dimensions: 17W X 16D.

J. Grab Bar GB-1, GB2, GB3:

1. Basis-of-Design Product: Bradley 832.
2. Mounting: Flanges with concealed fasteners.
3. Material: Stainless steel, 0.05 inch (1.3 mm) thick.
   a. Finish: Smooth, No. 4 finish (satin).
4. Outside Diameter: 1-1/4 inches.
5. Configuration and Length: Straight, 42 inches long GB-1
6. Configuration and Length: Straight, 48 inches long. GB-2
7. Configuration and Length: Straight, 18 inches long. GB-3

K. Coat Rack CR:

1. Basis of Design Product: Bradley 9944 Hat and Coat Rack
2. Mounting: Stainless Steel Screws.
3. Configuration and Length: 4 hooks, 36 inches long.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.

B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

C. All accessories to be mounted with **STAINLESS STEEL SCREWS**. For TTD, SCR, TB, RH, (and all other exposed fasteners) if non-stainless steel screws are provided by manufacturer, use **STAINLESS STEEL fasteners** of like type and size as those included by manufacturer in lieu of non-stainless steel screws provided by manufacturer.

END OF SECTION 102800

SECTION 123661 - SIMULATED STONE COUNTERTOPS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Cultured marble countertops with back and sidesplash.

1.2 ACTION SUBMITTALS

A. Product Data:

1. For countertop materials with integral bowl.
2. For adhesive.

B. Mfr’s installation manual.

C. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, and cutouts for plumbing fittings.

D. Sample.

PART 2 - PRODUCTS

2.1 CULTURED MARBLE COUNTERTOPS

A. Configuration: Provide countertops with the following front and backsplash style:

1. Front: Straight, slightly eased at top.
2. Backsplash: Integral, Coved, with 3/8-inch (9.5-mm) radius cove and top.
3. Overflow.
4. Sidesplash: Matching backsplash.

B. Fabrication: Fabricate tops in one piece with integral sink bowls and backsplashes.

2.2 COUNTERTOP MATERIALS

A. Adhesives: Adhesives shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."

B. Cultured Marble: Gel-coated solid fabrication of filled plastic resin complying with ANSI Z124.3, Type 4, with precoated finish, and not less than 1/2 inch (12.7 mm) thick.

1. Basis of Design: Imperial Marble Company C3722 (37 x 22) Oval Bowl Vanity Top with integral coved 3" H Backsplash with overflow or approved EQUAL approved during bidding (provide detail drawing, product data and sample of finish) by one of the following manufacturer's:

a. Bathroom World Manufacturing Company.
b. Cameo Marble.
c. Cherry Marble Group.
d. Comar Products, Inc.
e. Craig Baker Marble Co., Inc.
f. Cultured Marble Products.
g. Custom Marble Products.
h. Custom Marble Products, Inc.
i. Imperial Marble Corp.
j. Marbleon, Inc.
k. MarCraft, Inc.
l. Princess Marble.
m. Roma Marble, Inc.
n. Rynone Manufacturing Corp.
o. Tiffany Marble.

2. Colors and Patterns: Satin Stone with Matte Finish as selected by Architect from manufacturer's full range.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Per Manufacturer's instructions.

B. See SECTION 013546 – ENVIRONMENTAL REQUIREMENTS FOR INDOOR AIR QUALITY CONTROL for acceptable level of VOC for adhesives.

END OF SECTION 123661

SECTION 220500 - COMMON WORK RESULTS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes general requirements for plumbing systems.

B. Examine the drawings, specifications, and visit the site prior to submitting a bid.

C. The base bid shall include furnishing all materials, labor, tools, equipment and installation of all work required to install complete plumbing systems as outlined in Division-22.

D. Products and Topics in this Section Include:

1. Definitions.
2. Submittals.
3. Supplemental Engineering Services.
4. Interpretation of Documents.
5. Electronic Files.
6. Quality Assurance.
7. Performance Qualifications.
8. Performance Requirements.
9. Permits and Fees.
10. Warranty (Period of Correction).
11. Manufacturers.
12. Coordination of Plumbing Work.
13. Interruption of Utilities.
14. Damage by Leakage.
15. Emergency Repairs.
16. Phasing.
17. Supervision and Workmanship.
18. Locations and Inspection Of Site
19. Product Delivery, Storage, and Handling.
20. Substitutions.
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22. System Tests.
23. Cleaning Premises.
24. Maintenance, Operation Instructions, Etc.
25. Project Site Safety
26. Work in Existing Spaces.
27. Architectural Coordination Items

1.3 DEFINITIONS

A. Acceptance Testing Authorities (ATA): The individuals and/or business entities that participate in Acceptance Testing and report to the Owner when work appears to be compete. These parties represent the interest of the Owner.

B. Authority Having Jurisdiction (AHJ): The governmental agency or sub-agency having authority over the construction process and having the ultimate authority to enforce, uphold and rule on codes and safety compliance at the project site.

C. Contractor: The entity(s) contractually responsible for performing work of this Division.

D. Wherever the words “Site,” “Project Site,” or “Premises” appear in these specifications or related drawings, it shall be interpreted to mean real estate, buildings and structures where work shall be performed and where products shall be installed and reside.

E. Commissioning Authority: An agent of the Owner, often independent of the design team, responsible for ensuring compliance with the Owner’s project intent. The commissioning authority represents the interest of the Owner.

F. Contractor of Record: A business entity entering into a contract for any element of work defined in the Project Documents directly with the Owner, directly with the Construction Manager or directly with a General Contractor.

G. Designer: The Consultant(s) representing the Owner and directly responsible for specification of work within this Division, including related drawings. The Designer may or may not be affiliated with the architectural or an engineering firm of record for the Project. The Designer is a member of the project Design Team.

H. Furnish: To supply product or labor (context dependent) including associated shipping, storage, travel, lodging, miscellaneous and warranty expenses.

I. Install: To supply labor, tools and incidental materials necessary to handle, store, mount, terminate, program, configure and adjust a product in order to fulfill the requirements of the Project.

J. Provide: To furnish and install, inclusive of accessories, modules, and ancillary items necessary to render the respective product and system fully operational and usable to the Owner for the intended purpose.

K. Substantial Completion Division 21only:

1. The point in the Project where work of this Division that occurs at the project site has been completed. For work to be substantially complete, the following must be valid:

    a. Products have been delivered and installed at the project site, and;
    b. Systems have been installed, tested, adjusted and are operational for their intended purpose, and;
    c. Products have been labeled in accordance with the Contract Documents, and;
    d. Systems are performing in accordance with the design intent, and;
    e. Systems have been demonstrated to the Owner as complete and working.

L. Supply: Used interchangeably with “furnish.” See “Furnish.”

M. This Division: This Section and each specification section beginning with the same two digit number.

N. Work: The supply of products, materials, labor, incidentals and services necessary to fulfill the requirements of the Project.

1.4 SUBMITTALS

A. Comply with requirements of Section 22 05 03 “Submittals for Plumbing.”

B. General:

1. Comply with Section 22 05 03.00 “Submittals for Plumbing.”

C. Product Data (PD):

1. Provide product datasheets for all plumbing materials, components, fixtures, valves, and equipment.

D. Closeout Submittals (CO):

1. Provide operation and maintenance manuals for all plumbing components, fixtures, valves, and equipment.

1.5 SUPPLEMENTAL ENGINEERING SERVICES

A. In the event that the Designer is required to provide additional services as a result of Contractor errors, omissions or failure to conform to the requirements of the Contract Documents, or if the Designer is required to examine and evaluate any changes proposed by the Contractor solely for the convenience of the Contractor, then the Designer's expenses in connection with such additional services shall be paid by the Contractor and shall be deducted from any monies owed to the Contractor or billed separately, solely at the discretion of the Designer. Billable rates are the Designers standard rates, up to a maximum of $150 per man-hour.

1.6 INTERPRETATION OF DOCUMENTS

A. In the event of inconsistencies or conflict within or between the Contract Documents, provide the better quality, more costly or greater quantity of Work and comply with the more stringent requirements. Seek the direction of the Architect, Engineer or Designer for clarification of conflicts as soon as a conflict is identified.

1.7 ELECTRONIC FILES

A. Drawings for this project were prepared using AutoCAD software. Electronic files are available upon request for use by the successful contractor(s) for planning, coordination and installation.

B. There will be no charge for drawing files that were prepared using AutoCAD. These files will be available in the version in which they were created.

C. The Request Drawings form can be accessed, filled out and submitted at the following internet address (scroll down to bottom of home page): http://www.klhengrs.com.

1.8 QUALITY ASSURANCE

A. General: Refer to Division 1 Sections for general administrative/procedural requirements related to compliance with codes and standards.

B. Application: It is a general requirement that mechanical work comply with applicable requirements and recommendations of standards published by listed agencies and trade associations, except to extent more detailed and stringent requirements are indicated or required by governing regulations.

C. Listing of Associations, Standards and Abbreviations Specific to Plumbing Work (in addition to standards specified in individual work sections), conform to following applicable standards:

1. AWS American Welding Society, Inc.
2. AWWA American Water Works Association, Inc.
3. EPA Environmental Protection Agency
4. NIST National Institute for Standards and Technology
5. NEC National Electrical Code by NFPA
6. NFPA National Fire Protection Association
7. OSHA Occupational Safety and Health Administration (U.S. Department of Labor)
8. UL Underwriter's Laboratories, Inc.

D. Specifications

1. Specifications shall be interpreted in connection with the drawings hereinbefore described, and if anything is shown on drawings and not mentioned in the specifications, or vice versa, it is to be included in the work the same as though clearly set forth by both.
2. Furthermore, all materials and labor previously required to fully complete the work shall be included in the work even though each item necessarily involved be not specifically mentioned or shown. Such work and/or materials shall be of the same grade and quality as the parts actually specified and shown. Should there be a conflict between the plans and specifications, the greater quantity or better quality shall be furnished.

E. Plans

1. Plans are diagrammatic indicating required size, points of termination of piping and suggested routes. However, it is not intended that drawings indicate all necessary offsets. Install piping in such manner as to conform to the structure, avoid obstructions and preserve headroom.
2. Coordination Drawings: Provide coordination drawings and attend meetings as required to make sure all disciplines are coordinated and fit into specified spaces (i.e. ceilings, chases, and all others). The elevations of all disciplines shall be clearly marked throughout the drawings so that no interferences occur. Drawings shall depict actual clearances of installed equipment, penetration locations and service clearances. Indicate scheduling, sequencing, movement and positioning of large equipment during construction. Indicate 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. Conflicts in equipment and materials shall be corrected prior to installation.
3. All piping shall be run as straight as possible and symmetrical with architectural items.
4. Piping shall be concealed in pipe shafts, pipe spaces, and furring wherever possible.

5. Piping fabricated before coordination with the other trades will be done at one's own risk.

F. Installer's Qualifications: Firm with at least three (3) years of successful installation experience on projects with work similar to this project and meet applicable regulatory agencies requirements.

G. Compatibility: Provide products which are compatible with other products of the mechanical work, and with other work requiring interface with the mechanical work. Provide products with the proper and correct power characteristics, fuel-burning characteristics and similar adaptations for this project. Coordinate the selections from among options (if any) for compatibility of products.

H. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. Additional costs to other contractors as a result of providing equipment with higher electrical characteristics shall be the responsibility of the contractor making the substitution. If minimum energy ratings or efficiencies are specified, equipment shall comply with those requirements.

1.9 PERFORMANCE QUALIFICATIONS

A. Installer's Qualifications: Firm with at least five (5) years of successful installation experience on projects with work similar to this project and meet applicable regulatory agencies requirements.

B. Compatibility: Provide products which are compatible with other products of the mechanical work and with other work requiring interface with the mechanical work. Provide products with the proper or correct power characteristics, fuel-burning characteristics and similar adaptations for this project. Coordinate the selections from among options (if any) for compatibility of products.

C. Welding: Qualify procedures and personnel according to ASME Boiler and Pressure Vessel Code: Section IX.

D. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

E. Steel Pipe Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

F. Electrical Characteristics for Plumbing Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.10 PERFORMANCE REQUIREMENTS

A. Examine all Mechanical, Electrical, Architectural, Site and Structural Drawings, and available soil reports. Visit site and become acquainted with all conditions which may affect execution of work.

B. Provide all work in accordance with State and Local Codes, Regulations and/or Ordinances, and meet approval of authorities having jurisdiction. Provide only new material and as specified.

C. Furnish to the Owner, with a copy to the Owner a Certificate of Final Approval from governing authority prior to Owner's final acceptance, where applicable.

D. General Outline: The facilities and systems of the mechanical work include all Division 22 Sections.

E. Design supports for multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

F. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.11 PERMITS AND FEES

A. Unless specifically described differently in another front-end specification section, all permits and fees of every nature required in connection with this work shall be obtained and paid for by contractor, including installation fees and similar charges.

B. Laws and regulations which bear upon or affect the various branches of this work shall be complied with.

C. All work which laws require to be inspected shall be submitted to the proper public officials for inspections and certificates of final approval must be furnished to the Owner before final acceptance will be given by the Engineer.

1.12 WARRANTY (PERIOD OF CORRECTION)

A. Where not specifically listed within specific specification section, products and workmanship shall be covered by the Contractor for a period of (1) year from the date of Substantial Completion.

1. Supplied products with manufacturer's warranties of less than the warranty term shall be extended and warranted by the Contractor for the full specified warranty term.
2. Supplied products featuring a standard manufacturer's warranty whose term extends beyond the Contract Warranty term shall be facilitated by the Contractor for the full duration and under the terms and conditions of the manufacturer's warranty.

B. The Warranty supplied shall be a full "System Warranty" that covers workmanship and products and includes coverage of onsite and off-site labor and related personnel transportation and product shipping expenses.

1. During this period, the Contractor shall remedy (at no cost to the Owner) any problem with the system, or any of its related components that is the result of defective materials, equipment settings, workmanship, or loss of programming.

C. Individual sections of this Division may feature more stringent requirements than those set forth in this Section. The most stringent of these requirements shall apply.

D. Warranty work shall be performed at the Contractor's expense and to the satisfaction of the Owner.

E. Incomplete work discovered after assertion of work completion is not subject to the (1) year warranty limit and shall be performed upon discovery over the life of the facility(s).

F. Response Requirements:

1. During the Warranty Period, the Contractor shall:

a. Respond by phone within four (4) business hours of notice by the Owner of a problem, and;
b. Supply qualified personnel onsite within one (1) business day to begin remediation of the problem, if the problem cannot be remediated over the phone in less time, and;
c. Supply "on-call" emergency response service labor (at the request and authorization of the Owner) at an hourly rate that does not exceed the Contractor's published emergency service rates, or two-times the Contractor's standard hourly rate, whichever is lower.

PART 2 - PRODUCTS

2.1 DIELECTRIC FITTINGS

A. Dielectric fittings shall be provided where two materials of different types of metal connect or come in contact with each other.

2.2 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type stainless steel, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

1. Coordinate subparagraph and list below with Part 2 "Manufacturers" Article. Retain "Available" for nonproprietary and delete for semiproprietary specifications.

C. Manufacturers:

1. Hilti, Inc.
2. B-Line Systems, Inc.; a division of Cooper Industries.

3. ITW Ramset/Red Head.
4. Masterset Fastening Systems, Inc.
5. MKT Fastening, LLC.
6. Powers Fasteners.
7. Empire Fastening, LLC

PART 3 - EXECUTION

3.1 MANUFACTURERS

A. Provide products from manufacturers regularly engaged in the manufacture of products of quality, types and sizes required; and which have been in satisfactory use of not less than four (4) years in similar service, except as otherwise noted in specific sections of this division.

3.2 COORDINATION OF PLUMBING WORK

A. Refer to Division 1 Sections for general coordination requirements applicable to entire work. The contract documents are diagrammatic in showing certain physical relationships which must be established within mechanical work, and in its interface with other work, including utilities, control and electrical work.

B. Arrange plumbing work in a neat, well organized manner, with piping and similar services running parallel with primary lines of the building.

C. Give right-of-way to piping which may slope for drainage.

D. Locate operating and control equipment properly to provide easy access, and arrange entire plumbing work with adequate access for operation and maintenance.

E. Advise other trades of openings required in their work for the subsequent move-in of large units of plumbing work (equipment).

F. Strictly adhere to invert elevations for all underground piping. Pitch piping evenly between pipe junctions and where indicated on the drawings. Piping, not installed at invert elevations indicated on the drawings, shall be removed and re-laid.

3.3 INTERRUPTION OF UTILITIES

A. This project includes elements of work that will require disconnection and modification of existing systems, with resultant outages. These episodes must be strictly limited and controlled. No outage affecting any portion of the existing facilities will be allowed without specific written authorization by the Owner.

B. The Contractor shall schedule and coordinate all interruptions of utilities with the applicable utility provider and the Owner within 20 working days after award of contract. At least 3 working days prior to the interruption, the Contractor shall submit to the Owner a schedule request indicating the proposed date, time and duration of interruption, the work to be accomplished, the area(s) that will be affected and a proposed contingency plan to be followed in the event that normal services or facilities cannot be restored on schedule. Do not commence with the work until the Owner has approved the time, date and contingency in writing.

C. Provide all labor, materials, equipment and personnel necessary to restore services on a contingency basis should normal service of facilities not be restored on schedule.

3.4 DAMAGE BY LEAKAGE

A. The Contractor shall be responsible for damage to the grounds, walks, roads, buildings (including walls, floors and ceilings), piping systems, mechanical and electrical systems (and their related equipment and contents) caused by leakage in the piping systems being installed or having been installed herein. The Contractor shall repair all damage caused at no additional cost to the Owner. All repair work shall be performed as directed by the Owner.

3.5 EMERGENCY REPAIRS

A. The Owner reserves the right to make emergency repairs as may be required to keep equipment in operation without voiding the Contractor's guarantee bond or relieving the Contractor of his responsibilities.

3.6 PHASING

A. General: Where the scope of work dictates that the project shall be constructed in phases, all costs shall be included for any temporary work required so that previous phases can be operational while construction is being done to adjacent spaces.

3.7 SUPERVISION AND WORKMANSHIP

A. Workmanship throughout shall conform to the standards of best practice and all labor employed must be competent to do all the work required.

B. Furnish the services of an experienced superintendent to be in constant charge of the work at all times.

C. Quality Assurances: If requested, provide documentation that confirms the ability to perform all work to be included under the contract. Assurance if requested, shall be in the form of a list of past projects of similar size and complexity and a list of six (6) references pertaining to those projects. Failure to demonstrate these quality assurances shall be taken as a statement of inability to perform.

D. A minimum of five (5) years experience in the installation of plumbing systems similar to the systems specified is required.

E. Core Drilling: Use core drills rather than percussion type equipment for making holes in concrete. All percussion type drilling including hammer drills must be scheduled through owner's representative.

F. Inspection: Provisions shall be made for owner's representative to make rough-in and open ceiling inspections prior to covering up work.

3.8 LOCATIONS AND INSPECTION OF SITE

A. The Contractor shall fully familiarize himself regarding any and all peculiarities and limitations of the spaces available for the installation of all work and materials furnished and installed under this Contract. Coordinate with all other trades in advance of the work, requirements for openings, recesses and chases in the walls, partitions, equipment housekeeping pads, framing or openings, requirements for servicing equipment and routing of piping relative to each trade to alleviate conflicts. Should furnishing this information be neglected, delayed or incorrect and additional cutting is required, the cost of it shall be borne by the Contractor. Nothing in this paragraph shall be construed to relieve the Contractor of the responsibility for providing and paying for the required core drillings and openings in existing work.

B. Diagrammatic indications on the Drawings are:

1. Approximate only.
2. Shown distorted at various locations.
3. Possibly moved for visual clarity.

C. Exact locations shall:

1. Be required for proper installation in available space.
2. Be as required to preserve the required space for the servicing of equipment and components.
3. Avoid interference with Architectural and Structural features and the work of all other trades.
4. Be coordinated with the work of all other trades toward the general purpose of having the work progress rapidly and smoothly with a minimum interference between one trade and another.
5. Preserve headroom and keep openings and passageways clear.
6. Conceal all piping above ceilings, in walls, pipe shafts, pipe spaces and furring whenever possible.

D. Include a neat, orderly arrangement of piping symmetrical to building lines, light and tile patterns and other building elements. Any deviations not shown on the Drawings shall be requested in writing prior to implementation.

3.9 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Protect products against dirt, water, chemical and mechanical damage. Do not install damaged products.

B. Deliver products to site in factory fabricated containers, with the manufacturer's label clearly visible. Handle carefully to avoid damage to components, enclosure and finish, and in strict accordance with manufacturer's instructions.

C. Store products in clean dry place in original containers, protected from weather and construction traffic.

3.10 SUBSTITUTIONS

A. A substitution is the use of any product other than that identified as the "Basis of Design," the "Standard of Quality," or an "Additional Approved Product."

B. Substitutions require pre-bid approval. Only substitutions authorized via addendum shall be considered.

C. Substitutions are considered on a product-by-product and model specific basis.

D. Substitution Submittal Requirements:

1. Substitution requests must be received by the Designer sufficiently in advance of the scheduled bid date to allow time for review and issuance of an Addendum. If the timing of the request does not permit an Addendum, substitution shall not be considered or acceptable.
2. Substitution requests shall consist of the following for each proposed substitution:

a. Substitution Request Letter:

1) On company letterhead, for each specific product substitution request. The letter shall include the following:

i) The specification section and paragraph number and drawing number where the product requirement is identified.
ii) The specific system in which the product is to be used.
iii) The reason the Contractor is requesting the substitution.
iv) Statement of impact on the system(s) in which the product is used.
v) An enumeration declaring each difference between the Basis of Design product and the proposed substitute, including performance differences, technical specifications difference, feature differences, method of operation differences, warranty differences, dimensional differences, method and means of control differences, compliance differences. Failure to disclose 100-percent of the differences in this manner may be grounds for a post-bid and/or post–installation rejection of Contractor proposed substitute product.

2) A separate letter shall be furnished for each product substitution request.

b. Product Datasheets/Brochures:

1) Complete system brochure(s) and/or individual product data sheet(s), as applicable and appropriate for the Basis of Design product(s) the requested substitute is intended to replace.
2) Complete system brochure(s) and/or individual product data sheet(s), as applicable, for the proposed substitute product(s).

3. Failure to furnish the required information is sufficient grounds for rejection of the request for substitution.
4. A demonstration of the proposed substitute equipment and/or system(s) may be required by the Designer prior to consideration of substitute products or system(s). Costs associated with these demonstrations are the responsibility of the entity submitting the request.
5. Substitution Pre-Bid Submittal Exceptions:

a. Additional Approved Manufacturer(s):

1) These specifications may use phrases such as “or equal by,” or “Additional Approved Manufacture(s)” for products. When a product category uses these designations, it is an indication that a product model from one of the

listed manufacturer(s) may be provided without the requirement to obtain pre-bid approval for the model selected, provided that the Contractor has adequately researched and has become familiar with the Basis of Design product and intends to supply a model that is equal to or superior than the Basis of Design product.

2) Since it is impractical to enumerate every characteristic of modern electronic products, it is incumbent upon the Contractor to research manufacturer's publications to obtain the fullest possible understanding of Basis of Design / Standard of Quality products the Contractor proposes to substitute with a product from any Additional Approved Manufacturer considered.
3) Although not mandatory, for the Contractor's own protection, model specific pre-bid approval is strongly encouraged.
4) The decision as to whether a Contractor selected model from a list of Approved Additional Manufacturer(s) is acceptable remains solely with the Designer, and the Designer's decision is final.

E. Costs that result from the use of substitute products and/or Additional Approved Manufacturer(s), including costs for additional equipment, coordination, accessories, modules, interface products, cables, software, and programming, as well as costs for any additional labor, materials, and products incurred by other trades or members of the project Design Team or Owner, are the sole responsibility of the Contractor making the substitution. This includes costs that may not be incurred or known until after Contract award or Work execution. Such costs shall be deducted from final sum payable to the Contractor.

F. Post Contract award substitutions may be considered, but only if the proposed substitution includes substantial additional benefit to the Owner. Post award substitutions are considered solely at the discretion and convenience of the Designer. For a post Contract award substitution to be considered, one or more of the following shall apply:

1. The Designer initiates the request for substitution.
2. A basis of design product has become discontinued and is no longer available, and as a result, the use of a substitute product has become a necessity to meet the Owner's objectives for the Project. See "Discontinued Products."
3. The request for substitution is accompanied by a proposal that identifies the benefits to the Owner, including a fair-market Contract price reduction.

3.11 EXPLANATION AND PRECEDENCE OF DRAWINGS AND SPECIFICATIONS

A. Prior to submitting his bid, the Contractor shall review all Drawings and Specifications to determine any conflict with all applicable local codes, rules or regulations. The Contractor shall obtain clarification of such during bidding.

B. When the work as indicated on the Drawings and/or Specifications exceeds the minimum required by any code, standard, rule or regulation, the Drawings and/or Specifications shall govern the design and installation of the work.

C. For purposes of clarity and legibility, the Drawings are essentially diagrammatic although size and location of equipment are drawn to scale wherever possible. The Contractor shall make use of and verify all information on the Drawings and Specifications.

D. The Contractor shall fully inform himself regarding any and all peculiarities and limitations of the spaces available for the installation of all work and materials furnish and installed under this

Contract. He shall exercise due and particular caution to determine that all parts of his work are made readily accessible.

E. The Drawings indicate required sizes and points of termination of piping and suggests proper routes to conform to structure, avoid obstructions and preserve clearances. However, it is not intended that the Drawings indicate all necessary offsets, and it shall be the work of the Contractor to make the installation in such a manner as to conform to the structure, avoid obstructions, preserve headroom, keep openings and passageways clear and maintain required service clearances without additional cost to the Owner.

F. Significant changes by the Contractor in design, sizing and/or location of system piping, fixtures and/or equipment as shown on the Drawings are prohibited without prior written approval by the Owner. Should the Contractor fail to obtain the Owner's written approval and proceed to make these unauthorized changes, he does so at the risk of accepting total responsibility and related costs therein for the design elements he may alter.

G. It is intended that all plumbing devices, piping, etc. be located symmetrically with all Architectural elements. Refer to the Drawings and Specifications of all disciplines in completing the required coordination.

H. Where the Drawings and/or Specifications are in conflict, obtain clarification of such during bidding. Official clarification will only be given in written form. Any clarification issued by other than written form will not be considered official and shall be non-binding for work under this Contract. Where clarification cannot be delivered in a timely manner, the Contractor shall base his bid on the greater quantities, higher standards or more restrictive requirements. In the event of discrepancies in the Drawings and/or Specifications after the bid period, the Contractor shall advise the Architect and Engineer of such prior to proceeding with the work in question in order that correct progress of the work may be insured.

I. Prior to submitting his bid, the Contractor shall review all Drawings and Specifications to determine any conflict with all applicable local codes, rules or regulations. The Contractor shall obtain clarification of such during bidding as outlined above.

J. The submittal of his bid shall indicate the Contractor has examined the site; all applicable local codes, rules and regulations; the Drawings and Specifications and has included all required allowances in his bid. No allowance shall be made for any error or omission resulting from the Contractor's failure to visit the job site and/or review the Drawings and Specifications. The Contractor's bid shall include costs for all required drawings and changes as outlined above at no additional cost to the Owner.

3.12 SYSTEM TESTS

A. Perform all system tests in the presence of an authorized representative of the Owner and local authority having jurisdiction as applicable. Notify the Owner of all system's tests at least 48 hours in advance.

3.13 CLEANING PREMISES

A. During the progress of the work, clean up and leave the premises and all portions of the building in which work was performed in a clean and safe condition. Refer to Division 1.

3.14 MAINTENANCE, OPERATION INSTRUCTIONS, ETC.

A. General: Before final acceptance of the project by the Owner, the Contractor shall schedule with the Owner's maintenance personnel, at a time mutually convenient, a training session. At this time, he will thoroughly familiarize the Owner's maintenance personnel with all operating and service procedures (routine and emergency) associated with the building systems and equipment. Provide the Owner with a list of all equipment including the following information:

1. Manufacturer's name.
2. Equipment model number
3. Equipment serial number.
4. Local sales representative (including postal & email addresses and telephone & fax numbers).
5. Parts list, complete with source(s) of supply.
6. Complete internal wiring diagrams.
7. Warranties.

B. All directions for operation furnished by the manufacturer shall be carefully saved and turned over to the Owner, together with written sequence of operation, operating and maintenance schedules & instructions (routine and emergency) for each system and its equipment. All verbiage and units of measure shall be in English.

3.15 PROJECT SITE SAFETY

A. The Engineer claims no expertise in and assumes no responsibility for any and all safety procedures and protocols associated with the Contractor's work. The Contractor shall exercise due diligence and comply with all established safety standards and regulations as listed by OSHA and any equipment manufacturers' requirements as they may relate to personal safety. The Contractor shall insure that all of his subcontractor(s) and/or tradesmen are apprised of all safety-related standards and procedures as they may relate to their work and immediately correct any violation of OSHA standards and regulations or equipment manufacturers' safety recommendations.

3.16 WORK IN EXISTING SPACES

A. General: Care shall be taken when working in existing spaces so as not to damage existing walls and ceilings where work is being performed.

B. Existing Ceilings: Where work is being performed above ceilings, and the architectural drawings do not indicate ceiling modifications are the responsibility of others, remove and replace existing ceilings where work is being performed. In those instances, costs for all repair and installation of new grid, ceiling panels, etc shall be included. Match existing finishes.

C. New Ceilings: Where existing sprinklers are to remain, and the architectural drawings indicate replacement of the ceilings, temporarily remove and reinstall sprinkler escutcheons, etc. as required to accommodate the ceiling removal.

D. Walls & Floors: Patch existing walls and floors and match existing finishes where work is being removed or installed and patching is being performed, unless noted otherwise on the architectural drawings.

3.17 ARCHITECTURAL COORDINATION ITEMS

A. Cut and drill all openings in walls and floors required for the installation. Secure approval of Engineer before cutting and drilling. Neatly patch all openings cut.

B. Cutting and patching to be held to a minimum. Coordinate locations of sleeves and openings before construction is started.

C. Patching through fire rated walls and enclosures shall not diminish the rating of that wall or enclosure. Patch shall be equal to rockwool, firestop, caulk or approved "rated" patch.

D. Caulk or fire safe between sleeves and pipes, see Division 7 for caulking and fire-safing requirements and the floor plan and partition schedule for partition ratings.

E. Furnish all access panels required for proper servicing of equipment. Provide access panels for all concealed valves, controls, and sprinkler devices required by NFPA. Provide frame as required for finish. Exact locations to be approved by the Architect. Minimum size to be 12" x 12", units to be 16 gauge steel, locking device shall be screwdriver cam locks. Refer to Division 9 for access panel manufacturers and material requirements. Provide phenolic plate with ID of item behind access panel on the face of the door.

F. Install steel pipe sleeves two sizes larger than pipes passing through floors, walls or masonry construction.

G. Sleeves through walls to be cut flush with both faces.

H. Sleeves through floor to extend one inch above floor top elevation.

I. Caulk or fire safe between sleeves and pipes, see Division 7 for caulking and fire-safing requirements and the floor plan partition schedule for partition ratings.

J. Install manufactured chromium plated escutcheon plates wherever uninsulated exposed pipes pass through walls, floors, or ceilings. Escutcheon inside diameter to closely fit around pipe and outside diameter to completely cover opening.

K. Furnish and set all forms required in masonry walls or foundation to accommodate pipes.

L. Provide flexible connectors where all pipes cross building expansion joints. Coordinate exact quantity & location with Architectural plans prior to installation of piping.

END OF SECTION 220500

SECTION 220503 - SUBMITTALS FOR PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Division 22 General Requirements Section apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative, content and format requirements for preparation and submission of submittals.

B. Work of this Section is supplemental and additive to the requirements of Section 013300 where included in the Project Manual.

1.3 PRICE AND PAYMENT PROCEDURES

A. Payment in full or in part may be withheld from the Contractor for failure to comply with submittal requirements articulated in the Contract Documents.

1.4 SUBMITTALS

A. Submittals shall be furnished for each Section that includes one or more of the following elements of work:

1. Supply of one or more products.
2. Installation of one or more products.
3. Integration of one or more products.
4. Creation of one or more deliverable products.
5. Labeling of one or more products.
6. Contractor-based design or engineering of one or more products or systems.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Submittals shall be routed through established Project channels as identified by the Owner’s representative.

B. Coordinate, assemble, title, transmit and track Project submittals.

C. Label each submittal of each type similarly for consistency and so they appear as if prepared by the same entity. Like-type submittals (e.g., Product Data) from different Sections shall feature the same appearance and organization as those of other Sections.

D. Submittals prepared by subcontractors or vendors shall not be accepted unless prepared in compliance with the Contract Documents.

E. Submittal items listed in this Section represent the common items required to be supplied for the various specification Sections throughout the duration of the Project. Individual Sections will vary and may include additional or lesser requirements.

F. Designer reserves the right to require additional submittals or to waive select submittal requirements on a Section-by-Section basis. Additional submittals shall be provided at the Contractor's expense.

G. The cost for preparation and transportation of submittals is Work of the Contract.

H. Bind physical/hardcopy submittals together. Do not submit loose or paper clipped documents.

I. Supply separate submittals for each Section. Do not combine multiple Sections together into a single submittal, except where expressly directed within the Contract Documents.

J. Where electronic submittals are required or permitted, comply with the requirements for electronic submittals as identified in the Contract Documents.

K. Organize submittals as identified in the Contract Documents.

L. Furnish submittals for different Sections each with its own transmittal form. A single transmittal shall not be used to identify submittals for more than one (1) Section at a time. This allows for tracking and processing efficiency, so that:

1. Each Section may be reviewed simultaneously by different individuals, as appropriate.
2. Individual Sections may be processed and returned more quickly than others when some Sections require longer review times.
3. Submittals that are returned and marked as "Revise and Resubmit" do not cause submittals for other Sections to be also be resubmitted due to the fact that they were bound together as a single unit.

M. Use of Electronic Drawings from the Owner's Design Team:

1. Plan drawings for the Project were created with AutoCAD.
2. If expressly permitted by the Owner and the terms of the Contract, editable electronic versions of standard-scale, AutoCAD-based plan drawings may be made available for the creation of shop and as-built drawings.
3. Due to the proprietary nature of internal design systems, editable native-software versions of some drawings, including but not limited to system diagrams and details will not be made available in an editable form. In these cases, electronic versions of the drawings may be made available only in PDF, JPG or similar non-editable electronic form, at the sole discretion of the Designer.

3.2 SUBMITTAL TYPES

A. The following are the common submittal types referenced in this Section:

1. Quality Assurance (QA).
2. Quality Control (QC).
3. Product Data (PD).
4. Shop Drawing (SD).
5. Training (TG).
6. Field Observation Response (FO).
7. Closeout Submittal (CO).

3.3 SUBMITTAL SEQUENCE

A. Quality Assurance Submittal:

1. When not expressly requested to be supplied with bid, the Quality Assurance submittal(s) shall be supplied upon request. When requested the submittal shall be delivered to the Designer within 16 business hours.

B. Product Data Submittal:

1. Submit following contract award or notice of intent to award a contract. Product data shall be submitted and reviewed prior to procurement of materials.

C. Shop Drawing Submittal:

1. Submit for review prior to commencement of fabrication and installation.
2. Submit concurrently with Section-specific Product Data submittals.

D. Samples Submittal:

1. Submit concurrent with, or soon after, product data and shop drawings and prior to installation of Work.

E. Training Submittal:

1. Submit thirty (30) days prior to the first training session.

F. Field Observation Report Submittal:

1. Submit five (5) business days prior to punch list walkthrough.

G. Closeout Submittal:

1. Submit following completion of onsite work but not more than ten (10) business days following successful Acceptance Testing.

3.4 SUBMITTAL IDENTIFICATION

A. Identify each submittal uniquely.

B. Identify each submittal by specification Section number, submittal type, and submittal iteration.

C. The format for labeling the submittals shall be as follows:

1. Section Number–Submittal Type Abbreviation–Submittal Iteration.
2. Examples:

    a. First Product Data Submittal for section 224000: “224000-PD-00.”
    b. Revised Product Data Submittal for section 224000: “224000-PD-01.”
    c. Second Revised Product Data Submittal for 224000: “224000-PD-02.”

3.5 SUBMITTAL CONTENTS

A. All Submittals:

1. Transmittal:

    a. Supply a dedicated transmittal for submittals for each individual Section.
    b. Itemize the specific submittals included by Section, submittal type, and iteration.

2. Title Sheet:

    a. Include a separate title sheet with each submittal, of each type.
    b. Title sheets for each Section, for each submittal type, shall have the same appearance.
    c. Title sheets for product data submittals shall be 8-1/2 inches x 11 inches.
    d. Title sheets for drawings shall be the same size as the associated drawings.
    e. Create title sheets to have the appearance and information identified on the sample title sheet published at the end of this Section.

3. Index:

    a. Include an index outlining and identifying the contents of the submittal.
    b. The index for drawing submittals shall be incorporated onto the title sheet of the corresponding drawing set.

4. Checklists:

    a. Include the checklist(s) published in the Contract Documents corresponding to the type of submittal being supplied. Applicable checklists are found at the end of this Section and may also be found within individual Sections.

5. Title Blocks:

    a. Drawing submittals shall be created on the Contractor’s, manufacturer’s, or vendor’s own title block. The title blocks of the Owner, Architect, Engineer, Designer or their Consultants shall not be reproduced on any document (electronic or hardcopy) that is prepared or altered by the Contractor.

6. Legend:

    a. Drawing submittals shall include a legend of symbology.

7. Resubmittals:

a. Resubmittals shall include a replica of the reviewer's comments that necessitated the resubmittal, along with an accompanying item-by-item explanation of the actions taken and changes that will be found within the resubmittal.

B. Quality Assurance Submittals:

1. List of Subcontractors to be used on the Project along with a description of the role each will play on the Project.
2. The last six (6) projects that the Contractor (and each proposed Subcontractor) has completed that are of similar scope, size and contract value. References shall include:

a. Owner's name and current contact information.
b. Project address.
c. Description of the system(s) and scope of actual work performed.
d. Monetary contract value of the Work performed.

3. Financial Disclosure of the Contractor: Prior to contract award, upon request.

C. Product Data Submittals:

1. Bill of Materials (BOM):

a. Separate list for each system:

1) When a Section covers products for use in multiple systems, supply separate BOM for each unique system covered by the Section. Label each with the system name, space/room name, and room number.

b. Include the following:

1) Make, model, and description of each product.
2) Quantity estimates for each product.
3) Section paragraph number from which the product requirement is derived. Use drawing and detail references when the requirement is derived from the Drawings.

c. Organize the BOM to follow the order in which products appear within the Section. Products shown on the Drawings but not enumerated within the Specifications shall be placed at the end of the list and include a reference to the Drawing from which the product requirement was derived.

2. Product Datasheets Submittals:

a. Separate manufacturer datasheets for each product.
b. Datasheets shall be manufacturer originals or first generation printed versions (i.e., from PDF) of the manufacturer's official electronic datasheet:

1) Distributor modified, distributor branded, and/or html based "web" datasheets are not acceptable.
2) Datasheets shall include size and technical support data.

c. Where manufacturer's datasheets depict multiple products, versions and options, indicate via highlighting, underlining, or with bold visible arrows the model(s),

version(s) and option(s) being supplied. Exact catalog number(s) shall be indicated.

d. Each datasheet shall be labeled with the Section paragraph reference number. Datasheets shall include the Drawing reference when no specific paragraph reference exists within the Section.

D. Shop Drawing Submittals:

1. General:

a. Drawing descriptions identify the required contents of common drawings required under the Contract.
b. Drawings identified within individual Sections, along with any additional drawings deemed necessary by the Designer, are required.
c. Drawing Scales:

1) Floor plans shall be drawn to scale.
2) Section drawings shall be drawn to scale.
3) Elevation drawings shall be drawn to scale.
4) Details of physical items shall be drawn to scale.

d. Sizes:

1) Sheet sizes shall match the size of the Contract Drawings sheets, except where otherwise expressly requested or approved in advance by the Designer.

E. Training Submittals:

1. Proposed schedule.
2. Training agendas for each session.
3. Identification of personnel that will conduct training.
4. Handouts proposed for distribution during training.

F. Field Observation Report Submittals:

1. Written responses to Field Observation Reports supplied to the Contractor during the course of the Project:

a. The response shall include a copy of the original Field Observation Report.
b. The response shall include detail of the corrective action taken, the date the action was taken and the identity of the individual who took the action.

G. Closeout Submittals:

1. As-Built Drawings:

a. General:

1) Requirements for Shop Drawings apply to “As-Built” drawings.

b. Required Drawings:

1) Title Sheet.

2) Floor Plans.
3) As-built version of each Project shop drawing.

c. Drawing Formats:

1) Electronic Editable: Editable version using the native application used to create the file (e.g., Revit, AutoCAD).
2) Non-Editable: PDF file format.
3) Printed Hardcopy.
4) Sheets shall be the same size and feature consistent title block information in the lower-right corner.

d. Drawing Organization:

1) Hardcopy drawings shall be bound together into logical sets, bound along the left edge of the sheets.
2) The first page of the set shall include a detailed index and sheet-by-sheet description of each drawing sheet.

2. Operation and Maintenance Manuals:

a. Manual Format:

1) Hard-cover 3-ring type binder.
2) Front clear plastic cover pocket complete with Project and system Information insert.
3) Clear plastic spine pocket with Project and system Information insert.
4) Binder sized to suit the contents only, neither oversized nor undersized.
5) Maximum binder thickness: 3 inches.

b. Manual Contents and Organization:

1) General:

i) Separate binder (or binder set) for each system, labeled. Provide no more than one system per binder (or binder set).
ii) Separate CD-ROM (or CD-ROM set) for each system, labeled. Provide no more than one system per CD-ROM (or CD-ROM set).
iii) Do not overfill. Binders shall not be filled beyond an easily usable capacity.
iv) Insert labeled tabs within binder to identify separate contents of the manual.
v) Labeled sub-directories shall be created on the CD-ROM to label and separate contents for the manual.

2) Project Information Cover:

i) Title of Project.
ii) Name and address of Owner, Designer, Architect, Contractor of Record and Subcontractor.
iii) System name and specification references.

3) Index:

i) Contents of the manual.

4) Warranty Statement:

i) A warranty statement shall be included for each system. The warranty statement shall reiterate the terms of warranty identified within the Contract Documents, as well as identify how the Owner is to obtain warranty service.
ii) The warranty statement shall clearly identify which products are covered by Manufacturer warranties beyond the Contractor required minimum warranty period. The term of manufacturer warranty shall also be identified (e.g., 2 year parts and labor).
iii) A separate warranty statement shall be supplied for each system.
iv) Identify the date that the warranty for the system starts. This date shall be the date listed on the Certificate of Substantial Completion (if one was issued to the contractor specifically for the system) or the date listed on the Notice of Final Completion.
v) Supply standard out-of-warranty service rates and service contact information.

5) Bill of Materials:

i) List of products supplied.
ii) Serial numbers of each product.

6) Product Datasheets (supply only in the electronic version of Operation and Maintenance Manual):

i) Manufacturer datasheets for each product supplied.

7) Manufacturer Owner / User Manuals:

i) Manufacturer's Owner's or User's manual for each product.
ii) Manufacturer's Installation instructions and other documentation supplied with the product.

8) Test Reports and Checklists:

i) Test reports, checklists, and other forms generated and completed during the course of the Project.

9) Training Information:

i) Photocopy of training outlines / agendas.
ii) Photocopy of training session handouts.
iii) Photocopy of training sign-in sheets.
iv) Photocopy of signed delivery receipt for each training session recording (applicable to those Sections/systems requiring recording).

10) As-Built Drawings:

i) The hardcopy manual shall contain reduced scale printed version (11x17) of system-specific drawings.

ii) The electronic manual shall contain electronic PDF version of the as-built drawings.

3.6 SUBMITTAL QUANTITY

A. General:

1. The quantity of submittals required shall be the greater of the following:

a. Quantity identified within Division 01.
b. Quantity identified within the individual Section.
c. Quantity identified herein.

2. In addition to the Contract required quantity, the Contractor shall also submit any additional quantities required for its own use and records, and for distribution to other trades.
3. The Designer shall retain a copy of each submittal received. Others in the submittal communication chain may also retain copies.

B. Product Data Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

C. Shop Drawings Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

D. Training Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

E. Field Observation Report Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

F. Samples Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

G. Closeout Submittals:

1. Two (2) Hardcopies.
2. One (2) Electronic.

3.7 SUBMITTAL REJECTION

A. The following items are representative reasons that submittals may need to be revised and resubmitted:

1. Binding submittals for multiple Sections together.
2. Failing to supply separate transmittal for submittals for each Section.
3. Failing to include a submittal title sheet.
4. Failing to use and accurately complete the published title sheet.
5. Failing to supply and accurately complete the submittal checklists.
6. Failing to supply product data and shop drawings at the same time.
7. Failing to include a detailed BOM with the product data.
8. Failing to supply product data sheets.
9. Failing to supply product data sheets with the correct product and required accessories enumerated.
10. Failing to supply shop drawings.
11. Failing to supply shop drawings with required information.
12. Failing to supply accurate information.
13. Failing to supply relevant information required by the Specifications.
14. Failing to supply products that are in compliance with the Specifications.
15. Failing to supply the required information in the required format.

3.8 RESUBMITTALS

A. Revise and Resubmit:

1. When a submittal is rejected and flagged as “Revise and Resubmit,” the entire submittal shall be reviewed, revised and resubmitted in totality.
2. Resubmittals shall be checked for compliance with the Contract Documents, inclusive of requirements for submittals. In addition, any comments and deficiencies identified by the reviewer shall be appropriately acted upon.

B. Exceptions Noted:

1. When a submittal is flagged as “Exceptions Noted,” the specific actions identified shall be taken.
2. If the reviewer’s comments include selective rejection of products, the resubmittal shall be limited to include those items commented upon.

C. Resubmittals shall:

1. Include a copy of the reviewer’s previous comments.
2. Include a written description of the action(s) taken.
3. Be labeled chronologically.
4. Be inclusive of all corrective action identified by the previous reviewer.

3.9 ELECTRONIC SUBMITTALS

A. Electronic submittals shall only be permissible where electronic submittals are expressly required and where express approval for such has been granted.

B. Electronic submittal files shall be compatible for opening and viewing with electronic PDF file readers that fully support and recognize the Adobe PDF Portable Document Format Standard, version 1.5.

C. Major text within the files shall be electronically searchable using the search-for-text features of current generation Adobe PDF reader software. Files shall be prepared in such manner that reviewers will have the option to search for and find words and phrases that appear within the document, electronically. Documents featuring raster-based text and text that is otherwise not searchable shall not be acceptable. This precludes the use of documents that have been electronically scanned and then converted to or embedded within an electronic file.

D. The organization, contents, and labeling of information along with other requirements for submittals apply also to electronic versions of the submittals.

E. Single File Submission:

1. Option 1 – Single File, PDF Format:

a. Single PDF file submittals shall be assembled from a series of individual files that are organized, indexed, bound together as one composite file that is bookmarked to aid the reviewer in navigating the content.
b. The file shall feature a navigational tree of contents, organized by content groups (e.g., Title Page, Index, BOM, Datasheets, Shop Drawings). Content groups shall be organized in the same relative order identified within the Contract Documents.
c. Within each content group shall be the supporting elements of the group (e.g., product datasheets under the Datasheets group). Each element of the content group shall appear separately as a subordinate element of the group (e.g., separate entry for each product datasheet, separate entry for each shop drawing), and viewable from the navigational contents tree.
d. Under the Datasheets content group, individual product datasheet entries shall be identified by Make/Brand and Model. Entries shall be organized in a sorted manner, first by make, then by model.
e. If the resulting size of the composite PDF file exceeds 10 Megabytes, supply the submittal using the Single Zip File method instead, as described in this Section.
f. The file name used to label the submittal shall be the section number followed by the submittal instance number for that Section (e.g., 224000-PD-01.pdf).

1) Where the Designer directs the supply of multiple zip files for a submittal, add additional text to the file name to identify that the file is part of a multi-file set of submittals, as per the following examples:

i) 224000-PD-01 (1 of 3).pdf
ii) 224000-PD-01 (2 of 3).pdf
iii) 224000-PD-01 (3 of 3).pdf

2. Option 2 – Single File, Zip Format:

a. Single Zip File submittals shall be assembled from a series of individual PDF files and file directories that are contained with a single compressed WinZip compatible ".zip" file.
b. The file shall contain separate top-level directories that are used to group related content (e.g., 00-Title Page, 01-Index, 02-BOM, 03-Datasheets, 04-Shop Drawings), with each directory appearing in the same relative order as that identified in the Contract Documents.

c. Within each content group directory shall be separate PDF-compliant files featuring the information required (e.g., separate datasheet file for each product, separate file for each drawing, separate file for each BOM).
d. Product datasheet files shall be named using a consistent naming convention that enables those files to appear sorted and grouped when the file is opened for navigation, viewing or extraction by the reviewer.
e. Product datasheet files shall be consistently named with the make/brand of the product, followed by model number, followed by any additional information beneficial.
f. Consult the Designer for supplement instructions should the WinZip file exceed 50 Megabytes in size.
g. The file name used for the submittal shall be the Section number followed by the submittal instance number for that Section (e.g., 224000-PD-01.zip).

    1) Where the Designer directs the supply of multiple zip files for a submittal, add text to the file name that identifies the file is part of a multi-file set as per the following examples:

        i) 224000-PD-01 (1 of 3).zip
        ii) 224000-PD-01 (2 of 3).zip
        iii) 224000-PD-01 (3 of 3).zip

END OF SECTION 220503

SUBMITTAL TITLE SHEET
EXAMPLE
(Form: Sub-1)

PROJECT TITLE:
Project Name Line 1
Project Name Line 2
Project Name Line 2

SUBMITTAL TYPE:
Product Data

SECTION SUBMITTAL NUMBER
224000-PD-00

SECTION TITLE:
Plumbing Fixtures

Date Prepared:
yyyy-mm-dd

CONTRACTOR OF RECORD:
Firm Name
Address1
Address 2
City, State, Zip
Phone (000) 000-0000, Fax (000) 000-0000
Project Manager: Full Name
PM E-Mail: xxxxxxxx@xxxx.xxx

SECTION SUBCONTRACTOR(S):

Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: xxxxxxxxx@xxxx.xx	Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: xxxxxxxxx@xxxx.xx

PRODUCT DATA SUBMITTAL
CHECKLIST
(Form: Sub-2)

Each line below featuring text shall be supplied with an answer.

	No	Yes
Transmittal		
Title Sheet		
Project Name		
Specification Section number		
Submittal iteration number *(0 for first iteration, 1 + for each subsequent iteration (e.g., 224000-0, 224000-1))*		
Contractor of Record identified		
Sub-contractor / vendor / supplier name identified		
Title Sheet appearance consistent with sample title sheet		
Bill of Materials		
Section paragraph and/or Drawing reference identified		
Make		
Model		
Product Description		
Separate lists included for each system		
Checklists included		
This checklist		
Checklists from Section being submitted (where applicable)		
Previous submittal review, with contractor actions and comments		
Product Datasheets included		
Datasheets are manufacturer originals		
Datasheets for each product included		
Section paragraph and/or Drawing reference on each datasheet		
Product accessories and options identified		
Products organized by paragraph (or alphabetically by brand)		
No photocopies, faxes and other illegible datasheets included		
Shop Drawings included		
Shop drawings accompany this product data submittal.		
This submittal contains product data for one Section only.		

This checklist serves as a simple and abbreviated reminder of the contents and format of the aforementioned submittal. Refer to Section 220503 "Submittals for Plumbing" and each specific Section for additional submittal requirements. Submittals are subject to rejection if this checklist is not accurately completed and provided along with the specified information. Reproduce this checklist and submit with each submittal for each Section.

SECTION 220505 - EXISTING CONDITIONS AND DEMOLITION

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 DESCRIPTION OF WORK

A. Prior to submitting a bid, the Plumbing Contractor shall perform a detailed walk-through field inspection, to review the existing structures and premises, to determine all existing conditions, equipment/ piping locations, etc. and shall make all necessary allowances for all required Plumbing related demolition and relocation work. This pre-bid inspection by the Plumbing Contractor shall include inspection of all applicable accessible ceiling cavity, areas, etc.

B. Should the Plumbing Contractor take any exceptions to providing any related demolition or relocation work, such exceptions shall be stated in detail within the Prime Contractor's bid. No subsequent allowance to the contract cost shall be made for any insufficient allowances made by the Plumbing Contractor during bidding which may result from the Plumbing Contractor's failure to visit job site and review drawings.

C. Demolition related work may not be specifically indicated on drawings, but shall be included under base bid. All Plumbing related demolition, relocation, etc. work, including work described herein, shall be under base bid.

D. It is not the intent of these contract documents that existing conditions be accurately shown. Existing Plumbing work is shown to a limited extent on drawings and is shown for general planning reference only. Such locations, etc. have been located from portions of contract documents which were prepared for previously installed work (not from "as-builts"). These locations are not guaranteed. The successful Plumbing Contractor shall have access to all available existing building/system plans and specifications.

E. The existing plumbing systems may be utilized only to the extent indicated herein or on drawings and/or as directed by Owner's representative in field.

F. Routing of all new plumbing systems in existing buildings shall be approved by Owner's representative prior to installation.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 AFFECT ON ADJACENT OCCUPIED AREAS

A. Locate, identify, and protect existing Plumbing services passing through demolition areas and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services for affected areas.

B. It is recognized that there may be some systems rendered inactive by demolition, causing disconnection of "downstream" branches, equipment, etc. which serve occupied areas. It shall be the responsibility of the Plumbing Contractor to investigate these types of conditions (for all systems) prior to demolition. Provide all necessary corrective Plumbing work prior to demolition to ensure that such "downstream" work remain permanently active throughout demolition, new construction and after project completion.

C. All work and system shutdowns shall be carefully coordinated in advance with owner's representative and all affected trades so that normal building activities and other construction trades are minimally affected. All required Plumbing related demolition and/or new construction work, which will affect any and all occupied areas (including those which are located outside the immediate area of project work) shall be performed at special times if/as directed by Owner's representative in field.

D. All existing systems and components shall remain fully operational in all occupied spaces during all occupied periods.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent finished areas and/or other system components. During cutting and patching operations, protect adjacent installations. Remove protection and barriers after demolition operations are complete.

3.2 WORK IN EXISTING SPACES

A. General: Care shall be taken when working in existing spaces so as not to damage existing walls and ceilings where work is being performed.

B. Existing Ceilings: Where work is being performed above ceilings, and the architectural drawings do not indicate ceiling modifications by the General Contractor, it shall be the responsibility of this contractor to remove and replace existing ceilings where work is being performed. In those instances, all repair and installation of new grid, ceiling panels, etc shall be the responsibility of this contractor. Match existing finishes.

C. Walls & Floors: It shall be the responsibility of this contractor to patch existing walls and floors and match existing finishes where work is being removed or installed and patching is being performed, unless noted otherwise on the architectural drawings.

D. If asbestos, PCB's, or other hazardous materials are encountered in the course of the work, stop work in the vicinity of such materials and report their presence to the Owner. Owner will arrange for proper removal and disposal of hazardous materials.

3.3 GENERAL DEMOLITION

A. Provide complete Plumbing demolition as required for all systems throughout all project areas not indicated to be salvaged or saved. Unless specifically noted otherwise on plans or determined otherwise during this contractor's pre-demolition survey, all abandoned existing Plumbing work in the project areas shall be disconnected and removed in its entirety by the Plumbing Contractor. All related work shall comply with the notes specified herein.

B. Provide demolition work as required to clear and remove all existing Plumbing work to be abandoned and as required to accommodate all new work of all trades. In general, remove existing related piping, control media, etc. back to nearest concealed accessible terminal or take-off "upstream". Extend piping, etc. as required to accommodate new or relocated Plumbing work.

C. Remove abandoned, inactive and obsolete equipment, piping, etc. Abandoned work embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove all abandoned materials above accessible ceilings.

D. Perform cutting and patching required for demolition in accordance with the contract documents.

E. All abandoned and piping shall be removed and capped back to respective sources, even if sources are outside of the confines of the project area. Coordinate all work carefully with Owner prior to beginning any Plumbing demolition work.

F. All piping, etc. conflicting with construction related work of any and all trades shall be removed and/or relocated by the Plumbing Contractor as necessary and/or as directed by Owner's representative in the field. Plumbing disconnections (and/or reconnections) for equipment to be removed (and/or relocated) shall be by the Plumbing Contractor. This shall apply to all existing Plumbing work whether shown on drawings or not.

G. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

H. Provide new work as required to accommodate relocations, etc. Routing of all new and piping in existing buildings shall be held tight to structure above wherever possible and shall be approved by owner's representative prior to installation.

3.4 DISPOSITION OF REMOVED EQUIPMENT & MATERIALS

A. Except where specifically noted otherwise herein or on drawings, all Plumbing work shown on new work plans shall be new.

B. If required to accommodate construction related activities, remove and reinstall any conflicting fixtures, devices or equipment that are to remain.

C. All abandoned materials removed during demolition and thereafter shall be referred to the Owner's representative for disposal instructions. All materials which the Owner elects to retain shall be neatly stored at the site by the Plumbing Contractor as designated by the Owner's representative. All materials which the Owner elects not to retain shall be disposed of by the Plumbing Contractor in a lawful manner.

D. All fixtures, devices or equipment designated for salvage (removal and reuse, or for turning over to Owner) shall be disconnected and removed undamaged. Disconnect all pigtails, etc. from equipment terminal points and carefully transport and neatly store same to a protected on-site storage location as directed in field.

E. Components to be reused shall be cleaned (inside and out) and reinstalled where indicated on drawings. Modify and/or extend related existing ductwork and/or piping as required.

F. Components turned over to Owner shall be neatly stored as groups by system type.

3.5 PRE-EXISTING CODE VIOLATIONS

A. All existing work which is accessed and/or used under this project shall be inspected and brought into compliance with current codes and standards by the Plumbing Contractor. This shall apply only to the extent that such work is uncovered in the immediate project areas affected by demolition and/or new construction and only to the limited extent that it applies to pre-existing general installation methods (i.e. a missing hanger/support, a missing seal and other minor incidental work.

B. If more extensive code or safety violations are discovered by the Plumbing Contractor, they shall be immediately brought to the attention (detailed in writing) of the Owner's representative along with the contractors proposed cost for corrections.

3.6 INTERIM LIFE SAFETY WORK

A. Provide interim fire protection (sprinkler) work in all demolition and construction areas for full code coverage. Further definition will be provided in field if required.

END OF SECTION 220505

SECTION 22 05 18.00 - ESCUTCHEONS FOR PLUMBING PIPING

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. Escutcheons.
   2. Floor plates.

PART 2 - PRODUCTS

2.1 ESCUTCHEONS

A. One-Piece, Cast-Brass Type: With polished, chrome-plated finish and setscrew fastener.

B. Split-Casting Brass Type: With polished, chrome-plated finish and with concealed hinge and setscrew.

2.2 FLOOR PLATES

A. One-Piece Floor Plates: Cast-iron flange with holes for fasteners.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install escutcheons for piping penetrations of walls, ceilings, and finished floors.

B. Install escutcheons with ID to closely fit around pipe, tube, and insulation of insulated piping and with OD that completely covers opening.
   1. Escutcheons for New Piping:
      a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
      b. Chrome-Plated Piping: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
      c. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.

d. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass or split-casting brass type with polished, chrome-plated finish.
e. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass or split-casting brass type with rough-brass finish.
f. Bare Piping in Equipment Rooms: One-piece, cast-brass or split-casting brass type with rough-brass finish.

2. Escutcheons for Existing Piping:
a. Chrome-Plated Piping: Split-casting brass type with polished, chrome-plated finish.
b. Bare Piping at Wall and Floor Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
c. Bare Piping at Ceiling Penetrations in Finished Spaces: Split-casting brass type with polished, chrome-plated finish.
d. Bare Piping in Unfinished Service Spaces: Split-casting brass type with rough-brass finish.
e. Bare Piping in Equipment Rooms: Split-casting brass type with rough-brass finish.

C. Install floor plates for piping penetrations of equipment-room floors.

D. Install floor plates with ID to closely fit around pipe, tube, and insulation of piping and with OD that completely covers opening.
1. New Piping: One-piece, floor-plate type.
2. Existing Piping: Split-casting, floor-plate type.

3.2 FIELD QUALITY CONTROL

A. Replace broken and damaged escutcheons and floor plates using new materials.

END OF SECTION 22 05 18.00

SECTION 220523 - GENERAL-DUTY VALVES FOR PLUMBING PIPING

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. Bronze ball valves.
2. Bronze swing check valves.

B. The requirements of the Lead-Free Law S.3874 are currently being enforced in California, Vermont, and Delaware, and will go into effect for all areas in the United States on January 4, 2014. Where the Law pertains, it is the contractor's responsibility to provide lead-free products as mandated by the Law and as required/interpreted by the Authority Having Jurisdiction. This requirement will be enforced by inspectors at the time of inspection, not based on the day that the project was permitted.

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene copolymer rubber.

C. NBR: Acrylonitrile-butadiene, Buna-N, or nitrile rubber.

D. PTFE: Polytetrafluoroethylene.

E. NRS: Nonrising stem.

F. OS&Y: Outside screw and yoke.

G. RS: Rising stem.

1.4 SUBMITTALS

A. General:

1. Comply with Section 22 05 03.00 "Submittals for Plumbing."

B. Product Data (PD):

1. Provide product datasheets for all valves.

C. Closeout Submittals (CO):

1. Provide operation and maintenance manuals for all valves.

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance: NSF 61 for valve materials for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces, grooves, and weld ends.
3. Set ball and plug valves open to minimize exposure of functional surfaces.
4. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

A. Refer to valve schedule articles for applications of valves.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve Sizes: Same as upstream piping unless otherwise indicated.

D. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.

E. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Grooved: With grooves according to AWWA C606.
3. Solder Joint: With sockets according to ASME B16.18.

    a. Use solder with melting point below 840 deg F for check valves and below 421 deg F for ball valves

4. Threaded: With threads according to ASME B1.20.1.

2.2 BRONZE BALL VALVES

A. Two-Piece, Full-Port, Bronze Ball Valves with Bronze Trim:

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. American Valve, Inc.
    b. Conbraco Industries, Inc.; Apollo Valves.
    c. Crane Co.; Crane Valve Group; Crane Valves.
    d. Hammond Valve.
    e. Lance Valves; a division of Advanced Thermal Systems, Inc.
    f. Legend Valve.
    g. Milwaukee Valve Company.
    h. NIBCO INC.
    i. Red-White Valve Corporation.
    j. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

2. Description:

    a. Standard: MSS SP-110.
    b. CWP Rating: 600 psig.
    c. Body Design: Two piece.
    d. Body Material: Bronze.
    e. Seats: PTFE or TFE.
    f. Stem: Bronze.
    g. Ball: Chrome-plated brass.
    h. Port: Full.

2.3 BRONZE SWING CHECK VALVES

A. Class 125, Bronze Swing Check Valves with Bronze Disc:

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. American Valve, Inc.
    b. Crane Co.; Crane Valve Group; Crane Valves.
    c. Crane Co.; Crane Valve Group; Jenkins Valves.
    d. Crane Co.; Crane Valve Group; Stockham Division.
    e. Hammond Valve.

f. Kitz Corporation.
g. Milwaukee Valve Company.
h. NIBCO INC.
i. Powell Valves.
j. Red-White Valve Corporation.
k. Watts Regulator Co.; a division of Watts Water Technologies, Inc.
l. Zy-Tech Global Industries, Inc.

2. Description:

a. Standard: MSS SP-80, Type 3.
b. CWP Rating: 200 psig.
c. Body Design: Horizontal flow.
d. Body Material: ASTM B 62, bronze.
e. Ends: Threaded.
f. Disc: Bronze.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations.

C. Examine threads on valve and mating pipe for form and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown.

B. Locate valves for easy access and provide separate support where necessary.

C. Install valves in horizontal piping with stem at or above center of pipe.

D. Install valves in position to allow full stem movement.

E. Install check valves for proper direction of flow and as follows:

1. Swing Check Valves: In horizontal position with hinge pin level.

3.3 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.4 DOMESTIC WATER VALVE SCHEDULE

A. Isolation/Control Valves

1. All valves installed in domestic water piping 3” and smaller shall be ball valves.

a. Ball Valves - 1 Inch and Smaller: 2-piece body, 600 psi CWP, lead-free dezincification-resistant body, full port, PTFE seats, blowout-proof stem, adjustable packing gland and vinyl-covered steel handle. Provide extended valve stems for valves used on insulated lines. Provide equal to Nibco Series 685-80-LF.

b. [Ball Valves – 1-1/4 Inch and Larger: 3-piece body, 600 psi CWP, lead-free dezincification-resistant body, full port, PTFE seats, blowout-proof stem, adjustable packing gland and vinyl-covered steel handle. Provide extended valve stems for valves used on insulated lines. Provide equal to Nibco Series 595-Y-LF.

B. Check Valves

1. Valves shall be Y-pattern swing-type rated 200 psi non-shock CWP. Body, bonnet, and disc hanger are to be lead-free dezincification-resistant material and PTFE seat disc. Valve ends may be threaded or solder-type. Provide equal to Nibco 413-Y-LF.

END OF SECTION 220523

SECTION 220529 - HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

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 pipe hangers and supports.
2. Trapeze pipe hangers.
3. Metal framing systems.
4. Thermal-hanger shield inserts.
5. Fastener systems.
6. Pipe stands.
7. Pipe positioning systems.
8. Equipment supports.

B. Related Sections:

1. Section 055000 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 220516 "Expansion Fittings and Loops for Plumbing Piping" for pipe guides and anchors.
3. Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment" for vibration isolation devices.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for plumbing piping and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, including pipe stands, capable of supporting combined weight of supported systems, system contents, and test water.
2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

3. Design seismic-restraint hangers and supports for piping and equipment and obtain approval from authorities having jurisdiction.
4. Where more than one type of material is allowed, the hangers and supports provided shall be rated to support the piping and equipment they are intended to hang or support.

1.5 SUBMITTALS

A. General:

1. Comply with Section 22 05 03.00 “Submittals for Plumbing.”

B. Product Data (PD):

1. Provide product datasheets for all hangers and supports.

C. Closeout Submittals (CO):

1. Provide operation and maintenance manuals for all hangers and supports.

1.6 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped.
3. Nonmetallic Coatings: Plastic coating, jacket, or liner.
4. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
5. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon or stainless steel.

B. Stainless-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
3. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon or stainless steel.

C. Copper Pipe Hangers:

1. Description: MSS SP-58, Types 1 through 58, copper-coated-steel, factory-fabricated components.
2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel or stainless steel.

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 METAL FRAMING SYSTEMS

A. Manufacturer Metal Framing Systems:

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. Allied Tube & Conduit.
    b. Cooper B-Line, Inc.
    c. Flex-Strut Inc.
    d. GS Metals Corp.
    e. Thomas & Betts Corporation.
    f. Unistrut Corporation; Tyco International, Ltd.
    g. Wesanco, Inc.
    h. Anvil International; a subsidiary of Mueller Water Products Inc.
    i. Empire Industries, Inc.
    j. ERICO International Corporation.
    k. Haydon Corporation; H-Strut Division.
    l. NIBCO INC.
    m. PHD Manufacturing, Inc.
    n. PHS Industries, Inc.

2. Description: Shop- or field-fabricated pipe-support assembly for supporting multiple parallel pipes.
3. Standard: MFMA-4.
4. Channels: Continuous slotted steel channel with inturned lips.
5. Channel Nuts: Formed or stamped steel nuts or other devices designed to fit into channel slot and, when tightened, prevent slipping along channel.
6. Hanger Rods: Continuous-thread rod, nuts, and washer made of carbon steel or stainless steel.

2.4 THERMAL-HANGER SHIELD INSERTS

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. Carpenter & Paterson, Inc.
2. Clement Support Services.
3. ERICO International Corporation.

4. National Pipe Hanger Corporation.
5. PHS Industries, Inc.
6. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
7. Piping Technology & Products, Inc.
8. Rilco Manufacturing Co., Inc.
9. Value Engineered Products, Inc.

B. Insulation-Insert Material for Cold Piping: ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength and vapor barrier.

C. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig or ASTM C 552, Type II cellular glass with 100-psig or ASTM C 591, Type VI, Grade 1 polyisocyanurate with 125-psig minimum compressive strength.

D. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

E. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

F. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.5 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated or stainless-steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

2.6 PIPE STANDS

A. General Requirements for Pipe Stands: Shop- or field-fabricated assemblies made of manufactured corrosion-resistant components to support roof-mounted piping.

B. Compact Pipe Stand: One-piece plastic unit with integral-rod roller, pipe clamps, or V-shaped cradle to support pipe, for roof installation without membrane penetration.

C. Low-Type, Single-Pipe Stand: One-piece plastic or stainless-steel base unit with plastic roller, for roof installation without membrane penetration.

D. High-Type, Single-Pipe Stand:

1. Description: Assembly of base, vertical and horizontal members, and pipe support, for roof installation without membrane penetration.
2. Base: Plastic or stainless steel.
3. Vertical Members: Two or more cadmium-plated-steel or stainless-steel, continuous-thread rods.
4. Horizontal Member: Cadmium-plated-steel or stainless-steel rod with plastic or stainless-steel, roller-type pipe support.

E. High-Type, Multiple-Pipe Stand:

1. Description: Assembly of bases, vertical and horizontal members, and pipe supports, for roof installation without membrane penetration.
2. Bases: One or more; plastic.
3. Vertical Members: Two or more protective-coated-steel channels.
4. Horizontal Member: Protective-coated-steel channel.
5. Pipe Supports: Galvanized-steel, clevis-type pipe hangers.

F. Curb-Mounting-Type Pipe Stands: Shop- or field-fabricated pipe supports made from structural-steel shapes, continuous-thread rods, and rollers, for mounting on permanent stationary roof curb.

2.7 PIPE POSITIONING SYSTEMS

A. Description: IAPMO PS 42, positioning system of metal brackets, clips, and straps for positioning piping in pipe spaces; for plumbing fixtures in commercial applications.

2.8 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.9 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

B. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.

2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

C. Metal Framing System Installation: Arrange for grouping of parallel runs of piping, and support together on field-assembled metal framing systems.

D. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

E. Fastener System Installation:

1. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
2. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

F. Pipe Stand Installation:

1. Pipe Stand Types except Curb-Mounted Type: Assemble components and mount on smooth roof surface. Do not penetrate roof membrane.
2. Curb-Mounted-Type Pipe Stands: Assemble components or fabricate pipe stand and mount on permanent, stationary roof curb. See Section 077200 "Roof Accessories" for curbs.

G. Pipe Positioning-System Installation: Install support devices to make rigid supply and waste piping connections to each plumbing fixture.

H. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

I. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

J. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

K. Install lateral bracing with pipe hangers and supports to prevent swaying.

L. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, and strainers, NPS 2-1/2 and larger and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

M. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

N. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

O. Insulated Piping:

1. Attach clamps and spacers to piping.

a. Clamps shall not project through insulation.
b. Use thermal-hanger shield insert with clamp sized to match OD of insert.
c. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 39, protection saddles if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

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 a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Section 099113 "Exterior Painting", Section 099123 "Interior Painting" or Section 099600 "High-Performance Coatings."

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Specific hanger and support requirements are in Sections specifying piping systems and equipment.

B. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

C. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

D. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

E. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers, and metal framing systems and attachments for general service applications.

F. Use stainless-steel pipe hangers and stainless-steel or corrosion-resistant attachments for hostile environment applications.

G. Use copper-plated pipe hangers and copper or stainless-steel attachments for copper piping and tubing.

H. Use padded hangers for piping that is subject to scratching.

I. Use thermal-hanger shield inserts for insulated piping and tubing.

J. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Adjustable, Steel Clevis Hangers (MSS Type 1): For suspension of noninsulated or insulated, stationary pipes NPS 1/2 to NPS 30.
2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of up to 1050 deg F, pipes NPS 4 to NPS 24, requiring up to 4 inches of insulation.
3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes NPS 3/4 to NPS 36, requiring clamp flexibility and up to 4 inches of insulation.
4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes NPS 1/2 to NPS 24 if little or no insulation is required.
5. Pipe Hangers (MSS Type 5): For suspension of pipes NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable, Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of noninsulated, stationary pipes NPS 3/4 to NPS 8.
7. Adjustable, Steel Band Hangers (MSS Type 7): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
9. Adjustable, Swivel-Ring Band Hangers (MSS Type 10): For suspension of noninsulated, stationary pipes NPS 1/2 to NPS 8.
10. Split Pipe Ring with or without Turnbuckle Hangers (MSS Type 11): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of noninsulated, stationary pipes NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipes NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes NPS 4 to NPS 36, with steel-pipe base stanchion support and cast-iron floor flange or carbon-steel plate, and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes NPS 2-1/2 to NPS 36 if vertical adjustment is required, with steel-pipe base stanchion support and cast-iron floor flange.
17. Single-Pipe Rolls (MSS Type 41): For suspension of pipes NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes NPS 2-1/2 to NPS 24, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes NPS 2 to NPS 42 if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes NPS 2 to NPS 24 if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes NPS 2 to NPS 30 if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

K. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers NPS 3/4 to NPS 24.
2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers NPS 3/4 to NPS 24 if longer ends are required for riser clamps.

L. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.
3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450 deg F piping installations.

M. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction, to attach to top flange of structural shape.
3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
6. C-Clamps (MSS Type 23): For structural shapes.
7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
11. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

    a. Light (MSS Type 31): 750 lb.
    b. Medium (MSS Type 32): 1500 lb.
    c. Heavy (MSS Type 33): 3000 lb.

13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

N. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel-Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
2. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
3. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

O. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41, roll hanger with springs.
4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from hanger.
6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from base support.
7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to allow expansion and contraction of piping system from trapeze support.
8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:

    a. Horizontal (MSS Type 54): Mounted horizontally.
    b. Vertical (MSS Type 55): Mounted vertically.
    c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

P. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

Q. Comply with MFMA-103 for metal framing system selections and applications that are not specified in piping system Sections.

R. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

S. Use pipe positioning systems in pipe spaces behind plumbing fixtures to support supply and waste piping for plumbing fixtures.

END OF SECTION 220529

SECTION 220553 - IDENTIFICATION FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe labels.
2. Valve tags.

1.3 SUBMITTALS

A. General:

1. Comply with Section 22 05 03.00 “Submittals for Plumbing.”

B. Product Data (PD):

1. Provide product datasheets for all labels, signs, valve tags, and warning tags.

C. Closeout Submittals (CO):

1. Provide operation and maintenance manuals for all plumbing components, fixtures, valves, and equipment.
2. Valve numbering scheme.

1.4 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT LABELS

A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.
2. Letter Color: Black.
3. Background Color: White.
4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Label Content: Include equipment's Drawing designation or unique equipment number, Drawing numbers where equipment is indicated (plans, details, and schedules), and the Specification Section number and title where equipment is specified.

C. Equipment-Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules) and the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, with predrilled holes for attachment hardware.

B. Letter Color: White.

C. Background Color: Red.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service and showing flow direction.

B. Pretensioned Pipe Labels: Precoiled, semirigid plastic formed to cover full circumference of pipe and to attach to pipe without fasteners or adhesive.

C. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

D. Pipe-Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings; pipe size; and an arrow indicating flow direction.

1. Flow-Direction Arrows: Integral with piping-system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
2. Lettering Size: At least 1-1/2 inches high.

2.4 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping-system abbreviation and 1/2-inch numbers.

1. Tag Material: Brass, 0.032 inch thick, with predrilled holes for attachment hardware.
2. Fasteners: Brass beaded chain.

B. In Microsoft Excel format on CD, provide a spreadsheet listing of all valves utilized for this project which includes the following:

1. Valve number

a. Use “XX” for prefix, then number, where “XX” relates to the associated system where applicable:

1) DC Domestic Cold Water.
2) DH Domestic Hot Water.
3) DR Domestic Hot Water Return.
4) For all other systems, use logical naming convention.

2. Piping system associated with.
3. Location of valve (architectural room number).
4. Normal-operating position (open, closed, or modulating).
5. Identify special or unique characteristics (emergency shutoff).
6. Valve-tag schedule shall also be included in operation and maintenance data.

2.5 WARNING TAGS

A. Warning Tags: Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.

1. Size: 3 by 5-1/4 inches minimum.
2. Fasteners: Brass grommet and wire.
3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
4. Color: Yellow background with black lettering.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 EQUIPMENT LABEL INSTALLATION

A. Install or permanently fasten labels on each major item of mechanical equipment.

B. Locate equipment labels where accessible and visible.

3.3 PIPE LABEL INSTALLATION

A. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:

1. Near each valve and control device.
2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
4. At access doors, manholes, and similar access points that permit view of concealed piping.
5. Near major equipment items and other points of origination and termination.
6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

B. Pipe Label Color Schedule:

1. Domestic Cold Water, Hot Water and Hot Water Return Piping:

   a. Background Color: Green.
   b. Letter Color: White.

3.4 VALVE-TAG INSTALLATION

A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following subparagraphs:

1. Valve-Tags shall be round, 1-1/2 inches in diameter, with green background and white lettering.

3.5 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

END OF SECTION 220553

SECTION 220719 - PLUMBING SYSTEMS INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

1. Domestic cold-water piping.
2. Domestic hot and recirculating hot-water piping.
3. Exposed sanitary drains, domestic water, domestic hot water, and stops for plumbing fixtures for people with disabilities.

B. Related Sections:

1. Section 220716 "Plumbing Equipment Insulation."

1.3 SUBMITTALS

A. General:

1. Comply with Section 21 05 03.00 “Submittals for Plumbing.”

B. Quality Assurance (QA):

1. Provide documentation that shows qualifications and compliance with quality assurance requirements for qualified installer.

C. Product Data (PD):

1. Provide product datasheets for all insulation materials, adhesives, and sealants. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

1.4 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ASTM E 84 by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.
2. Insulation Installed Outdoors: Flame-spread index of 75 or less, and smoke-developed index of 150 or less.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.6 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.7 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

E. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

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

    a. Pittsburgh Corning Corporation; Foamglas.
    b. Owens-Corning Fiberglass Corp.
    c. Knauf
    d. CertainTeed.
    e. Johns Manville.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
5. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
6. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

F. Flexible Elastomeric Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials.

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

    a. Aeroflex USA, Inc.; Aerocel.
    b. Armacell LLC; AP Armaflex.
    c. K-Flex USA; Insul-Lock, Insul-Tube, and K-FLEX LS.

2.2 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated, unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive 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."

C. Flexible Elastomeric Adhesive: Comply with MIL-A-24179A, Type II, Class I.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
2. Adhesive 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."

D. PVC Jacket Adhesive: Compatible with PVC jacket.

1. For indoor applications, adhesive shall have a VOC content of 50 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.3 SEALANTS

A. Joint Sealants:

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

    a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
    b. Eagle Bridges - Marathon Industries; 405.
    c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
    d. Mon-Eco Industries, Inc.; 44-05.
    e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.
6. For indoor applications, sealants shall have a VOC content of 420 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).

2.4 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.
2. ASJ-SSL: ASJ with self-sealing, pressure-sensitive, acrylic-based adhesive covered by a removable protective strip; complying with ASTM C 1136, Type I.
3. FSK Jacket: Aluminum-foil, fiberglass-reinforced scrim with kraft-paper backing; complying with ASTM C 1136, Type II.

2.5 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; thickness as scheduled; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

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

    a. Johns Manville; Zeston.
    b. P.I.C. Plastics, Inc.; FG Series.
    c. Proto Corporation; LoSmoke.
    d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.

4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

2.6 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

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

    a. ABI, Ideal Tape Division; 428 AWF ASJ.
    b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
    c. Compac Corporation; 104 and 105.
    d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

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

    a. ABI, Ideal Tape Division; 370 White PVC tape.
    b. Compac Corporation; 130.
    c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

2.7 SECUREMENTS

A. Bands:

1. Stainless Steel: ASTM A 167 or ASTM A 240/A 240M; 0.015 inch thick, 1/2 inch wide.
2. Aluminum: ASTM B 209, Alloy 3003, 3005, 3105, or 5005; Temper H-14, 0.020 inch thick, 1/2 inch wide.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch-wide, stainless steel or Monel.

C. Wire: 0.080-inchnickel-copper alloy.

2.8 PROTECTIVE SHIELDING GUARDS

A. Protective Shielding Pipe Covers:

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. Engineered Brass Company.
b. Insul-Tect Products Co.; a subsidiary of MVG Molded Products.
c. McGuire Manufacturing.
d. Plumberex.
e. Truebro; a brand of IPS Corporation.
f. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.

2. Description: Manufactured plastic wraps for covering plumbing fixture water supplies and trap and drain piping. Comply with Americans with Disabilities Act (ADA) requirements.

B. Protective Shielding Piping Enclosures:

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. Truebro; a brand of IPS Corporation.
b. Zurn Industries, LLC; Tubular Brass Plumbing Products Operation.
c. ProFlo
d. Plumberex.

2. Description: Manufactured plastic enclosure for covering plumbing fixture hot- and cold-water supplies and trap and drain piping. Comply with ADA requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties.

B. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

C. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

D. Install insulation with longitudinal seams at top and bottom of horizontal runs.

E. Install multiple layers of insulation with longitudinal and end seams staggered.

F. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

G. Keep insulation materials dry during application and finishing.

H. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

I. Install insulation with least number of joints practical.

J. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

K. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

L. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch-wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

M. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

N. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

O. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

P. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside roof flashing at least 2 inches below top of roof flashing.
4. Seal jacket to roof flashing with flashing sealant.

B. Insulation Installation at Underground Exterior Wall Penetrations: Terminate insulation flush with sleeve seal. Seal terminations with flashing sealant.

C. Insulation Installation at Aboveground Exterior Wall Penetrations: Install insulation continuously through wall penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation inside wall surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.
3. Extend jacket of outdoor insulation outside wall flashing and overlap wall flashing at least 2 inches.
4. Seal jacket to wall flashing with flashing sealant.

D. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

E. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

F. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.

8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insulation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.
5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.

3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF FLEXIBLE ELASTOMERIC INSULATION

A. Seal longitudinal seams and end joints with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

B. Insulation Installation on Pipe Flanges:

1. Install pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of sheet insulation of same thickness as pipe insulation.
4. Secure insulation to flanges and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed valve covers manufactured of same material as pipe insulation when available.
2. When preformed valve covers are not available, install cut sections of pipe and sheet insulation to valve body. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.
4. Secure insulation to valves and specialties and seal seams with manufacturer's recommended adhesive to eliminate openings in insulation that allow passage of air to surface being insulated.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where glass-cloth jackets are indicated, install directly over bare insulation or insulation with factory-applied jackets.

1. Draw jacket smooth and tight to surface with 2-inchoverlap at seams and joints.
2. Embed glass cloth between two 0.062-inch-thick coats of lagging adhesive.
3. Completely encapsulate insulation with coating, leaving no exposed insulation.

B. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch-wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

C. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

D. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

3.9 FIELD QUALITY CONTROL

A. All insulation applications will be considered defective Work if sample inspection reveals non-compliance with requirements.

3.10 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Underground piping conveying unheated fluids.
3. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.11 INDOOR PIPING INSULATION SCHEDULE

A. Domestic Cold Water:

1. Insulation shall be one of the following:

    a. Cellular Glass: 1 inch thick.
    b. Flexible Elastomeric: 1/2 inch thick.
    c. Insulation thicknesses shall be doubled for piping installed in non-conditioned spaces such as boiler rooms, attics, crawl spaces, tunnels, etc.

B. Domestic Hot and Recirculated Hot Water:

1. Insulation shall be one of the following:

    a. Cellular Glass: 1-1/2 inches thick.
    b. Flexible Elastomeric: 1 inch thick.
    c. Insulation thicknesses shall be doubled for piping installed in non-conditioned spaces such as boiler rooms, attics, crawl spaces, tunnels, etc.

C. Exposed Sanitary Drains, Domestic Water, Domestic Hot Water, and Stops for Plumbing Fixtures for People with Disabilities:

1. All Pipe Sizes: Insulation shall be one of the following:

    a. One-piece PVC, with 1/8” thickness, meeting the standards of ASTM E 84-07 with a flame spread/ 450 smoke index per the building code. Surfaces to be soft, smooth, non-absorbent, easy to clean U/V inhibited, antimicrobial, antifungal properties. Insulator shall have a dual fastening system which consists of fusion bonded Velcro fastener strips for full slit enclosure and tamper resistant, smooth, non-abrasive snap-locking fasteners. PTrap Insulator: Shall have a one-piece design with a universal fit for 1 1/4"-1 1/2" brass or plastic traps, a longer neck area (for longer tailpieces) and a more forgiving girth area (for bulkier plastic DWV Schedule #40 plastic P-Traps w/swivel nut) and shall have drainage at lowest point to prevent condensation and/or leakage build up. Valve and Supply Insulator: Shall have a one-piece design with a universal fit over valve handles and brass, plastic or metal braided supplies and connectors and shall be able to flexcurl to a minimum of 360 degrees with a full slit closure for total compliance. Off-Set Insulator: Shall have a one-piece design with a universal fit and shall fit inside of P-trap insulator tailpiece area.
    b. Soft, resilient molded vinyl, with 1/8” minimum constant nominal wall thickness with internal ribs, UV resistant, which meets the requirements of ASTM D-635 burning characteristics.
    c. Insulation thicknesses shall be doubled for piping installed in non-conditioned spaces such as boiler rooms, attics, crawl spaces, tunnels, etc.

END OF SECTION 220719

SECTION 221116 - DOMESTIC WATER PIPING

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. Aboveground domestic water pipes, tubes, and fittings inside buildings.

B. Related Requirements:

1. Section 221113 "Facility Water Distribution Piping" for water-service piping outside the building from source to the point where water-service piping enters the building.

1.3 SUBMITTALS

A. General:

1. Comply with Section 22 05 03.00 “Submittals for Plumbing.”

B. Product Data (PD):

1. Provide product datasheets for all piping, fittings, and solvents.

1.4 FIELD CONDITIONS

A. Interruption of Existing Water Service: Do not interrupt water service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary water service according to requirements indicated:

1. Notify Architect, Construction Manager, and Owner no fewer than seven days in advance of proposed interruption of water service.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

B. Potable-water piping and components shall comply with NSF 14 and NSF 61. Plastic piping components shall be marked with "NSF-pw."

2.2 COPPER TUBE AND FITTINGS

A. Hard Copper Tube: ASTM B 88, Type L water tube, drawn temper.

B. Cast-Copper, Solder-Joint Fittings: ASME B16.18, pressure fittings.

C. Wrought-Copper, Solder-Joint Fittings: ASME B16.22, wrought-copper pressure fittings.

D. Bronze Flanges: ASME B16.24, Class 150, with solder-joint ends.

E. Copper Unions:

1. MSS SP-123.
2. Cast-copper-alloy, hexagonal-stock body.
3. Ball-and-socket, metal-to-metal seating surfaces.
4. Solder-joint or threaded ends.

F. Copper Pressure-Seal-Joint Fittings:

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. Elkhart Products Corporation.
   b. NIBCO Inc.
   c. Viega.

2. Fittings for NPS 2 and Smaller: Wrought-copper fitting with EPDM-rubber, O-ring seal in each end.
3. Fittings for NPS 2-1/2 to NPS 4: Cast-bronze or wrought-copper fitting with EPDM-rubber, O-ring seal in each end.

2.3 PIPING JOINING MATERIALS

A. Pipe-Flange Gasket Materials:

1. AWWA C110/A21.10, rubber, flat face, 1/8 inch thick or ASME B16.21, nonmetallic and asbestos free unless otherwise indicated.
2. Full-face or ring type unless otherwise indicated.

B. Metal, Pipe-Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

C. Solder Filler Metals: ASTM B 32, lead-free alloys.

D. Flux: ASTM B 813, water flushable.

2.4

2.5 TRANSITION FITTINGS

A. General Requirements:

1. Same size as pipes to be joined.
2. Pressure rating at least equal to pipes to be joined.
3. End connections compatible with pipes to be joined.

B. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.

C. Sleeve-Type Transition Coupling: AWWA C219.

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. Cascade Waterworks Manufacturing.
b. Dresser, Inc.; Piping Specialties Products.
c. Ford Meter Box Company, Inc. (The).
d. JCM Industries.
e. Romac Industries, Inc.
f. Smith-Blair, Inc.; a Sensus company.
g. Viking Johnson.

2.6 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

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. Capitol Manufacturing Company; member of the Phoenix Forge Group.
b. Central Plastics Company.
c. Hart Industries International, Inc.
d. Jomar International.
e. Matco-Norca.
f. McDonald, A. Y. Mfg. Co.
g. Watts; a division of Watts Water Technologies, Inc.
h. Wilkins; a Zurn company.

2. Standard: ASSE 1079.
3. Pressure Rating: 125 psig minimum at 180 deg F
4. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

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. Capitol Manufacturing Company; member of the Phoenix Forge Group.
    b. Central Plastics Company.
    c. Matco-Norca.
    d. Watts; a division of Watts Water Technologies, Inc.
    e. Wilkins; a Zurn company.

2. Standard: ASSE 1079.
3. Factory-fabricated, bolted, companion-flange assembly.
4. Pressure Rating: 125 psig minimum at 180 deg F.
5. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

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. Advance Products & Systems, Inc.
    b. Calpico, Inc.
    c. Central Plastics Company.
    d. Pipeline Seal and Insulator, Inc.

2. Nonconducting materials for field assembly of companion flanges.
3. Pressure Rating: 150 psig.
4. Gasket: Neoprene or phenolic.
5. Bolt Sleeves: Phenolic or polyethylene.
6. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

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. Elster Perfection Corporation.
    b. Grinnell Mechanical Products; Tyco Fire Products LP.
    c. Matco-Norca.
    d. Precision Plumbing Products, Inc.
    e. Victaulic Company.

2. Standard: IAPMO PS 66.
3. Electroplated steel nipple complying with ASTM F 1545.
4. Pressure Rating and Temperature: 300 psig at 225 deg F.
5. End Connections: Male threaded or grooved.
6. Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of domestic water piping. Indicated locations and arrangements are used to size pipe and calculate friction loss, expansion, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install copper tubing under building slab according to CDA's "Copper Tube Handbook."

C. Install shutoff valve, hose-end drain valve, strainer, pressure gage, and test tee with valve inside the building at each domestic water-service entrance. Comply with requirements for pressure gages in Section 220519 "Meters and Gages for Plumbing Piping" and with requirements for drain valves and strainers in Section 221119 "Domestic Water Piping Specialties."

D. Install shutoff valve immediately upstream of each dielectric fitting.

E. Install piping concealed from view and protected from physical contact by building occupants unless otherwise indicated and except in equipment rooms and service areas.

F. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

G. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal, and coordinate with other services occupying that space.

H. Install piping to permit valve servicing.

I. Install nipples, unions, special fittings, and valves with pressure ratings the same as or higher than the system pressure rating used in applications below unless otherwise indicated.

J. Install piping free of sags and bends.

K. Install fittings for changes in direction and branch connections.

L. Install unions in copper tubing at final connection to each piece of equipment, machine, and specialty.

M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

N. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

O. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.2 JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipes, tubes, and fittings before assembly.

C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged.

D. Soldered Joints for Copper Tubing: Apply ASTM B 813, water-flushable flux to end of tube. Join copper tube and fittings according to ASTM B 828 or CDA's "Copper Tube Handbook."

E. Pressure-Sealed Joints for Copper Tubing: Join copper tube and pressure-seal fittings with tools recommended by fitting manufacturer.

F. Push-on Joints for Copper Tubing: Clean end of tube. Measure insertion depth with manufacturer's depth gage. Join copper tube and push-on-joint fittings by inserting tube to measured depth.

G. Flanged Joints: Select appropriate asbestos-free, nonmetallic gasket material in size, type, and thickness suitable for domestic water service. Join flanges with gasket and bolts according to ASME B31.9.

H. Joints for Dissimilar-Material Piping: Make joints using adapters compatible with materials of both piping systems.

3.3 TRANSITION FITTING INSTALLATION

A. Install transition couplings at joints of dissimilar piping.

B. Transition Fittings in Underground Domestic Water Piping:

1. Fittings for NPS 1-1/2 and Smaller: Fitting-type coupling.
2. Fittings for NPS 2 and Larger: Sleeve-type coupling.

C. Transition Fittings in Aboveground Domestic Water Piping NPS 2 and Smaller: Plastic-to-metal transition fittings or unions.

3.4 DIELECTRIC FITTING INSTALLATION

A. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.

B. Dielectric Fittings for NPS 2 and Smaller: Use dielectric couplings, nipples, or unions.

C. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits, or nipples.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger, support products, and installation in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Vertical Piping: MSS Type 8 or 42, clamps.
2. Individual, Straight, Horizontal Piping Runs:

    a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
    b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
    c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

3. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
4. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support vertical piping and tubing at base and at each floor.

C. Rod diameter may be reduced one size for double-rod hangers, to a minimum of 3/8 inch.

D. Install hangers for copper tubing with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 3/4 and Smaller: 60 inches with 3/8-inch rod.
2. NPS 1 and NPS 1-1/4: 72 inches with 3/8-inch rod.
3. NPS 1-1/2 and NPS 2: 96 inches with 3/8-inch rod.
4. NPS 2-1/2: 108 inches with 1/2-inch rod.
5. NPS 3 to NPS 5: 10 feet with 1/2-inch rod.

E. Install supports for vertical copper tubing every 10 feet.

F. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4and Smaller: 84 incheswith 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inchrod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3 and NPS 3-1/2: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.

G. Install supports for vertical steel piping every 15 feet.

H. Install supports for vertical stainless-steel piping every 15 feet.

I. Support piping and tubing not listed in this article according to MSS SP-69 and manufacturer's written instructions.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. When installing piping adjacent to equipment and machines, allow space for service and maintenance.

C. Connect domestic water piping to water-service piping with shutoff valve; extend and connect to the following:

1. Plumbing Fixtures: Cold- and hot-water-supply piping in sizes indicated, but not smaller than that required by plumbing code.
2. Equipment: Cold- and hot-water-supply piping as indicated, but not smaller than equipment connections. Provide shutoff valve and union for each connection. Use flanges instead of unions for NPS 2-1/2and larger.

3.7 IDENTIFICATION

A. Identify system components. Comply with requirements for identification materials and installation in Section 220553 "Identification for Plumbing Piping and Equipment."

B. Label pressure piping with system operating pressure.

3.8 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Piping Inspections:

a. Do not enclose, cover, or put piping into operation until it has been inspected and approved by authorities having jurisdiction.
b. During installation, notify authorities having jurisdiction at least one day before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction:

1) Roughing-in Inspection: Arrange for inspection of piping before concealing or closing in after roughing in and before setting fixtures.
2) Final Inspection: Arrange for authorities having jurisdiction to observe tests specified in "Piping Tests" Subparagraph below and to ensure compliance with requirements.

c. Reinspection: If authorities having jurisdiction find that piping will not pass tests or inspections, make required corrections and arrange for reinspection.
d. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

2. Piping Tests:

a. Fill domestic water piping. Check components to determine that they are not air bound and that piping is full of water.
b. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit a separate report for each test, complete with diagram of portion of piping tested.
c. Leave new, altered, extended, or replaced domestic water piping uncovered and unconcealed until it has been tested and approved. Expose work that was covered or concealed before it was tested.

d. Cap and subject piping to static water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow it to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
e. Repair leaks and defects with new materials, and retest piping or portion thereof until satisfactory results are obtained.
f. Prepare reports for tests and for corrective action required.

B. Domestic water piping will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

3.9 ADJUSTING

A. Perform the following adjustments before operation:

1. Close drain valves, hydrants, and hose bibbs.
2. Open shutoff valves to fully open position.
3. Open throttling valves to proper setting.
4. Adjust balancing valves in hot-water-circulation return piping to provide adequate flow.

    a. Manually adjust ball-type balancing valves in hot-water-circulation return piping to provide hot-water flow in each branch.
    b. Adjust calibrated balancing valves to flows indicated.

5. Remove plugs used during testing of piping and for temporary sealing of piping during installation.
6. Remove and clean strainer screens. Close drain valves and replace drain plugs.
7. Remove filter cartridges from housings and verify that cartridges are as specified for application where used and are clean and ready for use.
8. Check plumbing specialties and verify proper settings, adjustments, and operation.

3.10 CLEANING

A. Clean and disinfect potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging and disinfecting procedures prescribed by authorities having jurisdiction; if methods are not prescribed, use procedures described in either AWWA C651 or AWWA C652 or follow procedures described below:

    a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
    b. Fill and isolate system according to either of the following:

        1) Fill system or part thereof with water/chlorine solution with at least 50 ppm of chlorine. Isolate with valves and allow to stand for 24 hours.
        2) Fill system or part thereof with water/chlorine solution with at least 200 ppm of chlorine. Isolate and allow to stand for three hours.

c. Flush system with clean, potable water until no chlorine is in water coming from system after the standing time.
d. Repeat procedures if biological examination shows contamination.
e. Submit water samples in sterile bottles to authorities having jurisdiction.

B. Clean non-potable domestic water piping as follows:

1. Purge new piping and parts of existing piping that have been altered, extended, or repaired before using.
2. Use purging procedures prescribed by authorities having jurisdiction or; if methods are not prescribed, follow procedures described below:

a. Flush piping system with clean, potable water until dirty water does not appear at outlets.
b. Submit water samples in sterile bottles to authorities having jurisdiction. Repeat procedures if biological examination shows contamination.

C. Prepare and submit reports of purging and disinfecting activities. Include copies of water-sample approvals from authorities having jurisdiction.

D. Clean interior of domestic water piping system. Remove dirt and debris as work progresses.

3.11 PIPING SCHEDULE

A. Transition and special fittings with pressure ratings at least equal to piping rating may be used in applications below unless otherwise indicated.

B. Flanges and unions may be used for aboveground piping joints unless otherwise indicated.

C. Aboveground domestic water piping shall be one of the following:

1. Hard copper tube, ASTM B 88, Type L; wrought-copper, solder-joint fittings; and soldered joints.

3.12 VALVE SCHEDULE

A. Drawings indicate valve types to be used. Where specific valve types are not indicated, the following requirements apply:

1. Shutoff Duty: Use ball valves for piping NPS 2 and smaller. Use butterfly, ball, or gate valves with flanged ends for piping NPS 2-1/2 and larger.
2. Throttling Duty: Use ball or globe valves for piping NPS 2 and smaller. Use butterfly or ball valves with flanged ends for piping NPS 2-1/2 and larger.
3. Hot-Water Circulation Piping, Balancing Duty: Memory-stop balancing valves.
4. Drain Duty: Hose-end drain valves.

B. Use check valves to maintain correct direction of domestic water flow to and from equipment.

C. Iron grooved-end valves may be used with grooved-end piping.

END OF SECTION 221116

SECTION 221316 - SANITARY WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Pipe, tube, and fittings.
2. Specialty pipe fittings.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated:

1. Soil, Waste, and Vent Piping: 10-foot head of water.
2. Waste, Force-Main Piping: 100 psig.

1.4 SUBMITTALS

A. General:

1. Comply with Section 22 05 03.00 “Submittals for Plumbing.”

B. Product Data (PD):

1. Provide product datasheets for all piping, fittings, and solvents.

1.5 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.

1.6 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated:

1. Notify Architect, Construction Manager, and Owner no fewer than seven days in advance of proposed interruption of sanitary waste service.

2. Do not proceed with interruption of sanitary waste service without Architect's written permission.

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service class. All cast iron soil pipe and fittings shall be certified NSF and shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.

B. Gaskets: ASTM C 564, rubber.

2.3 HUBLESS, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 888, ASTM A 74, or CISPI 301. Fittings shall be cast iron conforming to ASME B16.4, ASME B16.12, ASTM A 74, ASTM A 888 or CISPI 301. All cast iron soil pipe and fittings shall be certified NSF and shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute.

B. Hubless-Piping Couplings:

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. ANACO-Husky.
    b. Dallas Specialty & Mfg. Co.
    c. Fernco Inc.
    d. Matco-Norca, Inc.
    e. MIFAB, Inc.
    f. Mission Rubber Company; a division of MCP Industries, Inc.
    g. Stant.
    h. Tyler Pipe.
    i. Ideal Tridon

2. Standards: ASTM C 1277 or CISPI 310. All couplings shall be certified NSF and certified to be tested according to ASTM C 1563..
3. Description: Stainless-steel corrugated shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.

2.4 COPPER TUBE AND FITTINGS

A. Copper DWV Tube: ASTM B 306, drainage tube, drawn temper.

B. Copper Drainage Fittings: ASME B16.23, cast copper or ASME B16.29, wrought copper, solder-joint fittings.

C. Hard Copper Tube: ASTM B 88, Type L and Type M, water tube, drawn temper.

D. Copper Pressure Fittings:

1. Copper Fittings: ASME B16.18, cast-copper-alloy or ASME B16.22, wrought-copper, solder-joint fittings. Furnish wrought-copper fittings if indicated.
2. Copper Unions: MSS SP-123, copper-alloy, hexagonal-stock body with ball-and-socket, metal-to-metal seating surfaces, and solder-joint or threaded ends.

E. Copper Flanges: ASME B16.24, Class 150, cast copper with solder-joint end.

1. Flange Gasket Materials: ASME B16.21, full-face, flat, nonmetallic, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
2. Flange Bolts and Nuts: ASME B18.2.1, carbon steel unless otherwise indicated.

F. Solder: ASTM B 32, lead free with ASTM B 813, water-flushable flux.

2.5 SPECIALTY PIPE FITTINGS

A. Transition Couplings:

1. General Requirements: Fitting or device for joining piping with small differences in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
3. Shielded, Nonpressure Transition Couplings:

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) Cascade Waterworks Mfg. Co.
2) Mission Rubber Company; a division of MCP Industries, Inc.
3) Dresser, Inc.
4) EBAA Iron, Inc.
5) JCM Industries, Inc.
6) Romac Industries, Inc.
7) Smith-Blair, Inc.; a Sensus company.
8) The Ford Meter Box Company, Inc.
9) Viking Johnson.

b. Standard: ASTM C 1460.
c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

B. Dielectric Fittings:

1. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.
2. Dielectric Unions:

    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) Capitol Manufacturing Company.
        2) Central Plastics Company.
        3) Hart Industries International, Inc.
        4) Jomar International Ltd.
        5) Matco-Norca, Inc.
        6) McDonald, A. Y. Mfg. Co.
        7) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
        8) Wilkins; a Zurn company.

    b. Description:

        1) Standard: ASSE 1079.
        2) Pressure Rating: 125 psig minimum at 180 deg F.
        3) End Connections: Solder-joint copper alloy and threaded ferrous.

3. Dielectric Flanges:

    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) Capitol Manufacturing Company.
        2) Central Plastics Company.
        3) Matco-Norca, Inc.
        4) Watts Regulator Co.; a division of Watts Water Technologies, Inc.
        5) Wilkins; a Zurn company.

    b. Description:

        1) Standard: ASSE 1079.
        2) Factory-fabricated, bolted, companion-flange assembly.
        3) Pressure Rating: 125 psig minimum at 180 deg F.
        4) End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

4. Dielectric-Flange Insulating Kits:

    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) Advance Products & Systems, Inc.
        2) Calpico, Inc.
        3) Central Plastics Company.
        4) Pipeline Seal and Insulator, Inc.

b. Description:

1) Nonconducting materials for field assembly of companion flanges.
2) Pressure Rating: 150 psig.
3) Gasket: Neoprene or phenolic.
4) Bolt Sleeves: Phenolic or polyethylene.
5) Washers: Phenolic with steel backing washers.

5. Dielectric Nipples:

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) Elster Perfection.
2) Grinnell Mechanical Products.
3) Matco-Norca, Inc.
4) Precision Plumbing Products, Inc.
5) Victaulic Company.

b. Description:

1) Standard: IAPMO PS 66
2) Electroplated steel nipple.
3) Pressure Rating: 300 psig at 225 deg F.
4) End Connections: Male threaded or grooved.
5) Lining: Inert and noncorrosive, propylene.

PART 3 - EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving" and Section 220500 “Common Work Results for Plumbing”.

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.

B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.

K. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.

L. Collect vent piping where practical so roof will be penetrated a minimum number of times. Vent sizes and heights above roof shall be per the Plumbing Code in force. Vents penetrating roofs shall be flashed with 4 lb. sheet lead. Vents shall not be terminated within ten feet of any outside air intakes, windows, or door openings.

M. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."

N. Install aboveground copper tubing according to CDA's "Copper Tube Handbook."

O. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.

P. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

Q. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

R. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 220518 "Escutcheons for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hubless, cast-iron soil piping according to CISPI 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.

1. Cast iron coupling for joining hubless cast iron pipe shall consist of neoprene gasket produced and labeled as ASTM C 564, cast iron clamps produced and labeled as ASTM A 48 and stainless steel bolts and nuts produced and labeled as ANSI B18.2.1 and ANSI B18.2.2. Neoprene gaskets shall be produced and labeled as ASTM C 564-70.

B. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

C. Join copper tube and fittings with soldered joints according to ASTM B 828. Use ASTM B 813, water-flushable, lead-free flux and ASTM B 32, lead-free-alloy solder.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:

1. Install transition couplings at joints of piping with small differences in OD's.
2. In Drainage Piping: Shielded, nonpressure transition couplings.
3. In Aboveground Force Main Piping: Fitting-type transition couplings.
4. In Underground Force Main Piping:

a. NPS 1-1/2 and Smaller: Fitting-type transition couplings.
b. NPS 2 and Larger: Pressure transition couplings.

B. Dielectric Fittings:

1. Install dielectric fittings in piping at connections of dissimilar metal piping and tubing.
2. Dielectric Fittings for NPS 2 and Smaller: Use dielectric nipples or unions.
3. Dielectric Fittings for NPS 2-1/2 to NPS 4: Use dielectric flanges, flange kits, or nipples.
4. Dielectric Fittings for NPS 5 and Larger: Use dielectric flange kits.

3.5 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."

1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.
2. Install stainless-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs:

a. 100 Feet and Less: MSS Type 1, adjustable, steel clevis hangers.
b. Longer Than 100 Feet: MSS Type 43, adjustable roller hangers.
c. Longer Than 100 Feet if Indicated: MSS Type 49, spring cushion rolls.

7. Multiple, Straight, Horizontal Piping Runs 100 Feet or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base of Vertical Piping: MSS Type 52, spring hangers.

B. Support horizontal piping and tubing within 12 inches of each fitting, valve, and coupling.

C. Support vertical piping and tubing at base and at each floor.

D. Rod diameter may be reduced one size for double-rod hangers, with 3/8-inch minimum rods.

E. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/2 and NPS 2: 60 inches with 3/8-inch rod.
2. NPS 3: 60 inches with 1/2-inch rod.
3. NPS 4 and NPS 5: 60 inches with 5/8-inch rod.
4. NPS 6 and NPS 8: 60 inches with 3/4-inch rod.
5. Spacing for 10-foot lengths may be increased to 10 feet. Spacing for fittings is limited to 60 inches.

F. Install supports for vertical cast-iron soil piping every 15 feet.

G. Install hangers for steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 1-1/4: 84 inches with 3/8-inch rod.
2. NPS 1-1/2: 108 inches with 3/8-inch rod.
3. NPS 2: 10 feet with 3/8-inch rod.
4. NPS 2-1/2: 11 feet with 1/2-inch rod.
5. NPS 3: 12 feet with 1/2-inch rod.
6. NPS 4 and NPS 5: 12 feet with 5/8-inch rod.
7. NPS 6 and NPS 8: 12 feet with 3/4-inch rod.

H. Install supports for vertical steel piping every 15 feet.

I. Install hangers for stainless-steel piping with the following maximum horizontal spacing and minimum rod diameters:

1. NPS 2: 84 inches with 3/8-inch rod.
2. NPS 3: 96 incheswith 1/2-inch rod.
3. NPS 4: 108 inches with 1/2-inch rod.
4. NPS 6: 10 feet with 5/8-inch rod.

J. Install supports for vertical stainless-steel piping every 10 feet.

3.6 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.

B. Use transition fitting to join dissimilar piping materials.

C. Connect drainage and vent piping to the following:

1. Plumbing Fixtures: Connect drainage piping in sizes indicated, but not smaller than required by plumbing code.
2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by plumbing code.
4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
5. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:

1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.
2. Install flanges, in piping NPS 2-1/2 and larger, adjacent to flanged valves and at final connection to each piece of equipment.

3.7 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.

1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for reinspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water. From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: After plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack

openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg. Use U-tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.

5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
6. Prepare reports for tests and required corrective action.

E. Test force-main piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:

1. Leave uncovered and unconcealed new, altered, extended, or replaced force-main piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
2. Cap and subject piping to static-water pressure of 50 psig above operating pressure, without exceeding pressure rating of piping system materials. Isolate test source and allow to stand for four hours. Leaks and loss in test pressure constitute defects that must be repaired.
3. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.
4. Prepare reports for tests and required corrective action.

3.8 CLEANING AND PROTECTION

A. Clean interior of piping. Remove dirt and debris as work progresses.

B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.

C. Place plugs in ends of uncompleted piping at end of day and when work stops.

D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.9 PIPING SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.

B. Aboveground, soil and waste piping shall be any of the following:

1. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
2. Copper DWV tube, copper drainage fittings, and soldered joints.
3. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

A. Aboveground, vent piping shall be any of the following:

4. Hubless, cast-iron soil pipe and fittings; hubless-piping couplings; and coupled joints.
5. Copper DWV tube, copper drainage fittings, and soldered joints.

a. Option for Vent Piping, NPS 2-1/2 and NPS 3-1/2: Hard copper tube, Type M; copper pressure fittings; and soldered joints.

6. Dissimilar Pipe-Material Couplings: Shielded, nonpressure transition couplings.

END OF SECTION 221316

SECTION 224000 - PLUMBING FIXTURES

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. Stainless steel sinks.
2. Service Receptors.
3. Faucets.
4. Showers
5. Drinking fountains and water coolers.
6. Supply Fittings.
7. Carriers.

1.3 SUBMITTALS

A. General:

1. Comply with Section 22 05 03.00 “Submittals for Plumbing.”

B. Product Data (PD):

1. Provide product datasheets for all plumbing fixtures.
2. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for fixtures.
3. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
4. Include diagrams for power, signal, and control wiring of automatic fixtures where applicable.

C. Closeout Submittals (CO):

1. Provide operation and maintenance manuals for all plumbing fixtures.
2. Furnish extra materials that are packaged with protective covering for storage and identified with labels describing contents as indicated below:

    a. Faucet Washers and O-Rings: Equal to 10 percent of amount of each type and size installed but not less than one.
    b. Faucet Cartridges and O-Rings: Equal to 5 percent of amount of each type and size installed but not less than one.
    c. Filter Cartridges for Drinking Fountains and Water Coolers: Equal to 20 percent of quantity installed for each type and size indicated, but no fewer than 1 of each.

PART 2 - PRODUCTS

2.1 STAINLESS STEEL SINKS

A. Stainless Steel Sinks:

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. Elkay Manufacturing Co.
    b. Just Manufacturing.
    c. Advance Tabco.
    d. Eagle Group; Foodservice Equipment Division.
    e. Amtekco Industries, Inc.
    f. Acorn Engineering Co.

B. Service Receptors:

1. Provide accessible check valves on the hot and cold water supply piping serving all service sinks (including mop sinks).
2. 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. American Standard America.
    b. Crane Plumbing, LLC.
    c. Acorn Engineering Co.
    d. Zurn Industries, LLC; Commercial Brass and Fixtures.
    e. Stern-Williams Co., Inc.
    f. E.L. Mustee & Sons, Inc.
    g. Creative Industries Inc.
    h. Florestone Products Co., Inc.

2.2 FAUCETS

A. Lavatory, Sink, Bathtub, and Shower Faucets:

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. American Standard America.
    b. Bradley Corporation.
    c. Chicago Faucet Company.
    d. Delta Faucet Company.
    e. Elkay Manufacturing Co.
    f. Grohe America, Inc.
    g. Just Manufacturing.
    h. Kohler Co.
    i. Speakman Company.
    j. T & S Brass and Bronze Works, Inc.

k. Zurn Industries, LLC; Commercial Brass and Fixtures.
l. Geberit.
m. Symmons Industries, Inc.
n. Powers, Watts Water Technologies Co.
o. http://www.specagent.com/LookUp/?uid=123456810699&mf=04&src=wdSloan Valve Company.
p. Encore by CHG.

2.3 SHOWERS

A. Showers:

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. http://www.specagent.com/LookUp/?uid=123456810699&mf=04&src=wdAcorn Engineering Company.
b. Acryline USA, Inc.
c. Aqua Bath Company, Inc.
d. Aquatic Industries, Inc.
e. American Standard America.
f. Aqua Glass Corporation.
g. Bradley Corporation.
h. Clarion Bathware.
i. Crane Plumbing, LLC.
j. Florestone Products Co., Inc.
k. Symmons, Inc.
l. Jason International, Inc.
m. Kohler Co.
n. LASCO Bathware.
o. MAAX.
p. MAAX; Aker Division.
q. Mustee, E. L. & Sons, Inc.
r. Praxis Industries, LLC; Aquarius Bathware.
s. Royal Baths Manufacturing Co.
t. Swan Corporation (The).
u. Sterling; a Kohler company.
v. Stern-Williams Co., Inc.
w. Toto USA, Inc.
x. Tower Industries.
y. Willoughby Industries, Inc.
z. Zurn Industries, LLC; Commercial Brass and Fixtures.

2.4 DRINKING FOUNTAINS AND WATER COOLERS

A. Drinking Fountains and Water Coolers:

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. Elkay Manufacturing Co.
b. Kohler Co.
c. Belson Outdoors, Inc.
d. Haws Corporation.
e. Petersen Manufacturing Co., Inc.
f. Sanderson Concrete Inc.
g. Stern-Williams Co., Inc.
h. Halsey Taylor.
i. Most Dependable Fountains, Inc.
j. Murdock-Super Secur; a division of Acorn Engineering Company.
k. Tri Palm International, LLC; Oasis Brand.
l. Filtrine Manufacturing Company.
m. Larco Inc.

2.5 SUPPLY FITTINGS

A. NSF Standard: Comply with NSF/ANSI 61, "Drinking Water System Components - Health Effects," for supply-fitting materials that will be in contact with potable water.

B. Standard: ASME A112.18.1/CSA B125.1.

C. Supply Piping: Chrome-plated-brass pipe or chrome-plated copper tube matching water-supply piping size. Include chrome-plated-brass or stainless-steel wall flange.

D. Supply Stops: Chrome-plated-brass, one-quarter-turn, ball-type or compression valve with inlet connection matching supply piping.

E. Risers:

1. NPS 1/2.
2. Chrome-plated, rigid-copper-pipe and brass straight or offset tailpieces, chrome-plated, soft-copper flexible tube, ASME A112.18.6, braided- or corrugated-stainless-steel, flexible hose riser.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of water supply and sanitary drainage and vent piping systems to verify actual locations of piping connections before fixture installation.

B. Examine walls and floors for suitable conditions where fixtures will be installed.

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

3.2 INSTALLATION

A. General Fixture Installation:

1. Install fixtures level and plumb according to roughing-in drawings.

B. Wall Flange and Escutcheon Installation:

1. Install wall flanges or escutcheons at piping wall penetrations in exposed, finished locations and within cabinets and millwork.
2. Install deep-pattern escutcheons if required to conceal protruding fittings.
3. Comply with escutcheon requirements specified in Section 220518 "Escutcheons for Plumbing Piping."

C. Joint Sealing:

1. Seal joints between fixtures and walls and floors using sanitary-type, one-part, mildew-resistant silicone sealant.
2. Match sealant color to water-closet color.
3. Comply with sealant requirements specified in Section 079200 "Joint Sealants."

D. Traps:

1. Install traps on fixture outlets.

a. Exception: Omit trap on fixtures with integral traps.
b. Exception: Omit trap on indirect wastes unless otherwise indicated.

E. Faucet Installation:

1. Install faucet flow-control fittings with specified flow rates and patterns in faucet spouts if faucets are not available with required rates and patterns. Include adapters if required.
2. Install shower flow-control fittings with specified maximum flow rates in shower arms.

F. Drinking Fountain and Water Cooler Installation:

1. Set free-standing drinking fountains and water coolers on floor.
2. Install recessed drinking fountains secured to wood blocking in wall construction.
3. Install off-the-floor carrier supports, affixed to building substrate, for wall-mounted fixtures.
4. Install frost-resistant drinking fountains in a manner that prevents supply and drain piping from freezing. Chases containing supply and drain piping for frost-resistant drinking fountains shall be open to the heated space and insulation shall be provided on the cold side.
5. Install water-supply piping with shutoff valve on supply to each fixture to be connected to domestic-water distribution piping. Use ball, gate, or globe valve. Install valves in locations where they can be easily reached for operation. Valves are specified in Section 220523 "General-Duty Valves for Plumbing Piping."

3.3 CONNECTIONS

A. Connect fixtures with water supplies, stops, risers, traps, soil, waste, and vent piping. Use size fittings required to match fixtures.

B. Comply with water piping requirements specified in Section 221116 "Domestic Water Piping."

C. Comply with soil and waste piping requirements specified in Section 221316 "Sanitary Waste and Vent Piping."

D. Where installing piping adjacent to fixtures, allow space for service and maintenance.

E. Install protective-shielding pipe covers and enclosures on exposed supplies and waste piping of accessible fixtures. Comply with requirements in Section 220719 "Plumbing Piping Insulation."

3.4 ADJUSTING

A. Operate and adjust fixtures and controls. Replace damaged and malfunctioning fixtures, fittings, and controls.

B. Adjust water pressure at fixtures to produce proper flow.

C. Where applicable, install fresh batteries in battery-powered, electronic-sensor mechanisms.

3.5 CLEANING AND PROTECTION

A. Clean fixtures and fittings with manufacturers' recommended cleaning methods and materials.

B. Install protective covering for installed fixtures and fittings.

C. Do not allow use of fixtures for temporary facilities unless approved in writing by Owner.

END OF SECTION 224000

SECTION 230170 - OPERATION AND MAINTENANCE OF HVAC 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. Operation and Maintenance Manuals.
2. Instructions for Owner's Personnel.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and mounting details.

2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
3. Detail fabrication and assembly.
4. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Drawings drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved.

B. Qualification Data: For manufacturer.

C. Seismic Qualification Certificates: For equipment, 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.

D. Welding certificates.

E. Field quality-control reports.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For equipment and systems to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

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

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

C. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer agrees to repair or replace components that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: one year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 OPERATING AND MAINTENANCE MANUALS

A. The contents of operating and maintenance manuals shall include the following:

1. Description of mechanical equipment and systems.
2. Operating instructions.
3. Routine maintenance schedules and procedures.

B. Organization - A manual of such purpose shall be arranged in two parts, with Part I dealing with information pertaining to systems and Part II covering information pertaining to equipment. These may be bound in as many volumes as may be required for convenience of use and reference.

1. Part 1 - Systems:

a. The systems volumes shall be organized into Divisions wherein each Division represents a generic function. Systems shall be classified under appropriate Divisions. An example of such an arrangement is as follows:

b. Division Title Division No.

1) Cooling 1.0

i) Air Conditioning
ii) Chilled Water
iii) Refrigeration

2) Heating 2.0

i) Hot Water Distribution
ii) Hot Water Heating

c. The material for each system shall be organized in sections descriptive of the following basic areas of information:

1) Descriptive Information.
2) Operating Instructions.
3) Inspection and Maintenance Instructions.

d. Sections could be organized to include the following categories of information:

1) Descriptive Information
2) Function of service.
3) Classification.
4) Design capability.
5) Performance characteristics.
6) Principal components.
7) Distribution arrangement.
8) Schematic diagram.
9) Control diagram.
10) Equipment Data.
11) Inventory designation.
12) Manufacturer and model.
13) Size and rating.
14) Pressure, speed and temperature limitations.
15) Operating Instructions.
16) Starting and stopping procedures.
17) Adjustment and regulation.
18) Seasonal start-up.
19) Seasonal shut-down.
20) Logs and records.
21) Inspection and Maintenance.
22) Inspection schedule and checklist.
23) Schedules and procedures for lubrication, replacements, adjustment, cleaning, painting, protection and testing.
24) Inspection and maintenance records.

e. Reference Documents:

1) Construction drawing list.

2) Construction specifications.
3) Record drawings.
4) Test and balance records.

2. Part 2 - Equipment:

a. This part of the manual shall be composed of manufacturers and fabricators data on equipment and materials organized into divisions wherein each division represents a generic classification of equipment such as:

b. Division Title

1) Air Conditioning and Ventilating
2) Controls
3) Instrument and Accessories
4) Motors
5) Valves

c. Each division shall be organized in sections wherein each section would represent a specific type of equipment in Division 1, the sections shall include the following:

1) Air Conditioning and Ventilating

i) Coils - Cooling
ii) preheat

d. Each section shall include the following manufacturer information:

1) Descriptive Literature

i) Catalog cuts, brochures or shop drawings
ii) Dimensional drawings
iii) Materials of construction
iv) Parts designations

2) Operating Characteristics

i) Performance tables and charts
ii) Performance curves
iii) Pressure, temperature and speed limitations
iv) Safety devices

3) Operating Instructions

i) Pre-start check list
ii) Start-up procedures
iii) Inspection during operation
iv) Adjustment and regulation
v) Testing
vi) Detection of malfunction
vii) Precautions

4) Inspection Instruments and Procedures

i) Normal and abnormal operating temperature, pressure and speed limits
ii) Schedule and manner of operation
iii) Detection signals

5) Maintenance Instructions and Procedures

i) Schedule of routing maintenance
ii) Procedures
iii) Troubleshooting chart

6) Parts List

i) Spare Parts
ii) Essential inventory
iii) Distributor directory

7) Service and Dealer Directory
8) Service Contracts

PART 3 - EXECUTION

3.1 INSTRUCTIONS FOR THE OWNER'S PERSONNEL

A. Arrange for suppliers and/or installers to meet with the Owner's operating and maintenance personnel to provide instruction in the proper operation and maintenance of equipment that requires routine servicing. Include the following:

1. Review of operation and maintenance manuals.
2. Required tools.
3. Lubricants.
4. Spare parts.
5. Cleaning.
6. Hazards.
7. Warranties and maintenance agreements.

B. Demonstrate equipment and systems operation including the following:

1. Start-up.
2. Shut-down.
3. Emergency conditions.
4. Safety procedures.
5. Setpoint and schedule adjustments.
6. Economy and efficiency adjustments.

END OF SECTION 230170

SECTION 230501 - COMMON REQUIREMENTS FOR HVAC

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 all sections.

1.2 SUMMARY

A. Scope:

1. The base bid shall include furnishing all materials, labor, tools, equipment and installation of all work required to install complete mechanical systems as outlined in the contract documents.
2. Submittal of a bid indicates that the contractor has examined the drawings, specifications, and visited the site and has included all required allowances for a complete bid.
3. Contractor shall be designated as the sub-contractor for that section of work unless specifically stated otherwise.

B. Permits, Fees, Inspection, Laws and Regulations

1. Permits and fees of every nature required in connection with this work shall be obtained and paid for by this contractor who shall also pay for all the installation fees and similar charges.
2. Laws and regulations which bear upon or affect the various branches of this work shall be complied with by this contractor, and are hereby made a part of this contract.
3. All work which laws require to be inspected shall be submitted to the proper public officials for inspections and certificates of final approval must be furnished to the Owner before final acceptance will be given by the Engineer.

1.3 ELECTRONIC FILES

A. Drawings for this project were prepared using AutoCAD software. Electronic files are available upon request for use by the successful contractor(s) for planning, coordination and installation.

B. There will be no charge for drawing files that were prepared using AutoCAD. These files will be available in the version in which they were created.

C. The Request Drawings Form can be accessed, filled out and submitted at the following internet address at the bottom of the page: http://www.klhengrs.com.

1.4 QUALITY ASSURANCE

A. General Standards

1. The installation of all work shall conform to the applicable State and Local codes and statures. The applicable provisions of the following standards shall govern:

a. State Building Code and applicable local amendments.
b. Local Building Code (if applicable)
c. American Society of Heating, Refirgeration and Air Conditioning Engineers (ASHRAE).
d. American Society of Test Materials (ASTM)
e. National Fire Protection Association (NFPA)
f. Underwriters Laboratories (UL)
g. National Sanitation Foundation (NSF)
h. Sheet Metal & Air Conditioning Contractors National Association (SMACNA)
i. American National Standards Institute (ANSI)
j. Building Code Seismic Relative Displacement Requirements

B. Definitions and Descriptions

1. “AS SHOWN” – As shown, indicated or described on the contract documents.
2. “CONTRACT DOCUMENTS” – Drawings, specification sections, contracts and submittals.
3. “CONTRACTOR DOCUMENTS” – All documents submitted by the contractor.
4. “PROVIDE” – To furnish and install.
5. “WORK” – All labor, materials and equipment described by the contract documents.
6. “WORK OF OTHER TRADES” – Work included in this contract that is normally described in other Sections of the Specifications under the Construction Specification Institute’s 28 Division format.
7. “REMOVE” – To disconnect, dismantle or disconnect and dismantle as necessary. All removals not designated for reuse nor designated to be salvaged for the Owner is the property of the contractor unless stated otherwise.
8. “REPLACE” – To remove existing and provide new as indicated in the same location.
9. “COORDINATE” – To locate and avoid both new and existing equipment, services and obstructions.
10. “REROUTE” – To remove part of system and provide extension to system to circumvent obstruction.
11. “RELOCATE” – To remove existing, install existing in a different location and make operational.
12. “REINSTALL” – To remove existing, install existing in the same location and make operational.

C. Qualifications

1. Installer Qualifications: An authorized representative who is trained and approved by manufacturer.
2. Welding Qualifications: Qualify procedures and personnel according to AWS D1.1/D1.1M, "Structural Welding Code – Steel."
3. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

D. Supervision and Workmanship

1. Workmanship throughout shall conform to the standards of best practice and all labor employed must be competent and qualified to do all the work required.
2. Contractor shall furnish the services of an experienced superintendent to be in constant charge of the work at all times.
3. Quality Assurances: Contractor if requested shall demonstrate his ability to perform all work to be included under the contract. Assurance if requested, shall be in the form of a list of past projects of similar size and complexity and a list of six (6) references

pertaining to those projects. Failure to demonstrate these quality assurances shall be taken as a statement of the contractor's inability to perform.

4. Contractor shall have a minimum five (5) years experience in the installation of HVAC systems similar to the systems specified.
5. Welders shall show proof satisfactory to the Engineer that they have passed qualifications prescribed by are certified by the National Certified Pipe Welding Bureau or by other reputable and recognized agency, acceptable to the Engineer, using welding procedures set forth in the ASME Boiler Construction Code, Section IX, Welding Qualifications. No welder shall be employed who does not meet the above requirements.
6. Core Drilling: Contractors shall use core drills rather than percussion type equipment for making holes in concrete. All percussion type drilling including hammer drills must be scheduled through owner's representative. Openings shall be no larger than required to install services.
7. Inspection: Provisions shall be made for owner's representative to make rough-in and open ceiling inspections prior to covering up work.

E. Materials

1. All materials installed shall be new, full weight and of the best quality. All similar materials shall be of the same type and manufacturer.
2. Contractor is responsible for the safety and good condition of the materials and equipment installed until final acceptance by the Owner. Materials shall be stored to prevent damage, freezing or weathering prior to installation.
3. When several materials, products or items of equipment are specified by name for one use, the contractor may select any one of those specified and shall include with his bid and Equipment List listing the equipment selected.
4. Any manufacturer(s) other than scheduled shall have unit dimensions, weights and clearances equal to or less than any specified base-bid equipment, unless reviewed by the Engineer.
5. The responsibility for costs incurred from deviation from the base scheduled and specified equipment shall be this contractor. Use of any equipment will be considered as a statement that capacities, requirements, clearances and arrangements have been checked, verified and found satisfactory and meet the intent of the scheduled and specified equipment. Such additional costs shall be approved in advance by appropriate Contract Modification for these increases.
6. All manufacturer or Mechanical Contractor provided electrical disconnect switches shall comply with current National Electric Code requirements and rated to meet or exceed the overcurrent device serving the equipment.

F. Specifications

1. Specifications shall be interpreted in connection with the drawings hereinbefore described, and if anything is shown on drawings and not mentioned in the specifications, or vice versa, it is to be included in the work the same as though clearly set forth by both.
2. Furthermore, all materials or labor previously required to fully complete the work shall be included in the contractor's work even though each item necessarily involved be not specifically mentioned or shown. Such work and/or materials shall be of the same grade or quality as the parts actually specified and shown. Should there be a conflict between the plans and specifications, the greater quantity or better quality shall be furnished.

G. Plans

1. Plans are diagrammatic indicating required size, points of termination of ducts and pipes and suggested routes. However, it is not intended that drawings indicate all necessary

offsets. It shall be the work of the contractor to install piping and ductwork in such manner as to conform to the structure, avoid obstructions, provide required service clearances and preserve headroom. Take field measurements to make these determinations. Do not rely on measurements taken or provided by others or scaled from drrawings.

2. Coordination Drawings: The contractor shall provide a 1/4" scale double line set of coordination drawings to the Engineer prior to installation of the systems. This contractor shall provide all necessary coordination drawings required to make sure all disciplines are coordinated and fit into specified mechanical spaces (i.e. ceilings, chases, and all others). The top elevation of all disciplines shall be clearly marked throughout the drawings so that no interferences occur. Drawings shall depict actual clearances of installed equipment, penetration locations and service clearances. Indicate scheduling, sequencing, movement and positioning of large equipment during construction. Indicate 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. Conflicts in equipment and materials shall be corrected prior to installation. Contractor shall provide drawings showing all disciplines for coordination.
3. Exact location of electric outlets, heating equipment, piping, lighting fixtures, ducts, etc., shall be coordinated so there will be no interferences at installation between the various trades. It is the work of the contractor to prepare complete coordination drawings indicating exact location of all items. The engineer shall have the option to move any piece of mechanical equipment up to fifteen feet from location shown on contract documents without any additional cost.
4. All ducts and piping shall be run as straight as possible and symmetrical with architectural items.
5. Ducts and piping shall be concealed in pipe shafts, pipe spaces, and furring wherever possible.
6. Piping and ductwork fabricated before coordination with the other trades will be done at the contractor's risk.

H. Utility Verification Requirements

1. Field verify locations of underground and aboveground utilities, or those otherwise obscured from view, in the vicinity of work prior to commencing work.
2. Camera/Scope existing piping, ductwork and pathways to confirm existing conditions and use including, but not limited to, voltage, natural gas pressure, sanitary, storm, chilled water, steam, etc…)
3. Obtain on-site approval from local utility prior to connected to existing services.
4. Failure to perform the above shall result in contractor proceeding at their risk and accepting full responsibility for incorrect connections.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Deliver equipment and materials according to factory shipping requirements. Pack components in factory-fabricated protective containers. Units shall be delivered in sections of such size as will pass through available openings.

B. Store equipment and materials in clean dry place and protect from weather and construction traffic. When stored inside, do not exceed structural capacity of the floor.

C. Handling and rigging of equipment and products shall be as recommended by the manufacturer. Components and equipment damaged during shipment or handling shall not be installed. Replace and return damaged components to the manufacturer.

D. All equipment and materials shall have the ability to be returned to the manufacturer after purchase and charged a reasonable restocking fee by the manufacturer equal to a small portion of the cost.

1.6 WARRANTY

A. The contractor shall provide a guarantee in written form stating that all work under this section shall be free of defective work, materials, or parts for a period of one year from the date of substantial completion owner's final acceptance and shall repair, revise or replace at no cost to the owner any such defects occurring within the guarantee period. Contractor shall also state in written form that any items or occurrences arising during the guarantee period will be attended to in a timely manner and will in no case exceed four (4) working days from date of notification by owner.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine products or materials before installation. Reject products or materials that are wet, moisture damaged, or mold damaged.

C. Examine roughing-in for piping to verify actual locations of piping connections before equipment installation.

D. Examine walls, floors, roofs, etc. for suitable conditions where product or system will be installed.

E. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

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

3.2 TEMPORARY SERVICE

A. Refer to Division 01

B. Temporary Heating or Cooling: Provide, maintain and pay for all charges for temporary heating or cooling and adequate ventilation in all construction areas of the project, as may be deemed necessary to protect the building and work installed therein from damage due to cold, dampness, or humidity and shall maintain heating or cooling during finishing operations and until date of final completion. Use of permanent and existing building heating/cooling systems will not be permitted without prior written permission from the owner, architect, and engineer.

3.3 FIRE ALARM RELATED WORK FOR MECHANICAL SYSTEMS

A. The following applies whether or not shown on drawings. Prior to submitting a bid, each contractor shall review documents of all other branches which may have an impact on such work.

1. It shall be the responsibility of the contractor who installs the alarm panel and/or wiring to provide all necessary working drawings and submittals (wiring diagrams, zone schedule, plan view layouts, routing, wiring, device & panel submittals, etc.). These submittals shall be reviewed by the State Fire Marshall's office (or a similar agency as locally required) prior to submittal to engineer. All components shall be UL listed and NFPA approved for their specific application. Where control panels are required, provide remote annunciator (at location as directed in field) and provide full battery back-up as required by NFPA.
2. All smoke detectors shall be specifically UL listed for use with the existing or new building fire alarm panel(s) and shall be provided with all required power supply/alarm wiring, sampling tubes, test station, auxiliary contacts, etc.
3. All work shall be in strict compliance with all applicable sections of the latest edition of NFPA. Each air handling unit, sprinkler flow switch and/or sprinkler tamper switch shall be separately zoned. All fire alarm system wiring shall be supervised and installed in conduit (3/4" minimum).

B. Unless local prevailing codes require otherwise, fire alarm related work for mechanical systems shall be as follows:

1. If a sprinkler system exists in the building, the sprinkler contractor shall furnish and install all required flow and tamper switches. The Electrical Contractor shall furnish, install and wire all required fire alarm system wiring as well as all required additional components within the fire alarm system control and annunciator panels to allow for the additional zoning.
2. Electrical contractor shall coordinate with mechanical contractors and shall install the detectors in easily accessible locations. Electrical Contractor shall provide all necessary fire alarm system wiring (in conduit) and supplementary work, components, equipment, etc. as required to interface the sprinkler and/or smoke detector work with the building fire alarm system(s).
3. HVAC Contractor shall make wiring connection from the auxiliary contacts of the relay module or detectors into fan control circuits to shutdown equipment, in a controlled and safe manner, in the presence of smoke. If alarm status for the smoke detector is indicated in specification section 23 09 93.00, then the HVAC/ Temperature Controls Contractor is responsible for providing a control relay and all wiring from the smoke detector to allow notification at the BAS. If a supply & return/exhaust fan arrangement is installed, the HVAC/ Temperature Controls Contractor shall provide a 3-Pole Double Throw relay to shut down both the supply and return/exhaust fans in event of presence of smoke.

3.4 ARCHITECTURAL COORDINATION ITEMS

A. Cutting and Patching:

1. Cut and drill all openings in walls and floors required for the installation. Secure approval of Engineer before cutting and drilling. Neatly patch all openings cut.
2. Cutting and patching to be held to a minimum by arranging with other contractors for all sleeves and openings before construction is started.

B. Fire Caulking:

1. Patching through fire rated walls and enclosures shall not diminish the rating of that wall or enclosure. Patch shall be equal to rockwool, firestop, caulk or approved "rated" patch.
2. Provide products equivalent to the following:

   a. For Floor Openings: Instant Firestop; 305-SL
   b. For Wall Openings: Instant Firestop; 344-GG
   c. Mineral Felt: Instant Firestop; Type MW
   d. For Insulated Pipes: Instant Firestop; Type PI
   e. For Fill Areas: Instant Firestop; C-1000

3. For larger openings where pipes penetrate fire rated enclosures that cannot be sealed with products described above, utilize approved UL products equal to 3M FireDam Spray 200. Install per manufacturer's instructions.

C. Access Panels and Pathways:

1. Furnish all access panels required for proper servicing of equipment. Provide access panels for all concealed valves, vents, controls, cleanout doors, and sprinkler devices required by NFPA. Provide access panels for all fire and/or fire & smoke dampers. Provide frame as required for finish. Furnish panels to General Contractor. Exact locations to be approved by the Architect. Minimum size to be 12" x 12", units to be 16 gauge steel, locking device shall be screwdriver cam locks.
2. For equipment above gypsum board or "hard ceilings", provide equipment access panels sized to permit complete holistic removal of the unit in its entirety. Access panel shall also be sized to accommodate removal of the largest piece of equipment in the case where such access panel is used as a removal pathway for multiple pieces of equipment.
3. Provide and maintain a minimum 34" wide by 80" high pathway for removal of equipment. Pathway shall be continuous from location of installed to building exterior. Ductwork, piping and conduit shall not be installed within this pathway.

D. Piping Sleeves:

1. Install standard Schedule 40 black steel pipe sleeves two sizes larger than pipes passing through floors, walls or masonry construction.
2. Sleeves through walls to be cut flush with both faces.
3. Sleeves through floor to extend one inch above floor top elevation.
4. Pipes penetrating roof shall use a pipe curb assembly equal to Pate Co. Curb type and flashing per roofing manufacturer's requirements.
5. Caulk between sleeves and pipes with rockwool and caulk around sleeves with sealing compound. Material must meet all applicable fire ratings required.

E. Piping Escutcheon plates:

1. Install manufactured chromium plated escutcheon plates wherever uninsulated exposed pipes pass through walls, floors, or ceilings. Escutcheon inside diameter to closely fit around pipe and outside diameter to completely cover opening.

F. Piping Penetrations:

1. Furnish and set all forms required in masonry walls or foundation to accommodate pipes.

2. Provide flexible connectors where all pipes or ducts cross building expansion joints equal to Flexonics. Coordinate exact quantity & location with Architectural plans prior to installation of piping or ductwork.

3.5 ROOFING, FINISHED FLOORS AND SLABS

A. Protect roofs and flooring by using plywood planking to cover walkways and work areas on roofs, slabs and floors.

B. Make roof penetrations and install roof curbs and flashing in accordance with roofing manufacturer's recommendations. Obtain written certification from roofing manufacturer that work has been performed properly and that roof warranty has not been voided.

3.6 INSTALLATION

A. Equipment shall be installed in accordance with manufactures installation recommendations.

B. Provide and maintain service, maintenance and operating clearances as required by the manufacturer.

3.7 CLEANING EQUIPMENT AND PREMISES

A. Clean all parts of the apparatus and equipment. Exposed parts which are to be painted shall be cleaned of cement, plaster and other materials and all oil and grease spots shall be removed. Such surfaces shall be carefully wiped and all corners and cracks scraped out.

B. Exposed metal work shall be brushed down with steel brushes to remove rust and other spots and left smooth and clean. Remove trapped elements during cleaning and flushing period, after which they shall be replaced and adjusted.

C. During the progress of the work, the contractor shall clean up after his men and leave the premises and all portions of the building in which he is working in a clean and safe condition.

3.8 FIELD QUALITY CONTROL

A. Prepare test and inspection reports.

B. Prepare and provide Utility Verification reports.

3.9 STARTUP SERVICE

A. Engage a factory-authorized service representative to perform startup service.

1. Complete installation and startup checks according to manufacturer's written instructions.
2. Unit may be started up and utilized only after the floor has been prepared and after drywall sanding has occurred 100%. Coordinate with all trades prior to startup.

3.10 ADJUSTING

A. Adjust hardware and moving parts to function smoothly, and lubricate as recommended by manufacturer.

3.11 PROTECTION

A. Protect installed equipment, ductwork, piping, devices and accessories during construction. Items damaged during construction will not be accepted and shall be replaced by this contractor with new at this contractor’s expense.

B. Remove and replace products or materials that are wet, moisture damaged, or mold damaged.

3.12 DEMONSTRATION

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

END OF SECTION 230501

SECTION 230503 - SUBMITTALS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Division 23 General Requirements Section apply to this Section.

1.2 SUMMARY

A. Section Includes: Administrative, content and format requirements for preparation and submission of submittals.

B. Work of this Section is supplemental and additive to the requirements of Section 013300 where included in the Project Manual.

1.3 PRICE AND PAYMENT PROCEDURES

A. Payment in full or in part may be withheld from the Contractor for failure to comply with submittal requirements articulated in the Contract Documents.

1.4 SUBMITTALS

A. Submittals shall be furnished for each Section that includes one or more of the following elements of work:

1. Supply of one or more products.
2. Installation of one or more products.
3. Integration of one or more products.
4. Programming of one or more products.
5. Creation of one or more deliverable products.
6. Labeling of one or more products.
7. Contractor-based design or engineering of one or more products or systems.

1.5 REFERENCES

A. Definitions:

1. Component Identifier / Component ID: See Device ID.
2. Device.ID: The unique identifier given to a specific instance of a product, module and assembly. Identifiers are unique within the context of the system and product in which it is used.
3. Product Identifier / Product ID: See Device ID.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Submittals shall be routed through established Project channels as identified by the Owner's representative.

B. Coordinate, assemble, title, transmit and track Project submittals.

C. Label each submittal of each type similarly for consistency and so they appear as if prepared by the same entity. Like-type submittals (e.g., Product Data) from different Sections shall have the same appearance and organization as those of other Sections.

D. Submittals prepared by subcontractors or vendors shall not be accepted unless prepared in compliance with the Contract Documents.

E. Submittal items listed in this Section represent the common items required to be supplied for the various specification Sections throughout the duration of the Project. Individual Sections will vary and may include additional or lesser requirements.

F. Engineer reserves the right to require additional submittals or to waive select submittal requirements on a Section-by-Section basis.

G. The cost for preparation and transportation of submittals is Work of the Contract.

H. Bind physical/hardcopy submittals together. Do not submit loose or paper clipped documents.

I. Supply separate submittals for each Section. Do not combine multiple Sections together into a single submittal, except where expressly directed within the Contract Documents.

J. Where electronic submittals are required or permitted, comply with the requirements for electronic submittals as identified in the Contract Documents.

K. Organize submittals as identified in the Contract Documents.

L. Furnish submittals for different Sections each with its own transmittal form. A single transmittal shall not be used to identify submittals for more than one (1) Section at a time. This allows for tracking and processing efficiency, so that:

1. Each Section may be reviewed simultaneously by different individuals, as appropriate.
2. Individual Sections may be processed and returned more quickly than others when some Sections require longer review times.
3. Submittals that are returned and marked as "Revise and Resubmit" do not cause submittals for other Sections to be also be resubmitted due to the fact that they were bound together as a single unit.

M. Use of Electronic Drawings from the Owner's Design Team:

1. Plan drawings for the Project were created with AutoCAD.
2. If expressly permitted by the Owner and the terms of the Contract, editable electronic versions of standard-scale, AutoCAD-based plan drawings may be made available for the creation of shop and as-built drawings.

3. Due to the proprietary nature of internal design systems, editable native-software versions of some drawings, including but not limited to system diagrams and details will not be made available in an editable form. In these cases, electronic versions of the drawings may be made available only in PDF, JPG or similar non-editable electronic form, at the sole discretion of the Designer.

3.2 SUBMITTAL TYPES

A. The following are the common submittal types referenced in this Section:

1. Quality Assurance (QA).
2. Quality Control (QC).
3. Product Data (PD).
4. Shop Drawing (SD).
5. Samples (SS).
6. Training (TG).
7. Field Observation Response (FO).
8. Pre-Acceptances (PA).
9. Closeout Submittal (CO).

3.3 SEQUENCE

A. Quality Assurance Submittal:

1. When not expressly requested to be supplied with bid, the Quality Assurance submittal(s) shall be supplied upon request. When requested the submittal shall be delivered to the Designer within 16 business hours.

B. Product Data Submittal:

1. Submit following contract award or notice of intent to award a contract. Product data shall be submitted and reviewed prior to procurement of materials.

C. Shop Drawing Submittal:

1. Submit for review prior to commencement of fabrication and installation.
2. Submit concurrently with Section-specific Product Data submittals.

D. Training Submittal:

1. Submit thirty (30) days prior to the first training session.

E. Field Observation Report Submittal:

1. Submit prior to or as part of the Pre-Acceptance Submittal.
2. Submit five (5) business days prior to punch list walkthrough.

3.4 IDENTIFICATION

A. Identify each submittal uniquely.

B. Identify each submittal by specification Section number, submittal type, and submittal iteration.

C. The format for labeling the submittals shall be as follows:

1. Section Number–Submittal Type Abbreviation–Submittal Iteration.
2. Examples:

a. First Product Data Submittal for section 23 31 13.00: “233113-PD-00.”
b. Revised Product Data Submittal for section 23 31 13: “233113-PD-01.”
c. Second Revised Product Data Submittal for 23 31 13: “233113-PD-02.”

3.5 CONTENTS

A. General:

1. Transmittal:

a. Supply a dedicated transmittal for submittals for each individual Section.
b. Itemize the specific submittals included by Section, submittal type, and iteration.

2. Title Sheet:

a. Include a separate title sheet with each submittal, of each type.
b. Title sheets for each Section, for each submittal type, shall have the same appearance.
c. Title sheets for product data submittals shall be 8-1/2 inches x 11 inches.
d. Title sheets for drawings shall be the same size as the associated drawings.
e. Create title sheets to have the appearance and information identified on the sample title sheet published at the end of this Section.

3. Index:

a. Include an index outlining and identifying the contents of the submittal.
b. The index for drawing submittals shall be incorporated onto the title sheet of the corresponding drawing set.

4. Checklists:

a. Include the checklist(s) published in the Contract Documents corresponding to the type of submittal being supplied. Applicable checklists are found at the end of this Section and within individual Sections.

5. Title Blocks:

a. Drawing submittals shall be created on the Contractor’s, manufacturers, or vendor’s own title block. The title blocks of the Owner, Architect, Engineer, Designer or their Consultants shall not be reproduced on any document (electronic or hardcopy) that is prepared or altered by the Contractor.

6. Legend:

a. Drawing submittals shall include a legend of symbology.

7. Resubmittals:

    a. Resubmittals shall include a replica of the reviewer's comments that necessitated the resubmittal, along with an accompanying item-by-item explanation of the actions taken and changes that will be found within the resubmittal.

B. Quality Assurance:

1. List of Subcontractors to be used on the Project along with a description of the role each shall play on the Project.
2. Proof of Quality Assurance compliance, as identified within each Division 23 Section "Quality Assurance" and in each individual Section.
3. The last six (6) projects that the Contractor (and each proposed Subcontractor) has completed that are of similar scope, size and contract value. References shall include:

    a. Owner's name and current contact information.
    b. Project address.
    c. Description of the system(s) and scope of actual work performed.
    d. Monetary contract value of the Work performed.

4. Financial Disclosure of the Contractor: Prior to contract award, upon request.

C. Product Data Submittals:

1. Product Datasheets:

    a. Separate manufacturer datasheets for each product.
    b. Datasheets shall be manufacturer originals or first generation printed versions (i.e., from PDF) of the manufacturer's official electronic datasheet:

        1) Distributor modified, distributor branded, and/or html based "web" datasheets are not acceptable.
        2) Datasheets shall include size and technical support data.

    c. Where manufacturer's datasheets depict multiple products, versions and options, indicate via highlighting, underlining, or with bold visible arrows the model(s), version(s) and option(s) being supplied. Exact catalog number(s) shall be indicated.
    d. Each datasheet shall be labeled with the Section paragraph reference number. Datasheets shall include the Drawing reference when no specific paragraph reference exists within the Section.

D. Shop Drawings Submittals:

1. General:

    a. Drawing descriptions identify the required contents of common drawings required under the Contract.
    b. Drawings identified within individual Sections, along with any additional drawings deemed necessary by the Designer, are required.
    c. Drawing Scales:

        1) Floor plans shall be drawn to scale.
        2) Section drawings shall be drawn to scale.

3) Elevation drawings shall be drawn to scale.
4) Details of physical items shall be drawn to scale.
5) System drawings and schematic drawings shall be drawn 1:1 (no scale).

d. Sizes:

1) Sheet sizes shall match the size of the Contract Drawings sheets, except where otherwise expressly requested or approved in advance by the Designer.

2. Floor Plans:

a. Location of major system components.
b. Location of equipment that is Work of another Section to which Work interconnects.

3. Reflected Ceiling Plans:

a. Location of ceiling devices, coordinated with devices that are Work of others, and existing devices (where applicable).

4. System Diagrams:

a. Hybrid schematic / block wiring diagram.
b. System products depicted.
c. Product inputs, outputs and other ports depicted.
d. Product brand, model, description, options, and accessories declared.
e. Equipment ID assignment for each product.
f. Interconnections depicted between system products.
g. Interconnections depicted between system products and related system products.

5. Custom Assemblies and Products:

a. Manufacturer.
b. Materials.
c. Finish and color(s).
d. Parts list.
e. Nomenclature sizes, colors.
f. Dimensions.
g. Schematic diagram(s), where applicable.

6. Mounting Details:

a. Depicting the materials and means of securing installed products.
b. Finishes and colors of exposed parts.

E. Training Submittals:

1. Proposed schedule.
2. Training agendas for each session.
3. Identification of personnel that will conduct training.
4. Handouts proposed for distribution during training.

F. Field Observation Reports Submittals:

1. Written responses to Field Observation Reports supplied to the Contractor during the course of the Project:

    a. The response shall include a copy of the original Field Observation Report.
    b. The response shall include detail of the corrective action taken, the date the action was taken and the identity of the individual who took the action.

G. Closeout Submittals:

1. As-Built Drawings:

    a. General:

        1) Requirements for Shop Drawings apply to “As-Built” drawings.

    b. Required Drawings:

        1) Title Sheet.
        2) Floor Plans.
        3) System Diagrams.
        4) Mounting Details.
        5) Labeling Schema.
        6) As-built version of each Project shop drawing.

    c. Drawing Formats:

        1) Electronic Editable: Editable version using the native application used to create the file (e.g., Revit, AutoCAD, Star-Draw, Visio, VidCAD).
        2) Non-Editable: PDF file format.
        3) Printed Hardcopy.
        4) Sheets shall be the same size and feature consistent title block information in the lower-right corner.

    d. Drawing Organization:

        1) Hardcopy drawings shall be bound together into logical sets, bound along the left edge of the sheets.
        2) The first page of the set shall include a detailed index and sheet-by-sheet description of each drawing sheet.

2. Operation and Maintenance Manuals:

    a. Manual Format:

        1) Hard-cover 3-ring type binder.
        2) Front clear plastic cover pocket complete with Project and system Information insert.
        3) Clear plastic spine pocket with Project and system Information insert.
        4) Binder sized to suit the contents only, neither oversized nor undersized.
        5) Maximum binder thickness: 3 inches.

    b. Manual Contents and Organization:

        1) General:

i) Separate binder (or binder set) for each system, labeled. Provide no more than one system per binder (or binder set).
ii) Separate CD-ROM (or CD-ROM set) for each system, labeled. Provide no more than one system per CD-ROM (or CD-ROM set).
iii) Do not overfill. Binders shall not be filled beyond an easily usable capacity.
iv) Insert labeled tabs within binder to identify separate contents of the manual.
v) Labeled sub-directories shall be created on the CD-ROM to label and separate contents for the manual.

2) Project Information Cover:

i) Title of Project.
ii) Name and address of Owner, Designer, Architect, Contractor of Record and Subcontractor.
iii) System name and specification references.

3) Index:

i) Contents of the manual.

4) Completion Forms:

i) Photocopy of “Acceptance Testing Completion” form(s).
ii) Photocopy of “Certificate of Substantial Completion” form(s). and/or “Notice of Completion” form(s).

5) Warranty Statement:

i) A warranty statement shall be included for each system. The warranty statement shall reiterate the terms of warranty identified within the Contract Documents, as well as identify how the Owner is to obtain warranty service.
ii) The warranty statement shall clearly identify which products are covered by Manufacturer warranties beyond the Contractor required minimum warranty period. The term of manufacturer warranty shall also be identified (e.g., 2 year parts and labor).
iii) A separate warranty statement shall be supplied for each system.
iv) Identify the date that the warranty for the system starts. This date shall be the date listed on the Certificate of Substantial Completion (if one was issued to the contractor specifically for the system) or the date listed on the Notice of Final Completion.
v) Supply standard out-of-warranty service rates and service contact information.

6) Product Datasheets (supply only in the electronic version of Operation and Maintenance Manual):

i) Manufacturer datasheets for each product supplied.

7) Manufacturer Owner / User Manuals:

i) Manufacturer’s Owner’s or User’s manual for each product.

ii) Manufacturer's Installation instructions and other documentation supplied with the product.

8) Test Reports and Checklists:

i) Test reports, checklists, and other forms generated and completed during the course of the Project.

9) Training Information:

i) Photocopy of training outlines / agendas.
ii) Photocopy of training session handouts.
iii) Photocopy of training sign-in sheets.
iv) Photocopy of signed delivery receipt for each training session recording (applicable to those Sections/systems requiring recording).

10) As-Built Drawings:

i) The hardcopy manual shall contain reduced scale printed version (11x17) of system-specific drawings.
ii) The electronic manual shall contain electronic PDF version of the as-built drawings.

11) Software (electronic manual only):

i) Editable configuration files for system equipment.
ii) Software source code use in supplied products.
iii) Compiled versions of configuration files and source code.
iv) Software required for reviewing and editing supplied files.

3.6 QUANTITY

A. General:

1. The quantity of submittals required shall be the greater of the following:

a. Quantity identified within Division 01.
b. Quantity identified within the individual Section.
c. Quantity identified herein.

2. In addition to the Contract required quantity, the Contractor shall also submit any additional quantities required for its own use and records, and for distribution to other trades.
3. The Designer shall retain a copy of each submittal received. Others in the submittal communication chain may also retain copies.

B. Product Data Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

C. Shop Drawings Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

D. Training Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

E. Field Observation Reports Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

F. Pre-Acceptance Submittals:

1. Two (2) Hardcopies.
2. One (1) Electronic.

G. Closeout Submittals:

1. Two (2) Hardcopies.
2. One (2) Electronic.

3.7 REJECTION

A. The following items are representative reasons that submittals may need to be revised and resubmitted:

1. Binding submittals for multiple Sections together.
2. Failing to supply separate transmittal for submittals for each Section.
3. Failing to include a submittal title sheet.
4. Failing to use and accurately complete the published title sheet.
5. Failing to supply and accurately complete the submittal checklists.
6. Failing to supply product data and shop drawings at the same time.
7. Failing to supply product data sheets.
8. Failing to supply product data sheets with the correct product and required accessories enumerated.
9. Failing to supply shop drawings.
10. Failing to supply shop drawings with required information.
11. Failing to supply accurate information.
12. Failing to supply relevant information required by the Specifications.
13. Failing to supply products that are in compliance with the Specifications.
14. Failing to supply the required information in the required format.

3.8 RESUBMITTALS

A. Revise and Resubmit:

1. When a submittal is rejected and flagged as “Revise and Resubmit,” the entire submittal shall be reviewed, revised and resubmitted in totality.

2. Resubmittals shall be checked for compliance with the Contract Documents, inclusive of requirements for submittals. In addition, any comments and deficiencies identified by the reviewer shall be appropriately acted upon.

B. Exceptions Noted:

1. When a submittal is flagged as “Exceptions Noted,” the specific actions identified shall be taken.
2. If the reviewer’s comments include selective rejection of products, the resubmittal shall be limited to include those items commented upon.

C. Resubmittals shall:

1. Include a copy of the reviewer’s previous comments.
2. Include a written description of the action(s) taken.
3. Be labeled chronologically.
4. Be inclusive of all corrective action identified by the previous reviewer.

3.9 ELECTRONIC SUBMITTALS

A. Electronic submittals shall only be permissible where electronic submittals are expressly required and where express approval for such has been granted.

B. Electronic submittal files shall be compatible for opening and viewing with electronic PDF file readers that fully support and recognize the Adobe PDF Portable Document Format Standard, version 1.5.

C. Major text within the files shall be electronically searchable using the search-for-text features of current generation Adobe PDF reader software. Files shall be prepared in such manner that reviewers will have the option to search for and find words and phrases that appear within the document, electronically. Documents featuring raster-based text and text that is otherwise not searchable shall not be acceptable. This precludes the use of documents that have been electronically scanned and then converted to or embedded within an electronic file.

D. The organization, contents, and labeling of information along with other requirements for submittals apply also to electronic versions of the submittals.

E. Single File Submission:

1. Option 1 – Single File, PDF Format:

a. Single PDF file submittals shall be assembled from a series of individual files that are organized, indexed, bound together as one composite file that is bookmarked to aid the reviewer in navigating the content.
b. The file shall feature a navigational tree of contents, organized by content groups (e.g., Title Page, Index, Datasheets, Shop Drawings). Content groups shall be organized in the same relative order identified within the Contract Documents.
c. Within each content group shall be the supporting elements of the group (e.g., product datasheets under the Datasheets group). Each element of the content group shall appear separately as a subordinate element of the group (e.g., separate entry for each product datasheet, separate entry for each shop drawing), and viewable from the navigational contents tree.

d. Under the Datasheets content group, individual product datasheet entries shall be identified by Make/Brand and Model (e.g., Carrier – 48TJ008 – Gas-Fired Rooftop Unit). Entries shall be organized in a sorted manner, first by make, then by model.
e. If the resulting size of the composite PDF file exceeds 10 Megabytes, supply the submittal using the Single Zip File method instead, as described in this Section.
f. The file name used to label the submittal shall be the section number followed by the submittal instance number for that Section (e.g., 233113-PD-01.pdf).

1) Where the Designer directs the supply of multiple zip files for a submittal, add additional text to the file name to identify that the file is part of a multi-file set of submittals, as per the following examples:

i) 233113-PD-01 (1 of 3).pdf
ii) 233113-PD-01 (2 of 3).pdf
iii) 233113-PD-01 (3 of 3).pdf

2. Option 2 – Single File, Zip Format:

a. Single Zip File submittals shall be assembled from a series of individual PDF files and file directories that are contained with a single compressed WinZip compatible ".zip" file.
b. The file shall contain separate top-level directories that are used to group related content (e.g., 00-Title Page, 01-Index, 02-Datasheets, 03-Shop Drawings), with each directory appearing in the same relative order as that identified in the Contract Documents.
c. Within each content group directory shall be separate PDF-compliant files featuring the information required (e.g., separate datasheet file for each product, separate file for each drawing, separate file for each shop drawing).
d. Product datasheet files shall be named using a consistent naming convention that enables those files to appear sorted and grouped when the file is opened for navigation, viewing or extraction by the reviewer.
e. Product datasheet files shall be consistently named with the make/brand of the product, followed by model number, followed by any additional information beneficial (e.g., Carrier – 48TJ008 – Gas-Fired Rooftop Unit).
f. Consult the Designer for supplement instructions should the WinZip file exceed 50 Megabytes in size.
g. The file name used for the submittal shall be the Section number followed by the submittal instance number for that Section (e.g., 233113-PD-01.zip).

1) Where the Designer directs the supply of multiple zip files for a submittal, add text to the file name that identifies the file is part of a multi-file set as per the following examples:

i) 233113-PD-01 (1 of 3).zip
ii) 233113-PD-01 (2 of 3).zip
iii) 233113-PD-01 (3 of 3).zip

END OF SECTION 230503

SUBMITTAL TITLE SHEET
EXAMPLE
(Form: Sub-1)

PROJECT TITLE:
Project Name Line 1
Project Name Line 2
Project Name Line 2

SUBMITTAL TYPE:
Product Data

SECTION SUBMITTAL NUMBER
233113-PD-00

SECTION TITLE:
Metal Ducts

Date Prepared:
yyyy-mm-dd

CONTRACTOR OF RECORD:
Firm Name
Address1
Address 2
City, State, Zip
Phone (000) 000-0000, Fax (000) 000-0000
Project Manager: Full Name
PM E-Mail: xxxxxxxx@xxxx.xxx

SECTION SUBCONTRACTOR(S):

Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: xxxxxxxxx@xxxx.xx	Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: xxxxxxxxx@xxxx.xx

PRODUCT DATA SUBMITTAL

CHECKLIST

(Form: Sub-2)

Each line below featuring text shall be supplied with an answer.

	No	Yes
Transmittal		
Title Sheet.		
Project Name.		
Spec Section number.		
Submittal iteration number. *(0 for first iteration, 1 + for each subsequent iteration (e.g. 231513-0,231513-1))*		
Contractor of Record identified.		
Sub-contractor / vendor / supplier name identified.		
Title Sheet appearance consistent with sample title sheet.		
Checklists included.		
This checklist.		
Checklists from Section being.		
Previous submittal review, with contractor actions and comments.		
Product Datasheets included.		
Datasheets are manufacturer originals.		
Datasheets for each product included.		
Section paragraph and/or drawing reference on each datasheet.		
Product accessories and options identified.		
Products organized by paragraph (or alphabetically by brand).		
No photocopies, faxes and other illegible datasheets included.		
Shop Drawings included.		
Shop drawings accompany this product data submittal.		
This submittal contains product data for one section only.		

This checklist serves as simple and abbreviated reminder of the contents and format of the aforementioned submittal. Refer to the 23 05 03.00 "Submittals for HVAC" and each specific Section for additional submittal requirements. Submittals are subject to rejection if this checklist is not accurately completed and supplied along with the specified information. Reproduce this checklist and submit with each submittal for each Section.

SYSTEM DIAGRAMS
SHOP DRAWING CHECKLIST
(Form: Sub-3)

Each line below featuring text shall be supplied with an answer.

	NO	YES
Transmittal		
Title Sheet		
Diagram assumes a hybrid schematic block-diagram like appearance.		
Product Blocks included.		
Each system product depicted.		
Make/brand identified.		
Model number identified.		
Description of each product instance is declared. *(e.g. "Boiler", "Chiller", "Rooftop Unit")*		
Product Interconnections depicted.		
Interconnection between system products shown.		
Interconnection between system products and related system products.		

This checklist serves as simple and abbreviated reminder of the contents and format of the aforementioned submittal. Refer to the 23 05 03 "Submittals for HVAC" and each specific Section for additional submittal requirements. Submittals are subject to rejection if this checklist is not accurately completed and supplied along with the specified information. Reproduce this checklist and submit with each submittal for each Section.

SECTION 230505 - EXISTING CONDITIONS AND DEMOLITION

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 DESCRIPTION OF WORK

A. Prior to submitting a bid, the Mechanical Contractor shall perform a detailed walk-through field inspection, to review the existing structures and premises, to determine all existing conditions, equipment/ductwork/piping locations, etc. and shall make all necessary allowances for all required mechanically related demolition and relocation work. This pre-bid inspection by the Mechanical Contractor shall include inspection of all applicable accessible ceiling cavity, areas, etc.

B. Should the Mechanical Contractor take any exceptions to providing any related demolition or relocation work, such exceptions shall be stated in detail within the Prime Contractor's bid. No subsequent allowance to the contract cost shall be made for any insufficient allowances made by the Mechanical Contractor during bidding which may result from the Mechanical Contractor's failure to visit job site and review drawings.

C. Demolition related work may not be specifically indicated on drawings, but shall be included under base bid. All mechanically related demolition, relocation, etc. work, including work described herein, shall be under base bid.

D. It is not the intent of these contract documents that existing conditions be accurately shown. Existing mechanical work is shown to a limited extent on drawings and is shown for general planning reference only. Such locations, etc. have been located from portions of contract documents which were prepared for previously installed work (not from "as-builts"). These locations are not guaranteed. The successful Mechanical Contractor shall have access to all available existing building/system plans and specifications.

E. The existing ductwork and piping systems may be utilized only to the extent indicated herein or on drawings and/or as directed by Owner's representative in field.

F. Routing of all new ductwork and piping work in existing buildings shall be approved by Owner's representative prior to installation.

PART 2 - PRODUCTS

2.1 NOT USED

PART 3 - EXECUTION

3.1 AFFECT ON ADJACENT OCCUPIED AREAS

A. Locate, identify, and protect existing mechanical services passing through demolition areas and serving other areas outside the demolition limits. Maintain services to areas outside demolition limits. When services must be interrupted, install temporary services (including proper filtration) for affected areas.

B. It is recognized that there may be some ductwork and/or piping systems rendered inactive by demolition, causing disconnection of "downstream" terminals, equipment, etc. which serve occupied areas. It shall be the responsibility of the Mechanical Contractor to investigate these types of conditions (for all systems) prior to demolition. Provide all necessary corrective mechanical work prior to demolition to ensure that such "downstream" work remain permanently active throughout demolition, new construction and after project completion.

C. All work and system shutdowns shall be carefully coordinated in advance with owner's representative and all affected trades so that normal building activities and other construction trades are minimally affected. All required mechanical related demolition and/or new construction work, which will affect any and all occupied areas (including those which are located outside the immediate area of project work) shall be performed at special times if/as directed by Owner's representative in field.

D. All existing systems and components shall remain fully operational in all occupied spaces during all occupied periods.

E. Provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to adjacent finished areas and/or other system components. During cutting and patching operations, protect adjacent installations. Remove protection and barriers after demolition operations are complete.

3.2 WORK IN EXISTING SPACES

A. General: Care shall be taken when working in existing spaces so as not to damage existing walls and ceilings where work is being performed.

B. Existing Ceilings: Where work is being performed above ceilings, and the architectural drawings do not indicate ceiling modifications by the General Contractor, it shall be the responsibility of this contractor to remove and replace existing ceilings where work is being performed. In those instances, all repair and installation of new grid, ceiling panels, etc shall be the responsibility of this contractor. Match existing finishes.

C. New Ceilings: Where existing air outlets are to remain, and the architectural drawings indicate replacement of the ceilings, this contractor shall temporarily remove air outlets, clean and store temporarily. This contractor shall support existing run outs to structure to facilitate replacement of ceiling. This contractor shall re-install existing air outlets at previous locations and extend run outs to air outlets after new ceiling is installed. Refer to architectural drawings for all required ceiling replacements. Coordinate with all trades prior to re-installation.

D. Walls & Floors: It shall be the responsibility of this contractor to patch existing walls and floors and match existing finishes where work is being removed or installed and patching is being performed, unless noted otherwise on the architectural drawings.

E. HVAC Units: Replace all air filters in all HVAC equipment serving renovated space prior to turning space over to owner.

F. If asbestos, PCB's, or other hazardous materials are encountered in the course of the work, stop work in the vicinity of such materials and report their presence to the Owner. Owner will arrange for proper removal and disposal of hazardous materials.

3.3 GENERAL DEMOLITION

A. Provide complete mechanical demolition as required for all systems throughout all project areas not indicated to be salvaged or saved. Unless specifically noted otherwise on plans or determined otherwise during this contractor's pre-demolition survey, all abandoned existing mechanical work in the project areas shall be disconnected and removed in its entirety by the Mechanical Contractor. All related work shall comply with the notes specified herein.

B. Provide demolition work as required to clear and remove all existing mechanical work to be abandoned and as required to accommodate all new work of all trades. In general, remove existing related ductwork, piping, control media, etc. back to nearest concealed accessible terminal or take-off "upstream". Extend ductwork, piping, etc. as required to accommodate new or relocated mechanical work.

C. Remove abandoned, inactive and obsolete equipment, ductwork, piping, etc. Abandoned work embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove all abandoned materials above accessible ceilings.

D. Perform cutting and patching required for demolition in accordance with the contract documents.

E. All abandoned ductwork and piping shall be removed and capped back to respective sources, even if sources are outside of the confines of the project area. Coordinate all work carefully with Owner prior to beginning any mechanical demolition work.

F. All ductwork, piping, etc. conflicting with construction related work of any and all trades shall be removed and/or relocated by the Mechanical Contractor as necessary and/or as directed by Owner's representative in the field. Mechanical disconnections (and/or reconnections) for equipment to be removed (and/or relocated) shall be by the Mechanical Contractor. This shall apply to all existing mechanical work whether shown on drawings or not.

G. All refrigerant evacuations and reclaim shall be required for demolished or relocated equipment.

H. Disposal and Cleanup: Remove from the site and legally dispose of demolished materials and equipment not indicated to be salvaged.

I. Provide new work as required to accommodate relocations, etc. Routing of all new ductwork and piping in existing buildings shall be held tight to structure above wherever possible and shall be approved by owner's representative prior to installation.

3.4 DISPOSITION OF REMOVED EQUIPMENT & MATERIALS

A. Except where specifically noted otherwise herein or on drawings, all mechanical work shown on new work plans shall be new.

B. If required to accommodate construction related activities, remove and reinstall any conflicting fixtures, devices or equipment that are to remain.

C. All abandoned materials removed during demolition and thereafter shall be referred to the Owner's representative for disposal instructions. All materials which the Owner elects to retain shall be neatly stored at the site by the Mechanical Contractor as designated by the Owner's representative. All materials which the Owner elects not to retain shall be disposed of by the Mechanical Contractor in a lawful manner.

D. All fixtures, devices or equipment designated for salvage (removal and reuse, or for turning over to Owner) shall be disconnected and removed undamaged. Disconnect all pigtails, etc. from equipment terminal points and carefully transport and neatly store same to a protected on-site storage location as directed in field.

E. Components to be reused shall be cleaned (inside and out) and reinstalled where indicated on drawings. Modify and/or extend related existing ductwork and/or piping as required.

F. Components turned over to Owner shall be neatly stored as groups by system type.

3.5 PRE-EXISTING CODE VIOLATIONS

A. All existing work which is accessed and/or used under this project shall be inspected and brought into compliance with current codes and standards by the Mechanical Contractor. This shall apply only to the extent that such work is uncovered in the immediate project areas affected by demolition and/or new construction and only to the limited extent that it applies to pre-existing general installation methods (i.e. a missing hanger/support, a missing seal and other minor incidental work.

B. If more extensive code or safety violations are discovered by the Mechanical Contractor, they shall be immediately brought to the attention (detailed in writing) of the Owner's representative along with the contractors proposed cost for corrections.

3.6 INTERIM LIFE SAFETY WORK

A. Provide interim fire protection (sprinkler) work in all demolition and construction areas for full code coverage. Further definition will be provided in field if required.

3.7 INTERIM INDOOR AIR QUALITY (IAQ) WORK

A. All requirements of this IAQ subsection shall be implemented prior to commencement of any demolition/construction activities.

B. No airborne dust or particulate matter shall be permitted to enter any occupied spaces or any air intakes to existing systems.

C. Become familiar with all affected HVAC systems to ensure that positive pressure can be maintained, relative to construction areas, in all areas adjacent to construction areas. This shall include all possible operational sequences of all systems such, including operation of smoke control, fire dampers, etc.

D. All return air and exhaust air terminals within all demolition/construction spaces shall be covered and properly sealed until construction is complete.

E. All air filters shall be checked at the beginning and end of each work shift and shall be changed in-kind as required to permit free airflow at all times.

F. Provide temporary exhaust throughout all demolition/construction spaces to ensure proper negative pressure is maintained relative to adjacent areas, including allowances for normal construction traffic through all access doors. Ensure that no windows or doors are left open which could upset the desired negative pressure.

G. Designate a dedicated qualified person to be on site to monitor all IAQ requirements, including checking filters three to four times per shift, checking for any breeches (by any contractor) such as drilled/cut openings in walls/floors, open windows, etc. Ensure that openings through walls and floors (by any contractor) are made immediately prior to installation of work and properly/permanently sealed immediately thereafter.

END OF SECTION 230505

SECTION 230513 - COMMON MOTOR REQUIREMENTS FOR HVAC

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. Motors Furnished with HVAC Equipment

B. Related Sections:

1. Section 23 05 03.00 “Submittals for HVAC”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.
3. Clearly state equipment markings (i.e. AHU-1), capacities, voltages and model numbers on all submittals.

B. Shop Drawings:

1. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
2. Include diagrams for power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: drawings and details, drawn to scale, on which all items, including other trades, are shown and coordinated with each other, code required clearances, manufactured recommended service clearances, using input from installers of the items involved.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For equipment to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Comply with NFPA 70, “National Electrical Code”

1.7 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of equipment that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: One year from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. All mechanical equipment shall be UL listed for use with "HACR" circuit breakers.

B. The motor control apparatus shall be furnished complete as a part of the motor and apparatus which it operates when called for in certain instances in the Mechanical Division. Motor control apparatus except as above shall be complete, factory wired and tested, ready for connections to be made under Division 26.

2.2 MOTORS

A. All motors shall be in accordance with the latest standards of NFPA 70, "National Electrical Code".

B. Refer to HVAC/Electrical Coordination Schedule and the Electrical specifications and drawings for the exact voltage of motors.

C. Wherever in these specifications, a motor voltage is listed, the motor shall be wound for the listed voltage and none other will be accepted.

D. Service Factors indicated for motors are minimum values and apply at frequency and utilization voltage at which motor is connected. Provide motors, which will operate in the service factor range when supply voltage is within 10 percent of motor voltage rating.

E. Provide grounding rings and brushes on motor shaft to divert shaft to ground current flow around bearings.

F. Temperature Rise: Based on 100 degree F ambient except as otherwise indicated.

G. Three-Phase Motors

1. Squirrel cage induction type.
2. NEMA design letter Designation "B".
3. Internal thermal overload protection.
4. Bearings: double shielded, prelubricated, regreasable.
5. Energy Efficient Motors: equal or greater than NEMA MG-1.
6. 1.25 Service factor.

7. Multi Speed Motors: separate windings for each speed.

H. Single-Phase Motors

1. Internal thermal overload protection.
2. Motor starters incorporated as an integral part of equipment shall be NEMA standard.
3. Sealed, prelubricated bearings.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine products or materials before installation. Reject products or materials that are wet, moisture damaged, or mold damaged.

C. Examine walls, floors, roofs, and equipment for suitable conditions where equipment will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

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

3.2 ELECTRICAL INSTALLATION

A. All electrical work associated with this section shall be in accordance with the latest standards of NFPA 70, "National Electrical Code".

B. Electrical wiring shall be provided under Division 26 unless specifically called for in another section of the specifications.

C. An enclosed safety type, NEMA Type HD motor disconnect switch shall be furnished and installed for each motor installation unless specifically mentioned as furnished under another section of these specifications.

3.3 FIELD QUALITY CONTROL

A. Manufacturer's Field Inspection: Arrange and pay for a factory-authorized service representative to perform the following:

1. Prepare a written report on findings and recommended corrective actions if any are required.

3.4 STARTUP PROCEDURES

A. Energize motor, verify proper operation of motor, drive system, and fan wheel.

B. Measure and record motor electrical values for voltage and amperage.

3.5 MOTOR ADJUSTMENT

A. Adjust hardware and moving parts to function smoothly, and lubricate as recommended by manufacturer.

3.6 PROTECTION

A. Remove and replace products or materials that are wet, moisture damaged, or mold damaged.

END OF SECTION 230513

SECTION 230523 - GENERAL DUTY VALVES FOR HVAC PIPING

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. Ball valves
2. Butterfly valves
3. Check valves
4. Globe valves
5. Plug Valves

B. Related Sections:

1. Section 23 05 03.00 “Submittals for HVAC”.
2. Section 23 05 53.00 "Identification for HVAC Piping and Equipment" for valve tags and schedules.
3. Section 23 21 13.23 “Aboveground Hydronic Piping and Specialties”

1.3 DEFINITIONS

A. CWP: Cold working pressure.

B. EPDM: Ethylene propylene diene terpolymer rubber.

C. NPS: Nominal Pipe Size

D. NRS: Non-rising stem.

E. OS&Y: Outside screw and yoke.

F. PTFE: Polytetrafluoroethylene plastic

G. RS: Rising stem.

H. SWP: Steam working pressure.

I. TFE: Tetrafluroethylene plastic.

1.4 ACTION SUBMITTALS

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

1.5 QUALITY ASSURANCE

A. Source Limitations for Valves: Obtain each type of valve from single source from single manufacturer.

B. ASME Compliance:

1. ASME B16.10 and ASME B16.34 for ferrous valve dimensions and design criteria.
2. ASME B31.1 for power piping valves.
3. ASME B31.9 for building services piping valves.

C. NSF Compliance:

1. NSF 61 for valve material for potable-water service.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Prepare valves for shipping as follows:

1. Protect internal parts against rust and corrosion.
2. Protect threads, flange faces and weld ends.
3. Set globe valves closed to prevent rattling.
4. Set ball valves open to minimize exposure of functional surfaces.
5. Set butterfly valves closed or slightly open.
6. Block check valves in either closed or open position.

B. Use the following precautions during storage:

1. Maintain valve end protection.
2. Store valves indoors and maintain at higher than ambient dew point temperature. If outdoor storage is necessary, store valves off the ground in watertight enclosures.

C. Use sling to handle large valves; rig sling to avoid damage to exposed parts. Do not use handwheels or stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS FOR VALVES

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

1. Conbraco Industries Inc.; Apollo Valves.
2. Crane Co.; Crane Valve Group; Crane Valves.
3. Hammond Valve.
4. Milwaukee Valve Company.
5. Watts Regulator Co.; a division of Watts Water Technologies, Inc.

B. Valve Pressure and Temperature Ratings: Not less than indicated and as required for system pressures and temperatures.

C. Valve design: Valves shall have rising stem or rising outside screw and yoke stems; except non-rising stem valves may be used where headroom prevents full extension of rising stems.

D. Valve Sizes: Same as upstream piping unless otherwise indicated.

E. Valve Actuator Types:

1. Handwheel: For valves other than quarter-turn types.
2. Handlever: For quarter-turn valves NPS 6 and smaller, except for plug valves. Provide one wrench for every ten plug valves

F. Valves in Insulated Piping: With 2-inch stem extensions and the following features:

1. Ball Valves: With extended operating handle of non-thermal-conductive material, and protective sleeve that allows operation of valve without breaking the vapor seal or disturbing insulation.
2. Butterfly Valves: With extended neck.

G. Valve-End Connections:

1. Flanged: With flanges according to ASME B16.1 for iron valves.
2. Threaded: With threads according to ASME B1.20.1.

H. Valve Bypass and Drain Connections: MSS SP-45.

2.2 BALL VALVES

A. Size 1 inch and smaller:

1. Standard: MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body Design: Two piece.
5. Body Material: Bronze.
6. Ends: Threaded.
7. Seats: PTFE or TFE.
8. Stem: Bronze, blow-out proof.
9. Ball: Chrome-plated brass.
10. Port: Full.
11. Gland: Adjustable, packing.
12. Handle Material: Vinyl-covered steel.

B. Size 1-1/4 inch to 2 inch:

1. Standard: MSS SP-110.
2. SWP Rating: 150 psig.
3. CWP Rating: 600 psig.
4. Body Design: Three piece.
5. Body Material: Bronze.
6. Ends: Threaded.
7. Seats: PTFE or TFE.
8. Stem: Bronze, blow-out proof.
9. Ball: Chrome-plated brass.

10. Port: Conventional
11. Gland: Adjustable, packing.
12. Handle Material: Vinyl-covered steel.

2.3 BUTTERFLY VALVES

A. Size 4 inch and larger:

1. Standard: MSS SP-67, Type I.
2. Class B
3. CWP Rating: 200 psig.
4. Body Material: ASTM A 126, cast iron or ASTM A 536, ductile iron.
5. Body Design: Lug type; suitable for bidirectional dead-end service at rated pressure without use of downstream flange.
6. Seat: EPDM, field replaceable.
7. Stem: One- or two-piece stainless steel.
8. Stem Seals: EPDM O-ring
9. Disc: Ductile iron.
10. Operators:

    a. Size 4 inch through 6 inch: Lever type with locks.
    b. Size 8 inch and larger: Gear type with position indicators.

2.4 GLOBE VALVES

A. Size 2 inch and smaller:

1. Standard: MSS SP-80, Type 1.
2. CWP Rating: 125 psig.
3. Body Material: ASTM B 62, bronze with integral seat and screw-in bonnet.
4. Ends: Threaded.
5. Disc: Bronze or composition, replaceable.
6. Stem: Copper-Silicon alloy.
7. Packing: “Teflon” impregnated material.
8. Handwheel: Malleable iron.
9. Class 150 valves meeting the above shall be used where pressure requires.

B. Size 2-1/2 inch and larger:

1. Standard: MSS SP-80, Type 1.
2. CWP Rating: 125 psig.
3. Body Material: ASTM B 62, bronze with bolted bonnet.
4. Type: Outside screw and yoke
5. Ends: Flanged.
6. Disc: Bronze.
7. Stem: Copper-Silicon alloy.
8. Packing: “Teflon” impregnated material.

2.5 PLUG VALVES

A. Size 2 inch and smaller:

1. WOG Rating: 150 psi
2. Body Material: Bronze
3. Ends: Threaded
4. Flow Pattern: Straightaway
5. Square Head

B. Size 2-1/2 inch and larger:

1. Type: Lubricated plug, single gland.
2. CWP Rating: 175 psi.
3. Body Material: Semi-steel.
4. Ends: Flanged.
5. Wrench Operated

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine valve interior through the end ports for cleanliness, freedom from foreign matter, and corrosion. Remove special packing materials, such as blocks, used to prevent disc movement during shipping and handling.

B. Operate valves in positions from fully open to fully closed. Examine guides and seats made accessible by such operations. Following examination, return the valve closure member to the position in which it was shipped.

C. Examine threads on valve and mating pipe for form, out-of-round, local indentations and cleanliness.

D. Examine mating flange faces for conditions that might cause leakage. Check bolting for proper size, length, and material. Verify that gasket is of proper size, that its material composition is suitable for service, and that it is free from defects and damage.

E. Do not attempt to repair defective valves; replace with new valves.

3.2 GENERAL REQUIREMENTS FOR VALVE APPLICATIONS

A. If valve applications are not indicated, use the following:

1. Shutoff Service: Ball, butterfly valves. Shutoff service butterfly valves shall be minimum 6 inch pipe size.
2. Butterfly Valve Closed System Service: Ductile-Iron Disc for non-condenser water applications.
3. Throttling Service, Hydonic: Globe, ball, or butterfly valves. Throttling service butterfly valves shall be minimum 4 inch pipe size.
4. Throttling Service, Steam: Globe or butterfly valves.
5. Control valves: Globe or ball type modulating valves.

B. If valves with specified SWP classes or CWP ratings are not available, the same types of valves with higher SWP classes or CWP ratings may be substituted.

C. Select valves, except wafer types, with the following end connections:

1. For Copper Tubing, NPS 2 and Smaller: Threaded .
2. For Copper Tubing, NPS 2-1/2 to NPS 4: Flanged ends.
3. For Steel Piping, NPS 2 and Smaller: Threaded ends.
4. For Steel Piping, NPS 2-1/2 and Larger: Flanged ends.

3.3 VALVE INSTALLATION

A. Install valves with unions or flanges at each piece of equipment arranged to allow service, maintenance, and equipment removal without system shutdown. Unions are not required on flanged devices.

B. Isolation valves:

1. Branch piping serving two or more pieces of equipment
2. Every 100 feet of pipe run.

C. Install 3-valve bypass around each pressure reducing valve using throttling duty valve in the by-pass and shutoff type valves on each side of the pressure reducing valve.

D. Locate valves for easy access and provide separate support where necessary.

E. Install valves in horizontal piping with stem at or above center of pipe.

F. Install valves in position to allow full stem movement.

3.4 THREADED CONNECTIONS

A. Note the internal length of threads in valve ends and proximity of valve internal seat or wall to determine how far pipe should be threaded into valve.

B. Align threads at point of assembly.

C. Apply appropriate tape or thread compound to the external pipe threads except where dry seal threading is specified.

D. Assemble joint wrench tight. Wrench on valve shall be on the valve end into which the pipe is being threaded.

3.5 FLANGE CONNECTIONS

A. Align flange surfaces parallel.

B. Assemble joints by sequencing bolt tightening to make initial contact of flanges and gaskets as flat and parallel as possible. Use suitable lubricants on bolt threads. Tighten bolts gradually and uniformly using torque wrench.

3.6 ADJUSTING

A. Adjust or replace valve packing after piping systems have been tested and put into service but before final adjusting and balancing. Replace valves if persistent leaking occurs.

3.7 FIELD QUALITY CONTROL

A. Testing: After piping systems have been tested and put into service, but before final adjusting and balancing, inspect each valve for leaks. Adjust or replace packing to stop leaks. Replace valve if leak persists.

3.8 CLEANING

A. Clean mill scale, grease and protective coatings from exterior of valves and prepare to receive finish painting or insulation.

END OF SECTION 230523

SECTION 230529 - HANGERS AND SUPPORTS FOR HVAC PIPING AND EQUIPMENT

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 pipe hangers and supports
2. Trapeze pipe hangers
3. Metal framing systems
4. Thermal-hanger shield inserts
5. Fastener systems
6. Equipment supports

B. Related Sections:

1. Section 055000.00 "Metal Fabrications" for structural-steel shapes and plates for trapeze hangers for pipe and equipment supports.
2. Section 230503.00 “Submittals for HVAC”.
3. Section 232113.23 “Aboveground Hydronic Piping and Specialties”.
4. Section 233113.00 "Metal Ducts" and Section 233116.00 "Nonmetal Ducts" for duct hangers and supports.

1.3 DEFINITIONS

A. MSS: Manufacturers Standardization Society of The Valve and Fittings Industry Inc.

B. Terminology: As defined in MSS SP-90, “Guidelines to Terminology for Pipe Hangers and Supports”

1.4 PERFORMANCE REQUIREMENTS

A. Delegated Design: Design trapeze pipe hangers and equipment supports, including comprehensive engineering analysis by a qualified structural professional engineer, using performance requirements and design criteria indicated.

B. Structural Performance: Hangers and supports for HVAC piping, and equipment shall withstand the effects of gravity loads and stresses within limits and under conditions indicated according to ASCE/SEI 7.

1. Design supports for multiple pipes, capable of supporting combined weight of supported systems, system contents, and test water.

2. Design equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Metal pipe hangers and supports.
2. Thermal-hanger shield inserts.
3. Powder-actuated fastener systems.

B. Shop Drawings: Signed and sealed by a qualified professional engineer. Show fabrication and installation details and include calculations for the following; include Product Data for components:

1. Trapeze pipe hangers including product data for components
2. Metal framing systems including product data for components
3. Equipment supports

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates.

1.7 QUALITY ASSURANCE

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

B. Pipe Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

PART 2 - PRODUCTS

2.1 METAL PIPE HANGERS AND SUPPORTS

A. Carbon-Steel Pipe Hangers and Supports:

1. Description: MSS SP-58, Types 1 through 58, factory-fabricated components.
2. Galvanized Metallic Coatings: Pregalvanized or hot dipped for hangers in contact with galvanized piping.
3. Padded Hangers: Hanger with fiberglass or other pipe insulation pad or cushion to support bearing surface of piping.
4. Hanger Rods: Continuous-thread rod, nuts, and washer made of steel or stainless steel in moist area.

B. Copper Pipe Hangers:

1. Nonmetallic Coatings: Plastic coating, jacket, or liner for hangers in contact with copper piping.

2. Hanger Rods: Continuous-thread rod, nuts, and washer made of copper-coated steel.

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

1. Anvil International, Inc.
2. B-Line Systems, Inc. (a division of Cooper Industries)
3. ERICO/Michigan Hanger Company
4. PHD Manufacturing, Inc

2.2 TRAPEZE PIPE HANGERS

A. Description: MSS SP-69, Type 59, shop- or field-fabricated pipe-support assembly made from structural carbon-steel shapes with MSS SP-58 carbon-steel hanger rods, nuts, saddles, and U-bolts.

2.3 THERMAL-HANGER SHIELD INSERTS

A. Description: 100 psig minimum, compressive-strength insulation insert encased in sheet metal shield.

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

1. ERICO International Corporation.
2. Pipe Shields, Inc.; a subsidiary of Piping Technology & Products, Inc.
3. Rilco Manufacturing Co., Inc.

C. Insulation-Insert Material for Cold Piping: Water-repellent treated, ASTM C 552, Type II cellular glass with vapor barrier.

D. Insulation-Insert Material for Hot Piping: Water-repellent treated, ASTM C 533, Type I calcium silicate with 100-psig minimum compressive strength.

E. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.

F. For Clevis or Band Hangers: Insert and shield shall cover lower 180 degrees of pipe.

G. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.4 FASTENER SYSTEMS

A. Powder-Actuated Fasteners: Threaded-steel stud, for use in hardened portland cement concrete with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

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

a. Hilti, Inc.

b. ITW Ramset/Red Head
c. Masterset Fastening Systems, Inc
d. MKT Fastening, LLC
e. Powers Fasteners.

B. Mechanical-Expansion Anchors: Insert-wedge-type, zinc-coated steel anchors, for use in hardened portland cement concrete; with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

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

a. B-Line Systems Inc. (a division of Cooper Industries)
b. Empire Industries
c. Hilti, Inc
d. ITW Ramset/Red Head
e. MKT Fastening, LLC
f. Powers Fasteners

2.5 EQUIPMENT SUPPORTS

A. Description: Welded, shop- or field-fabricated equipment support made from structural carbon-steel shapes.

2.6 MISCELLANEOUS MATERIALS

A. Structural Steel: ASTM A 36/A 36M, carbon-steel plates, shapes, and bars; black and galvanized.

B. Grout: ASTM C 1107, factory-mixed and -packaged, dry, hydraulic-cement, nonshrink and nonmetallic grout; suitable for interior and exterior applications.

1. Properties: Nonstaining, noncorrosive, and nongaseous.
2. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT INSTALLATION

A. General: Install hangers, supports, clamps and attachments to support piping properly from building structure. Arrange for grouping of parallel runs of horizontal piping supported together on field-fabricated, heavy-duty trapeze hangers where possible. Where piping of various sizes is supported together by trapeze hangers, space hangers for smallest pipe size or install intermediate supports for smaller diameter pipe as specified above for individual pipe hangers.

B. Do not suspend hangers from roof decks. Suspend from roof trusses, joists and joist girders only at panel points and at top chords unless otherwise indicated.

C. All piping hangers in exterior spaces, such as parking garages, exposure to high humidity, etc., or in interior swimming pool areas shall be galvanized.

D. Comply with MSS SP-69 for pipe-hanger selections and applications that are not specified in piping system Sections.

E. Use hangers and supports with galvanized metallic coatings for piping and equipment that will not have field-applied finish.

F. Use nonmetallic coatings on attachments for electrolytic protection where attachments are in direct contact with copper tubing.

G. Use carbon-steel pipe hangers and supports, metal trapeze pipe hangers and metal framing systems and attachments for general service applications.

H. Use padded hangers for piping that is subject to scratching.

I. All mechanical equipment shall have concrete bases and/or structural steel supports and shall be provided by this contractor.

J. The use of pumps or other equipment as piping supports shall be prohibited. All such connectors and their supports shall be independently supported from the building structure and inspected and approved by the Engineer before bolting.

K. Piping connections to all equipment with moving parts shall be isolated with braided copper or stainless steel flexible links, which shall be selected to absorb the deflection on the isolating members.

L. Use thermal-hanger shield inserts for insulated piping and tubing.

M. Hangers: Provide adjustable, Steel Clevis Hangers (MSS Type 1) for suspension of noninsulated or insulated, stationary pipes.

N. Horizontal-Piping Clamps: Provide Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3) for suspension of pipes requiring clamp flexibility and up to 4 inches of insulation.

O. Vertical-Piping Clamps: Provide extension pipe or Riser Clamps (MSS Type 8) for support of pipe risers.

P. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
2. Steel Clevises (MSS Type 14): For 120 to 450 deg F piping installations.

Q. Building Attachments: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Inserts:

   a. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.

2. Clamps:

   a. C-Clamps (MSS Type 23): For structural shapes.

b. Malleable-Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.

3. Miscellaneous:

a. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
b. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:

1) Light (MSS Type 31): 750 lb.
2) Medium (MSS Type 32): 1500 lb.
3) Heavy (MSS Type 33): 3000 lb.

c. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
d. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where headroom is limited.

R. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Sections, install the following types:

1. Protection Shields (MSS Type 40): Of length recommended in writing by manufacturer to prevent crushing insulation.
2. Thermal-Hanger Shield Inserts: For supporting insulated pipe.

S. Comply with MSS SP-69 for trapeze pipe-hanger selections and applications that are not specified in piping system Sections.

T. Use powder-actuated fasteners or mechanical-expansion anchors instead of building attachments where required in concrete construction.

U. Metal Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from the building structure.

V. Metal Trapeze Pipe-Hanger Installation: Comply with MSS SP-69 and MSS SP-89. Arrange for grouping of parallel runs of horizontal piping, and support together on field-fabricated trapeze pipe hangers.

1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified for individual pipe hangers.
2. Field fabricate from ASTM A 36/A 36M, carbon-steel shapes selected for loads being supported. Weld steel according to AWS D1.1/D1.1M.

W. Thermal-Hanger Shield Installation: Install in pipe hanger or shield for insulated piping.

X. Fastener System Installation:

1. Verify suitability of fasteners in two subparagraphs below for use in lightweight concrete or concrete slabs less than 4 inches thick.
2. Install powder-actuated fasteners for use in lightweight concrete or concrete slabs less than 4 inches thick in concrete after concrete is placed and completely cured. Use op-

erators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.

3. Install mechanical-expansion anchors in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.

Y. Install hangers and supports complete with necessary attachments, inserts, bolts, rods, nuts, washers, and other accessories.

Z. Equipment Support Installation: Fabricate from welded-structural-steel shapes.

AA. Install hangers and supports to allow controlled thermal movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.

BB. Install lateral bracing with pipe hangers and supports to prevent swaying.

CC. Install building attachments within concrete slabs or attach to structural steel. Install additional attachments at concentrated loads, including valves, flanges, guides, expansion joints, strainers and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

DD. Provide pipe rollers for hot water mains where piping is above 140 degrees. Provide pipe rollers approved equal to Anvil Fig. 171, 175, 177, 181 and 271.

EE. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.

FF. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and to not exceed maximum pipe deflections allowed by ASME B31.9 for building services piping.

GG. Insulated Piping:

1. Attach clamps and spacers to piping.

    a. Clamps: Attach clamps, including spacers (if any), to piping with clamps projecting through insulation. Do not exceed pipe stresses allowed by manufacturer.
    b. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
    c. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
    d. Do not exceed pipe stress limits allowed by ASME B31.9 for building services piping.

2. Install MSS SP-58, Type 40, protective shields on cold piping with vapor barrier. Shields shall span an arc of 180 degrees.

    a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.

3. Shields:

    a. Install protective galvanized steel shields, MSS Type 40, on insulated piping smaller than 2-inch NPS. Shields shall span an arc of 180 degrees and shall be a minimum of 12-inches in length.

b. Install thermal-hanger shield inserts on all insulated piping 2-inch NPS and larger.

4. Shield Dimensions for Pipe: Not less than the following:

a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
b. NPS 4: 12 inches long and 0.06 inch thick.
c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.

5. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.2 EQUIPMENT SUPPORTS

A. Fabricate structural-steel stands to suspend equipment from structure overhead or to support equipment above floor.

B. Grouting: Place grout under supports for equipment and make bearing surface smooth.

C. Provide lateral bracing, to prevent swaying, for equipment supports.

3.3 METAL FABRICATIONS

A. Cut, drill, and fit miscellaneous metal fabrications for trapeze pipe hangers and equipment supports. Install and align fabricated anchors in indicated locations.

B. Fit exposed connections together to form hairline joints. Field weld connections that cannot be shop welded because of shipping size limitations.

C. Field Welding: Comply with AWS D1.1/D1.1M procedures for shielded, metal arc welding; appearance and quality of welds; and methods used in correcting welding work; and with the following:

1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
2. Obtain fusion without undercut or overlap.
3. Remove welding flux immediately.
4. Finish welds at exposed connections so no roughness shows after finishing and so contours of welded surfaces match adjacent contours.

3.4 ADJUSTING

A. Hanger Adjustments: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

B. Trim excess length of continuous-thread hanger and support rods to 1-1/2 inches.

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 a minimum dry film thickness of 2.0 mils.

B. Touchup: Cleaning and touchup painting of field welds, bolted connections, and abraded areas of shop paint on miscellaneous metal are specified in Division 9.

C. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

3.6 HANGER AND SUPPORT SCHEDULE

A. Piping:

Piping Material	Pipe Size	Hanger Spacing (OC)
Steel	NPS 1-1/4” and smaller	8’-0”
Steel	NPS 1-1/2” to NPS 2”	10’-0”
Steel	NPS 2-1/2” and larger	12’-0”
Copper	1” and smaller	6’-0”
Copper	1-1/4” and larger	8’-0”

1. In addition to supported pipe information above, support piping at each change in direction.

END OF SECTION 230529

SECTION 23 05 53.00 - IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

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. Warning signs and labels.
   2. Equipment labels.
   3. Pipe labels.
   4. Valve tags.
   5. Duct labels.

B. Related Sections:
   1. Section 23 05 03.00 “Submittals for HVAC”.

1.3 QUALITY ASSURANCE

A. Comply with ASTM E84

B. Comply with ASME A13.1 Scheme for the Identification of Piping Systems.

1.4 ACTION SUBMITTALS

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

B. Samples: For color, letter style, and graphic representation required for each identification material and device.

C. Equipment Label Schedule: Include a listing of all equipment to be labeled with the proposed content for each label.

D. Valve numbering scheme.

E. Valve Schedules: For each piping system, submit valve schedule for each piping system, typewritten and reproduced on 8-1/2" x 11" bond paper. Tabulate valve number, piping system, system abbreviation (as shown on tag), location of valve (room or space), and variations for identification (if any). Mark valves which are intended for emergency shut-off and similar special uses, by special "flags", in margin of schedule. In addition to mounted copies, furnish extra copies for Maintenance Manuals as specified.

1.5 COORDINATION

A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

B. Coordinate installation of identifying devices with locations of access panels and doors.

C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 MANUFACTURER

A. General: Subject to compliance with requirements, provide mechanical identification materials of one of the following:
   1. Brady (W.H.) Co., Signmark Div.
   2. Brimar
   3. Seton Name Plate Corp.

2.2 WARNING SIGNS AND LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.

B. Preprinted or partially preprinted, accident-prevention tags, of plasticized card stock with matte finish suitable for writing.
   1. Size: Approximately 4 by 7 inches.
   2. Fasteners: Brass grommet and wire.
   3. Nomenclature: Large-size primary caption such as "DANGER," "CAUTION," or "DO NOT OPERATE."
   4. Color: Yellow background with black lettering.

C. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

D. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

E. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

F. Fasteners: Stainless-steel rivets or self-tapping screws.

G. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

H. Label Content: Include caution and warning information, plus emergency notification instructions.

2.3 EQUIPMENT LABELS

A. Metal Labels for Equipment:
   1. Material and Thickness: Stainless steel, 0.025-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   3. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   4. Fasteners: Stainless-steel rivets or self-tapping screws.
   5. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

B. Plastic Labels for Equipment:
   1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
   2. Letter Color: Black.
   3. Background Color: White.
   4. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
   5. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
   6. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
   7. Fasteners: Stainless-steel rivets or self-tapping screws.
   8. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

C. Label Content: Include equipment's Drawing designation or unique equipment number.

D. Equipment Label Schedule: For each item of equipment to be labeled, on 8-1/2-by-11-inch bond paper. Tabulate equipment identification number and identify Drawing numbers where equipment is indicated (plans, details, and schedules), plus the Specification Section number and title where equipment is specified. Equipment schedule shall be included in operation and maintenance data.

2.4 PIPE LABELS

A. General Requirements for Manufactured Pipe Labels: Preprinted, color-coded, with lettering indicating service, and showing flow direction.

B. For piping less than NPS 6, Provide full-band pipe markers, extending 360 degrees around pipe, fastened by one of the following:
   1. Snap-on application of pre-tensioned semi-rigid plastic pipe marker.
   2. Adhesive lap joint in pipe marker overlap.
   3. Laminated or bonded application of pipe marker to pipe or insulation.
   4. Taped to pipe or insulation with color-coded plasic adhesive tape, not less than ¾" wide; full circle at both ends of pipe marker, tape lapped 1-1/2".

C. Pre-tensioned Pipe Labels: Pre-coiled, semi-rigid plastic formed to partially cover circumference of pipe and to attach to pipe without fasteners or adhesive.

D. Self-Adhesive Pipe Labels: Printed plastic with contact-type, permanent-adhesive backing.

E. Pipe Label Contents: Include identification of piping service using same designations or abbreviations as used on Drawings, pipe size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with piping system service lettering to accommodate both directions, or as separate unit on each pipe label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

2.5 VALVE TAGS

A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers.
   1. Tag Material: Brass or aluminum, 1-1/2" diameter, 0.032-inch minimum thickness, and having predrilled or stamped holes for attachment hardware.
   2. Fasteners: Brass wire-link or beaded chain; or S-hook.

2.6 DUCT LABELS

A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch or 1/8 inch thick, and having predrilled holes for attachment hardware.

B. Letter Color: Black.

C. Background Color: White.

D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.

E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.

F. Minimum Letter Size: 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.

G. Fasteners: Stainless-steel rivets or self-tapping screws.

H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

I. Duct Label Contents: Include identification of duct service using same designations or abbreviations as used on Drawings, duct size, and an arrow indicating flow direction.
   1. Flow-Direction Arrows: Integral with duct system service lettering to accommodate both directions, or as separate unit on each duct label to indicate flow direction.
   2. Lettering Size: At least 1-1/2 inches high.

PART 3 - EXECUTION

3.1 PREPARATION

A. Clean piping and equipment surfaces of substances that could impair bond of identification devices, including dirt, oil, grease, release agents, and incompatible primers, paints, and encapsulants.

3.2 WARNING-TAG INSTALLATION

A. Write required message on, and attach warning tags to, equipment and other items where required.

3.3 EQUIPMENT LABEL INSTALLATION

A. The contractor shall provide labeling for each piece of equipment above the ceiling. Labeling shall be on ceiling grid (not ceiling tile) below the equipment. The label shall match the equipment identification shown on the drawings sheet.

B. General: Install engraved plastic laminate sign on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device.

C. Install or permanently fasten labels on each major item of mechanical equipment.

D. Locate equipment labels where accessible and visible.

3.4 PIPE LABEL INSTALLATION

A. General: Install pipe markers on each system of flow, provide type and temperature identification, and include arrows to show normal direction of flow:
   1. Heating (200 degrees F) Supply Return

B. Locate pipe labels where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior exposed locations as follows:
   1. Near each valve and control device.
   2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
   3. Near penetrations through walls, floors, ceilings, and inaccessible enclosures.
   4. At access doors, manholes, and similar access points that permit view of concealed piping.
   5. Near major equipment items and other points of origination and termination.
   6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
   7. On piping above removable acoustical ceilings. Omit intermediately spaced labels.

C. Pipe Label Color Schedule:
   1. Chilled-Water Piping:
      a. Background Color: White.
      b. Letter Color: Blue.
   2. Heating Water Piping:
      a. Background Color: White.
      b. Letter Color: Red.
   3. Air conditioning Condensate Piping
      a. Background Color: White.
      b. Letter Color: Green.

3.5 VALVE-TAG INSTALLATION

A. General: Install engraved plastic laminate sign on or near each major item of mechanical equipment and each operational device, as specified herein if not otherwise specified for each item or device. Provide signs for the following general categories of equipment and operational devices:
   1. Main control and operating valves, including safety devices and hazardous units such as gas outlets.
   2. Meters, gages, thermometers and similar devices.

B. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.

C. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:

D. Provide a list of all valves utilized for this project which will include the following:
   1. Valve # as described below.
   2. Valve location.
   3. Architectural Room number to which service is provided by the valve.
   4. Equipment served (ex. VAV box, AHU, Unit Heater, etc…).
   5. Function (ex. Hot Water, Chilled Water, Condenser Water, etc…).

3.6 DUCT LABEL INSTALLATION

A. General: Identify air supply, return, exhaust, intake and relief ductwork with tags and arrows, showing ductwork service and direction of flow, in black or white (whichever provides most contrast with ductwork color).

B. Install plastic-laminated self-adhesive duct labels with permanent adhesive on air ducts in the following color codes:
   1. Blue: For cold-air supply ducts.
   2. Red: For hot-air supply ducts.
   3. Green: For exhaust-, outside-, relief-, return-, and mixed-air ducts.
   4. ASME A13.1 Colors and Designs: For hazardous material exhaust.

C. Location: In each space where ductwork is exposed, or concealed only by removable ceiling system, locate signs near points where ductwork originates or continues into concealed enclosures (shaft, underground or similar concealment), and at 50' spacings along exposed runs. Identification shall be applied only to new work.

END OF SECTION 23 05 53.00

SECTION 230593 - TESTING, ADJUSTING AND BALANCING FOR HVAC

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 specifies the requirements and procedures total mechanical systems testing, adjusting, and balancing. Requirements include measurement and establishment of the fluid quantities of the mechanical systems as required to meet design specifications, and recording and reporting the results.

B. Test, adjust, and balance the following mechanical systems:

1. Supply, return, exhaust and outside air systems for all pressure classes.
2. Hydronic systems.

C. Related Sections:

1. Section 23 05 03 “Submittals for HVAC”.

1.3 DEFINITIONS

A. Adjust: To regulate fluid flow rate and air patterns at the terminal equipment, such as to reduce fan speed or adjust a damper.

B. Balance: To proportion flows within the distribution system, including submains, branches, and terminals, according to indicated quantities.

C. Barrier or Boundary: Construction, either vertical or horizontal, such as walls, floors, and ceilings that are designed and constructed to restrict the movement of airflow, smoke, odors, and other pollutants.

D. Draft: A current of air, when referring to localized effect caused by one or more factors of high air velocity, low ambient temperature, or direction of airflow, whereby more heat is withdrawn from a person's skin than is normally dissipated.

E. NC: Noise criteria.

F. Procedure: An approach to and execution of a sequence of work operations to yield repeatable results.

G. RC: Room criteria.

H. Report Forms: Test data sheets for recording test data in logical order.

I. Static Head: The pressure due to the weight of the fluid above the point of measurement. In a closed system, static head is equal on both sides of the pump.

J. Suction Head: The height of fluid surface above the centerline of the pump on the suction side.

K. System Effect: A phenomenon that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.

L. System Effect Factors: Allowances used to calculate a reduction of the performance ratings of a fan when installed under conditions different from those presented when the fan was performance tested.

M. TAB: Testing, adjusting, and balancing.

N. Terminal: A point where the controlled medium, such as fluid or energy, enters or leaves the distribution system.

O. Test: A procedure to determine quantitative performance of systems or equipment.

P. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 ACTION SUBMITTALS

A. Agency Data

1. Submit proof that the proposed testing, adjusting, and balancing agency meets the qualifications specified below.

B. Maintenance Data: Submit maintenance and operating data that include how to test, adjust, and balance the building systems. Include this information in maintenance data specified in Division 1.

C. Certified Reports: Submit testing, adjusting, and balancing reports bearing the seal and signature of the Test and Balance Engineer. The reports shall be certified proof that the systems have been tested, adjusted, and balanced in accordance with the referenced standards; are an accurate representation of how the systems have been installed; are a true representation of how the systems are operating at the completion of the testing, adjusting, and balancing procedures; and are an accurate record of all final quantities measured, to establish normal operating values of the systems. Follow the procedures and format specified below:

1. Final Report: Upon verification and approval prepare final reports, type written, and organized and formatted as specified below. Submit 2 complete sets of final reports.
2. Report Format: Report forms shall be those standard forms prepared by the referenced standard for each respective item and system to be tested, adjusted, and balanced. Bind report forms complete with schematic systems diagrams and other data in reinforced, vinyl, three-ring binders. Provide binding edge labels with the project identification and a title descriptive of the contents. Divide the contents of the binder into the below listed divisions, separated by divider tabs:

    a. General Information and Summary
    b. Air Systems
    c. Hydronic Systems

D. Qualification Data: Within 30 days from Contractor's Notice to Proceed, submit 6 copies of evidence that TAB firm and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.

E. Contract Documents Examination Report: Within 30 days from Contractor's Notice to Proceed, submit 6 copies of the Contract Documents review report as specified in Part 3.

F. Strategies and Procedures Plan: Within 60 days from Contractor's Notice to Proceed, submit 6 copies of TAB strategies and step-by-step procedures as specified in Part 3 "Preparation" Article. Include a complete set of report forms intended for use on this Project.

G. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

H. Sample Report Forms: Submit two sets of sample TAB report forms.

1.5 QUALITY ASSURANCE

A. Codes and Standards:

1. AABC: "National Standards for Total System Balance".
2. ASHRAE: ASHRAE Handbook, Systems Volume, Chapter 37, Testing, Adjusting, and Balancing.

B. Agency Qualifications

1. The HVAC Contractor shall procure the services of an independent Balance and Testing Agency, approved by the Engineer, and a member of Associated Air Balance Council (AABC) or NEBB, which specializes in the balancing and testing of heating, ventilating, and air conditioning systems, to balance, adjust and test all air and water systems and equipment as herein specified.
2. All work by this agency shall be done under direct supervision of a qualified heating and ventilating Engineer employed by this agency.
3. All instruments used by this agency shall be accurately calibrated and maintained in good working order.

C. The Balance and Testing Agency must provide the technicians with the following instruments for field use:

1. One set of pressure gages and fittings.
2. Dry bulb thermometer.
3. Wet bulb thermometer.
4. Thermocouple unit and thermocouples.
5. Set of balancing cock adjustment wrenches.
6. Portable field flowmeter.

D. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

E. TAB Conference: Meet with Owner's and Architect's representatives on approval of TAB strategies and procedures plan to develop a mutual understanding of the details. Ensure the participation of TAB team members, equipment manufacturers' authorized service representatives, HVAC controls installers, and other support personnel. Provide seven days' advance notice of scheduled meeting time and location.

1. Agenda Items: Include at least the following:

    a. Submittal distribution requirements.
    b. The Contract Documents examination report.
    c. TAB plan.
    d. Work schedule and Project-site access requirements.
    e. Coordination and cooperation of trades and subcontractors.
    f. Coordination of documentation and communication flow.

2. Certification of TAB Reports: Certify TAB field data reports. This certification includes the following:

    a. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
    b. Certify that TAB team complied with approved TAB plan and the procedures specified and referenced in this Specification.

F. TAB Report Forms: Use standard forms from AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems." NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems." SMACNA's "HVAC Systems - Testing, Adjusting, and Balancing." TAB firm's forms approved by Architect.

G. Instrumentation Type, Quantity, and Accuracy: As described in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems NEBB's " Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems, " Section II, " Required Instrumentation for NEBB Certification."

H. Instrumentation Calibration: Calibrate instruments at least every six months or more frequently if required by instrument manufacturer.

1. Keep an updated record of instrument calibration that indicates date of calibration and the name of party performing instrument calibration.

1.6 SEQUENCING AND SCHEDULING

A. Systems shall be fully operational prior to beginning procedures.

B. Test, adjust, and balance the air systems before hydronic and refrigerant systems.

C. Test, adjust and balance air conditioning systems during summer season and heating systems during winter season, including at least a period of operation at outside conditions within 5 deg F wet bulb temperature of maximum summer design condition, and within 10 deg F dry bulb temperature of minimum winter design condition. Take final temperature readings during seasonal operation.

1.7 PROJECT CONDITIONS

A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.8 COORDINATION

A. Coordinate the efforts of factory-authorized service representatives for systems and equipment, HVAC controls installers, and other mechanics to operate HVAC systems and equipment to support and assist TAB activities.

B. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.

C. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

1.9 GUARANTEE

A. National Project Performance Guarantee: Provide a guarantee on AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" forms stating that AABC will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents.

B. Special Guarantee: Provide a guarantee on NEBB forms stating that NEBB will assist in completing requirements of the Contract Documents if TAB firm fails to comply with the Contract Documents. Guarantee shall include the following provisions:

1. The certified TAB firm has tested and balanced systems according to the Contract Documents.
2. Systems are balanced to optimum performance capabilities within design and installation limits.

PART 2 - PRODUCTS (NOT APPLICABLE)

PART 3 - EXECUTION

3.1 PRELIMINARY PROCEDURES FOR AIR SYSTEM BALANCING

A. Check filters for cleanliness.

B. Check dampers (both volume and fire) for correct and locked position, and temperature control for completeness of installation before starting fans.

C. Place outlet dampers in the full open position.

D. Lubricate all motors and bearings

E. Check fan belt tension

F. Check fan rotation

G. Air balance and testing shall not begin until the system has been completed and is in full working order. The Contractor shall put all heating, ventilating and air conditioning systems and equipment into full operation and shall continue the operation of same during each working day

of testing and balancing. The contractor shall submit within 30 days after receipt of contract, 8 copies of submittal data for the testing and balancing of the air conditioning, heating, and ventilating systems. The Air Balance and Testing Agency shall provide proof of having successfully completed at least five projects of similar size and scope.

H. The air balancing contractor shall include the additional cost to change every fan factory installed sheave, pulley and/or belt in order to obtain the design air flow.

I. Fan(s) shall be balanced so that VFD speed at 55 hz shall be equal to design air flow to allow for an increase in flow using the VFD.

J. Renovations:

1. In areas where existing air handling equipment or exhaust fans are being utilized, balancing contractor shall include the cost to pre-check each fan airflow (supply, return, exhaust) and any branch ductwork serving existing areas, prior to demolition and provide a report outlining existing air flows prior to any work. Any discrepancies of required air flows compared to design air flows shall be brought to the attention of the engineer prior to any work.
2. At the completion of construction, balancing contractor shall re-check and adjust each air handler or exhaust fan air flows. (supply, return, exhaust) to meet the required air flows. Change out sheaves, increase static pressure set-points, change motors and ramp up fans as required to obtain design air flows. Clean existing coils, change filters as required to obtain design air flows.
3. Adjust existing ductwork dampers serving existing spaces and balance to pre-checked air flows. Air flows serving existing spaces shall be similar after project is complete.

3.2 PRELIMINARY PROCEDURES FOR HYDRONIC SYSTEM BALANCING

A. Open valves to full open position.

B. Remove and clean all strainers.

C. Set temperature controls so all coils are calling for full flow.

D. Lubricate all motors and bearings.

E. Renovations:

1. In areas where existing pumping equipment is being utilized, balancing contractor shall pre-check each piece of equipment water flows and main pump water flows and pressure drop prior to demolition and provide a report outlining existing water flows prior to any work. Any discrepancies of existing to remain water flows plus new water flows compared to proposed design water flows shall be brought to the attention of the engineer prior to any work.
2. The balancing contractor shall re-check and adjust each piece of existing equipment to water flows after new construction and balance equal to flows before construction.
3. The balancing contractor shall balance existing pump water flows after new construction to the combined water flows of new and reused equipment. Change out existing pump impellers and motors as required to obtain total pump flow and ramp up existing pumps as required to obtain design water flows. Flush existing coils, replace strainers as required to obtain design water flows.

F. Pump(s) shall be balanced so that VFD speed at 55 hz shall be equal to design water flow to allow for an increase in flow using the VFD.

3.3 MEASUREMENTS

A. Provide all required instrumentation to obtain proper measurements, calibrated to the tolerances specified in the referenced standards. Instruments shall be properly maintained and protected against damage.

3.4 PERFORMING TESTING, ADJUSTING, AND BALANCING

A. Perform testing and balancing procedures on each system identified, in accordance with the detailed procedures outlined in the referenced standards.

B. Cut insulation, ductwork, and piping for installation of test probes to the minimum extent necessary to allow adequate performance of procedures.

1. Patch insulation, ductwork, and housings, using materials identical to those removed.
2. Seal ducts and piping after testing. Then test for leaks and repair if found.
3. Seal insulation to re-establish integrity of the vapor barrier.

C. Mark equipment settings, including damper control positions, valve indicators, fan speed control levers, and similar controls and devices, to show final settings. Mark with paint or other suitable, permanent identification materials.

D. Retest, adjust, and balance systems subsequent to significant system modifications, and resubmit test results.

END OF SECTION 230593

SECTION 230713 - DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following duct services:

1. HVAC Ductwork.

B. Related Sections:

1. Section 23 05 03 “Submittals for HVAC”.
2. Section 23 09 29 “Hangers and Supports for HVAC Piping and Equipment”.
3. Section 23 31 13 “Metal Ducts”.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory- and field-applied if any).

B. Schedule: Submit schedule showing insulation products which will be used for each application, indicating thickness, density, and accessories.

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

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail insulation application at elbows, fittings, dampers, specialties and flanges for each type of insulation.
3. Detail application at linkages of control devices.

D. Schedule: Submit schedule showing insulation products which will be used for each application, indicating thickness, density, installed R-values and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials, sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ANSI/ASTM E 84 and NFPA 255, by a testing agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

C. Installed R-Values for insulation on ducts shall comply with local mechanical and energy code as required for indoor applications.

D. Insulation tape shall comply with UL 181.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with duct Installer for duct insulation application. Before preparing ductwork Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing duct systems. Insulation application may begin on segments that have satisfactory test results.

PART 2 - PRODUCTS

2.1 DUCTWORK INSULATION MATERIALS

A. Manufacturers

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

    a. CertainTeed Corp.; SoftTouch Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Friendly Feel Duct Wrap.
    d. Owens Corning; SOFTR All-Service Duct Wrap.

B. Interior (indoor) ductwork insulation shall have an installed thermal resistance value of R6 or code minimum, whichever higher.

C. Products shall not contain asbestos, lead, mercury, or mercury compounds.

D. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, without facing and with vapor barrier Type II with factory-applied kraft paper, reinforcing scrim, aluminum foil and vinyl jackets.

E. Mineral-Fiber Board Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 612, Type IB. For duct and plenum applications, provide insulation without facing and with vapor barrier with factory-applied kraft paper, reinforcing scrim, aluminum foil and vinyl jacket.

F. Vapor Barrier Material for Ductwork: Paper-backed aluminum-foil, except as otherwise indicated; strength and permeability rating equivalent to factory-applied vapor barriers on adjoining ductwork insulation, where available; with following additional construction characteristics:

    1. High Puncture Resistance: Low vapor transmission (for ducts in exposed, high traffic areas susceptible to damage: Mech. Rooms, etc.)
    2. Moderate Puncture Resistance: Medium vapor transmission (for ducts in concealed areas).

G. Ductwork Insulation Accessories: Staples, bands, wires, tape, anchors, corner angles and similar accessories as recommended by insulation manufacturer for applications indicated.

H. Ductwork Insulation Compounds: Cements, mastics, adhesives, coatings, sealers, protective finishes and similar compounds as recommended by insulation manufacturer for applications indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

    1. Verify that systems to be insulated have been tested and are free of defects.
    2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of ducts and fittings.

B. Clean and dry ductwork prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

C. Maintain integrity of vapor-barrier on ductwork insulation, and protect it to prevent puncture and other damage.

D. Extend ductwork insulation without interruption through walls, floors and similar ductwork penetrations, except where otherwise indicated

E. Lined Ductwork: Except as otherwise indicated, omit insulation on ductwork where internal insulation or sound absorbing linings have been installed. Duct lining thermal resistance value shall comply with external duct wrap requirements.

F. Corner Angles: Install corner angles on external corners of insulation on ductwork in exposed finished spaces.

G. Provide insulation on collar and backside of supply diffusers in all ceiling spaces. Provide insulation on plenum box of all supply grilles and registers in all ceiling spaces.

H. Install insulation materials, vapor barriers or retarders, jackets, and thicknesses required for each item of duct system as specified in insulation system schedules.

I. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

J. Install insulation with longitudinal seams at top and bottom of horizontal runs.

K. Install multiple layers of insulation with longitudinal and end seams staggered.

L. Keep insulation materials dry during application and finishing.

M. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

N. Install insulation with least number of joints practical.

O. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

    1. Install insulation continuously through hangers and around anchor attachments.

2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.

P. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

Q. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

R. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

S. Do not overly compress insulation which will result in decreased thermal resistance properties. Install insulation as recommended by the insulation manufacturer.

T. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

3.4 DUCT INSULATION SCHEDULE, GENERAL

A. Plenums and Ducts Requiring Insulation:

1. Outside Air and/or Exhaust:

a. HVAC Ductwork (Outside Air) between outside air entrance and fan inlet or HVAC unit inlet.
b. HVAC Ductwork (Outside Air and Exhaust) in a location where the ambient air will be 15 degrees greater or less than the internal duct air temperature.
c. HVAC Louvers, Plenums and Ductwork three feet downstream of wall penetrations.
d. Exposed ductwork is not required to be insulated.

2. Supply and/or Return:

a. HVAC Ductwork (Supply) between fan discharge, or HVAC unit discharge, and room terminal outlet(s).
b. HVAC Ductwork (Supply & Return) in a location where the ambient air will be 15 degrees greater or less than the internal duct air temperature.
c. HVAC Ductwork (Supply & Return) located in un-insulated joist or attic space.
d. Exposed ductwork is not required to be insulated.

B. Grilles, Registers, and Diffusers:

1. Provide insulation on collar and backside of supply diffusers in all ceiling spaces. Provide insulation on plenum box of all supply grilles & registers in all ceiling spaces.

C. Items Not Insulated:

1. Fibrous-glass ducts.
2. Fabric ductwork.
3. Metal ducts with duct liner of sufficient thickness to comply with energy code and ASHRAE/IESNA 90.1.
4. Factory-insulated flexible ducts.
5. Factory-insulated plenums and casings.
6. Flexible connectors.
7. Vibration-control devices.
8. Factory-insulated access panels and doors.
9. HVAC Ductwork (Supply) exposed in conditioned spaces.

3.5 PENETRATIONS

A. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

B. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Terminate insulation at damper sleeves for fire-rated wall and partition penetrations. Externally insulate damper sleeves to match adjacent insulation and overlap duct insulation at least 2 inches.

C. Insulation Installation at Floor Penetrations:

1. Duct: For penetrations through fire-rated assemblies, terminate insulation at damper sleeves and externally insulate damper sleeve beyond floor to match adjacent duct insulation. Overlap damper sleeve and duct insulation at least 2 inches.

3.6 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Inspect ductwork, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to one location for each duct system defined in the "Duct Insulation Schedule, General" Article.

B. All insulation applications will be considered defective Work if sample inspection reveals noncompliance with requirements.

3.7 PROTECTION AND REPLACEMENT

A. Repair damaged vapor barrier using vapor barrier tape to fully cover torn area.

B. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

C. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

END OF SECTION 230713

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section includes insulating the following HVAC piping systems:

1. Air Conditioning Condensate drain piping.
2. Chilled-water piping.
3. Heating hot-water piping.

B. Related Sections:

1. Section 23 05 03 “Submittals for HVAC”.
2. Section 23 07 13 "Duct Insulation."
3. Section 23 07 16 "HVAC Equipment Insulation."

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include thermal conductivity, water-vapor permeance thickness, and jackets (both factory and field applied if any).

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

1. Detail application of protective shields, saddles, and inserts at hangers for each type of insulation and hanger.
2. Detail attachment and covering of heat tracing inside insulation.
3. Detail insulation application at pipe expansion joints for each type of insulation.
4. Detail insulation application at elbows, fittings, flanges, valves, and specialties for each type of insulation.
5. Detail removable insulation at piping specialties.
6. Detail application of field-applied jackets.
7. Detail application at linkages of control devices.

C. Schedule: Submit schedule showing insulation products which will be used for each application, indicating thickness, density, and accessories.

1.4 INFORMATIONAL SUBMITTALS

A. Qualification Data: For qualified Installer.

B. Material Test Reports: From a qualified testing agency acceptable to authorities having jurisdiction indicating, interpreting, and certifying test results for compliance of insulation materials,

sealers, attachments, cements, and jackets, with requirements indicated. Include dates of tests and test methods employed.

C. Field quality-control reports.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the Department of Labor, Bureau of Apprenticeship and Training.

B. Surface-Burning Characteristics: For insulation and related materials, as determined by testing identical products according to ANSI/ASTM E 84 and NFPA 255, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and adhesive, mastic, tapes, and cement material containers, with appropriate markings of applicable testing agency.

1. Insulation Installed Indoors: Flame-spread index of 25 or less, and smoke-developed index of 50 or less.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Packaging: Insulation material containers shall be marked by manufacturer with appropriate ASTM standard designation, type and grade, and maximum use temperature.

1.7 COORDINATION

A. Coordinate sizes and locations of supports, hangers, and insulation shields specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment."

B. Coordinate clearance requirements with piping Installer for piping insulation application. Before preparing piping Shop Drawings, establish and maintain clearance requirements for installation of insulation and field-applied jackets and finishes and for space required for maintenance.

C. Coordinate installation and testing of heat tracing.

1.8 SCHEDULING

A. Schedule insulation application after pressure testing systems and, where required, after installing and testing heat tracing. Insulation application may begin on segments that have satisfactory test results.

B. Complete installation and concealment of plastic materials as rapidly as possible in each area of construction.

PART 2 - PRODUCTS

2.1 INSULATION MATERIALS

A. Comply with requirements in "Piping Insulation Schedule, General," "Indoor Piping Insulation Schedule," "Outdoor, Aboveground Piping Insulation Schedule," and "Outdoor, Underground Piping Insulation Schedule" articles for where insulating materials shall be applied.

B. Products shall not contain asbestos, lead, mercury, or mercury compounds.

C. Products that come in contact with stainless steel shall have a leachable chloride content of less than 50 ppm when tested according to ASTM C 871.

D. Insulation materials for use on austenitic stainless steel shall be qualified as acceptable according to ASTM C 795.

E. Foam insulation materials shall not use CFC or HCFC blowing agents in the manufacturing process.

F. Cellular Glass: Inorganic, incombustible, foamed or cellulated glass with annealed, rigid, hermetically sealed cells.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Pittsburgh Corning Corporation; Foamglas.

2. Block Insulation: ASTM C 552, Type I.
3. Special-Shaped Insulation: ASTM C 552, Type III.
4. Board Insulation: ASTM C 552, Type IV.
5. Preformed Pipe Insulation without Jacket: Comply with ASTM C 552, Type II, Class 1.
6. Preformed Pipe Insulation with Factory-Applied ASJ: Comply with ASTM C 552, Type II, Class 2.
7. Factory fabricate shapes according to ASTM C 450 and ASTM C 585.

G. Mineral-Fiber Blanket Insulation: Mineral or glass fibers bonded with a thermosetting resin. Comply with ASTM C 553, Type II and ASTM C 1290, Type II with factory-applied vinyl jacket. Factory-applied jacket requirements are specified in "Factory-Applied Jackets" Article.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. CertainTeed Corp.; SoftTouch Duct Wrap.
    b. Johns Manville; Microlite.
    c. Knauf Insulation; Friendly Feel Duct Wrap.
    d. Owens Corning; SOFTR All-Service Duct Wrap.

H. Mineral-Fiber, Preformed Pipe Insulation:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Johns Manville; Micro-Lok.
    b. Knauf Insulation; 1000-Degree Pipe Insulation.
    c. Owens Corning; Fiberglas Pipe Insulation.

I. Vapor Barrier Material: Paper-backed aluminum foil, except as otherwise indicated, strength and permeability rating equivalent to adjoining pipe insulation jacketing

2.2 INSULATING CEMENTS

A. Mineral-fiber insulating cement is suitable for temperatures from 100 to 1600 deg F (38 to 871 deg C). Vermiculite insulating cement is suitable for temperatures from 100 to 1800 deg F (38 to 982 deg C).

B. Mineral-Fiber Insulating Cement: Comply with ASTM C 195.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Ramco Insulation, Inc.; Super-Stik.

C. Expanded or Exfoliated Vermiculite Insulating Cement: Comply with ASTM C 196.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Ramco Insulation, Inc.; Thermokote V.

D. Mineral-Fiber, Hydraulic-Setting Insulating and Finishing Cement: Comply with ASTM C 449.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Ramco Insulation, Inc.; Ramcote 1200 and Quik-Cote.

2.3 ADHESIVES

A. Materials shall be compatible with insulation materials, jackets, and substrates and for bonding insulation to itself and to surfaces to be insulated unless otherwise indicated.

B. Cellular-Glass Adhesive: Two-component, thermosetting urethane adhesive containing no flammable solvents, with a service temperature range of minus 100 to plus 200 deg F.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 81-84.

C. Mineral-Fiber Adhesive: Comply with MIL-A-3316C, Class 2, Grade A.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-127.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-60/85-70.
d. Mon-Eco Industries, Inc.; 22-25.

D. ASJ Adhesive, and FSK and PVDC Jacket Adhesive: Comply with MIL-A-3316C, Class 2, Grade A for bonding insulation jacket lap seams and joints.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-82.
b. Eagle Bridges - Marathon Industries; 225.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 85-50.
d. Mon-Eco Industries, Inc.; 22-25.

2.4 MASTICS

A. Materials shall be compatible with insulation materials, jackets, and substrates; comply with MIL-PRF-19565C, Type II.

B. Vapor-Barrier Mastic: Solvent based; suitable for indoor use on below-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-30.
b. Eagle Bridges - Marathon Industries; 501.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-35.
d. Mon-Eco Industries, Inc.; 55-10.

2. Water-Vapor Permeance: ASTM F 1249, 0.05 perm at 35-mil dry film thickness.
3. Service Temperature Range: 0 to 180 deg F.
4. Solids Content: ASTM D 1644, 44 percent by volume and 62 percent by weight.
5. Color: White.

C. Breather Mastic: Water based; suitable for indoor and outdoor use on above-ambient services.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-10.
b. Eagle Bridges - Marathon Industries; 550.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 46-50.
d. Mon-Eco Industries, Inc.; 55-50.
e. Vimasco Corporation; WC-1/WC-5.

2. Water-Vapor Permeance: ASTM F 1249, 1.8 perms at 0.0625-inch dry film thickness.
3. Service Temperature Range: Minus 20 to plus 180 deg F.
4. Solids Content: 60 percent by volume and 66 percent by weight.
5. Color: White.

2.5 LAGGING ADHESIVES

A. Description: Comply with MIL-A-3316C, Class I, Grade A and shall be compatible with insulation materials, jackets, and substrates.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-50 AHV2.
b. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-36.
c. Vimasco Corporation; 713 and 714.

2. Fire-resistant, water-based lagging adhesive and coating for use indoors to adhere fire-resistant lagging cloths over pipe insulation.
3. Service Temperature Range: 0 to plus 180 deg F.
4. Color: White.

2.6 SEALANTS

A. Joint Sealants:

1. Joint Sealants for Cellular-Glass, Phenolic, and Polyisocyanurate Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Eagle Bridges - Marathon Industries; 405.
c. Foster Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; 30-45.
d. Mon-Eco Industries, Inc.; 44-05.
e. Pittsburgh Corning Corporation; Pittseal 444.

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Permanently flexible, elastomeric sealant.
4. Service Temperature Range: Minus 100 to plus 300 deg F.
5. Color: White or gray.

B. ASJ Flashing Sealants, and Vinyl, PVDC, and PVC Jacket Flashing Sealants:

1. Products: Subject to compliance with requirements, provide one of the following:

a. Childers Brand, Specialty Construction Brands, Inc., a business of H. B. Fuller Company; CP-76.
b. Approved equal

2. Materials shall be compatible with insulation materials, jackets, and substrates.
3. Fire- and water-resistant, flexible, elastomeric sealant.
4. Service Temperature Range: Minus 40 to plus 250 deg F.
5. Color: White.

2.7 FACTORY-APPLIED JACKETS

A. Insulation system schedules indicate factory-applied jackets on various applications. When factory-applied jackets are indicated, comply with the following:

1. ASJ: White, kraft-paper, fiberglass-reinforced scrim with aluminum-foil backing; complying with ASTM C 1136, Type I.

2. FSP Jacket: Aluminum-foil, fiberglass-reinforced scrim with polyethylene backing; complying with ASTM C 1136, Type II.
3. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perm when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

    a. Products: Subject to compliance with requirements, provide one of the following:

        1) Dow Chemical Company (The); Saran 540 Vapor Retarder Film and Saran 560 Vapor Retarder Film.
        2) Approved equal

4. Vinyl Jacket: White vinyl with a permeance of 1.3 perms when tested according to ASTM E 96/E 96M, Procedure A, and complying with NFPA 90A and NFPA 90B.

2.8 FIELD-APPLIED JACKETS

A. Field-applied jackets shall comply with ASTM C 921, Type I, unless otherwise indicated.

B. FSK Jacket: Aluminum-foil-face, fiberglass-reinforced scrim with kraft-paper backing.

C. PVC Jacket: High-impact-resistant, UV-resistant PVC complying with ASTM D 1784, Class 16354-C; 20 mil thickness; roll stock ready for shop or field cutting and forming. Thickness is indicated in field-applied jacket schedules.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Johns Manville; Zeston.
    b. P.I.C. Plastics, Inc.; FG Series.
    c. Proto Corporation; LoSmoke.
    d. Speedline Corporation; SmokeSafe.

2. Adhesive: As recommended by jacket material manufacturer.
3. Color: White.
4. Factory-fabricated fitting covers to match jacket if available; otherwise, field fabricate.

    a. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, unions, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories.

D. PVDC Jacket for Indoor Applications: 4-mil- thick, white PVDC biaxially oriented barrier film with a permeance at 0.02 perms when tested according to ASTM E 96/E 96M and with a flame-spread index of 5 and a smoke-developed index of 20 when tested according to ASTM E 84.

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Dow Chemical Company (The); Saran 540 Vapor Retarder Film.
    b. Approved equal

2.9 TAPES

A. ASJ Tape: White vapor-retarder tape matching factory-applied jacket with acrylic adhesive, complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 428 AWF ASJ.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0836.
c. Compac Corporation; 104 and 105.
d. Venture Tape; 1540 CW Plus, 1542 CW Plus, and 1542 CW Plus/SQ.

2. Width: 3 inches.
3. Thickness: 11.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. ASJ Tape Disks and Squares: Precut disks or squares of ASJ tape.

B. FSK Tape: Foil-face, vapor-retarder tape matching factory-applied jacket with acrylic adhesive; complying with ASTM C 1136.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 491 AWF FSK.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0827.
c. Compac Corporation; 110 and 111.
d. Venture Tape; 1525 CW NT, 1528 CW, and 1528 CW/SQ.

2. Width: 3 inches.
3. Thickness: 6.5 mils.
4. Adhesion: 90 ounces force/inch in width.
5. Elongation: 2 percent.
6. Tensile Strength: 40 lbf/inch in width.
7. FSK Tape Disks and Squares: Precut disks or squares of FSK tape.

C. PVC Tape: White vapor-retarder tape matching field-applied PVC jacket with acrylic adhesive; suitable for indoor and outdoor applications.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 370 White PVC tape.
b. Compac Corporation; 130.
c. Venture Tape; 1506 CW NS.

2. Width: 2 inches.
3. Thickness: 6 mils.
4. Adhesion: 64 ounces force/inch in width.
5. Elongation: 500 percent.
6. Tensile Strength: 18 lbf/inch in width.

D. Aluminum-Foil Tape: Vapor-retarder tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

a. ABI, Ideal Tape Division; 488 AWF.
b. Avery Dennison Corporation, Specialty Tapes Division; Fasson 0800.
c. Compac Corporation; 120.
d. Venture Tape; 3520 CW.

2. Width: 2 inches.
3. Thickness: 3.7 mils.
4. Adhesion: 100 ounces force/inch in width.
5. Elongation: 5 percent.
6. Tensile Strength: 34 lbf/inch in width.

E. PVDC Tape for Indoor Applications: White vapor-retarder PVDC tape with acrylic adhesive.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Dow Chemical Company (The); Saran 540 Vapor Retarder Tape.
b. Approved equal

2. Width: 3 inches.
3. Film Thickness: 4 mils.
4. Adhesive Thickness: 1.5 mils.
5. Elongation at Break: 145 percent.
6. Tensile Strength: 55 lbf/inch in width.

2.10 SECUREMENTS

A. Bands:

1. Products: Subject to compliance with requirements, provide one of the following:

a. ITW Insulation Systems; Gerrard Strapping and Seals.
b. RPR Products, Inc.; Insul-Mate Strapping, Seals, and Springs.

B. Staples: Outward-clinching insulation staples, nominal 3/4-inch- wide, stainless steel or Monel.

C. Wire: 0.080-inch nickel-copper alloy.

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

a. C & F Wire.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine substrates and conditions for compliance with requirements for installation tolerances and other conditions affecting performance of insulation application.

1. Verify that systems to be insulated have been tested and are free of defects.
2. Verify that surfaces to be insulated are clean and dry.

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

3.2 PREPARATION

A. Surface Preparation: Clean and dry surfaces to receive insulation. Remove materials that will adversely affect insulation application.

B. Coordinate insulation installation with the trade installing heat tracing. Comply with requirements for heat tracing that apply to insulation.

C. Mix insulating cements with clean potable water; if insulating cements are to be in contact with stainless-steel surfaces, use demineralized water.

3.3 GENERAL INSTALLATION REQUIREMENTS

A. Install insulation on pipe systems subsequent to testing and acceptance of tests.

B. Repair or replace damaged existing insulation as indicated or required.

C. Install insulation materials, accessories, and finishes with smooth, straight, and even surfaces; free of voids throughout the length of piping including fittings, valves, and specialties. Do not use cut pieces or scraps abutting each other.

D. Clean and dry pipe surfaces prior to insulating. Butt insulation joints firmly together to ensure complete and tight fit over surfaces to be covered.

E. Maintain integrity of vapor-barrier jackets on pipe insulation, and protect to prevent puncture or other damage.

F. Cover valves, fittings and similar items in each piping system with equivalent thickness and composition of insulation as applied to adjoining pipe run. Install factory molded, precut or job fabricated units (at Installer's option) except where specific form or type is indicated.

G. Extend piping insulation without interruption through walls, floors and similar piping penetrations, except where otherwise indicated.

H. Provide continuous insulation through hangers, straps and all other supporting members.

I. Provide PVC jacketing around all piping and fittings that are exposed within building, not including mechanical rooms or equipment closets.

J. Install insulation materials, forms, vapor barriers or retarders, jackets, and thicknesses required for each item of pipe system as specified in insulation system schedules.

K. Install accessories compatible with insulation materials and suitable for the service. Install accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.

L. Install insulation with longitudinal seams at top and bottom of horizontal runs.

M. Install multiple layers of insulation with longitudinal and end seams staggered.

N. Do not weld brackets, clips, or other attachment devices to piping, fittings, and specialties.

O. Keep insulation materials dry during application and finishing.

P. Install insulation with tight longitudinal seams and end joints. Bond seams and joints with adhesive recommended by insulation material manufacturer.

Q. Install insulation with least number of joints practical.

R. Encase pipe fittings insulation with one-piece pre-molded PVC fitting covers.

S. Install protective metal shields and thermal hanger shield inserts at all supporting members to prevent compression of insulation. Refer to Section “Hangers And Supports For HVAC Piping And Equipment.”

T. Flexible Closed Cell Elastomeric Installation: Slide full sections of insulation onto pipe. Do not slit pipe to fit around piping. All edges shall be clean cut. Insulation shall be pushed onto pipe, never pulled. All seams and butt joints shall be adhered and sealed using adhesive equal to Armaflex 520 Adhesive.

U. Where vapor barrier is indicated, seal joints, seams, and penetrations in insulation at hangers, supports, anchors, and other projections with vapor-barrier mastic.

1. Install insulation continuously through hangers and around anchor attachments.
2. For insulation application where vapor barriers are indicated, extend insulation on anchor legs from point of attachment to supported item to point of attachment to structure. Taper and seal ends at attachment to structure with vapor-barrier mastic.
3. Install insert materials and install insulation to tightly join the insert. Seal insulation to insulation inserts with adhesive or sealing compound recommended by insulation material manufacturer.
4. Cover inserts with jacket material matching adjacent pipe insulation. Install shields over jacket, arranged to protect jacket from tear or puncture by hanger, support, and shield.

V. Apply adhesives, mastics, and sealants at manufacturer's recommended coverage rate and wet and dry film thicknesses.

W. Install insulation with factory-applied jackets as follows:

1. Draw jacket tight and smooth.
2. Cover circumferential joints with 3-inch- wide strips, of same material as insulation jacket. Secure strips with adhesive and outward clinching staples along both edges of strip, spaced 4 inches o.c.
3. Overlap jacket longitudinal seams at least 1-1/2 inches. Install insulation with longitudinal seams at bottom of pipe. Clean and dry surface to receive self-sealing lap. Staple laps with outward clinching staples along edge at 2 inches o.c.

    a. For below-ambient services, apply vapor-barrier mastic over staples.

4. Cover joints and seams with tape, according to insulation material manufacturer's written instructions, to maintain vapor seal.
5. Where vapor barriers are indicated, apply vapor-barrier mastic on seams and joints and at ends adjacent to pipe flanges and fittings.

X. Cut insulation in a manner to avoid compressing insulation more than 75 percent of its nominal thickness.

Y. Finish installation with systems at operating conditions. Repair joint separations and cracking due to thermal movement.

Z. Repair damaged insulation facings by applying same facing material over damaged areas. Extend patches at least 4 inches beyond damaged areas. Adhere, staple, and seal patches similar to butt joints.

AA. For above-ambient services, do not install insulation to the following:

1. Vibration-control devices.
2. Testing agency labels and stamps.
3. Nameplates and data plates.
4. Manholes.
5. Handholes.
6. Cleanouts.

3.4 PENETRATIONS

A. Insulation Installation at Roof Penetrations: Install insulation continuously through roof penetrations.

1. Seal penetrations with flashing sealant.
2. For applications requiring only indoor insulation, terminate insulation above roof surface and seal with joint sealant. For applications requiring indoor and outdoor insulation, install insulation for outdoor applications tightly joined to indoor insulation ends. Seal joint with joint sealant.

B. Insulation Installation at Interior Wall and Partition Penetrations (That Are Not Fire Rated): Install insulation continuously through walls and partitions.

C. Insulation Installation at Fire-Rated Wall and Partition Penetrations: Install insulation continuously through penetrations of fire-rated walls and partitions.

1. Comply with requirements in Section 078413 "Penetration Firestopping" for firestopping and fire-resistive joint sealers.

D. Insulation Installation at Floor Penetrations:

1. Pipe: Install insulation continuously through floor penetrations.
2. Seal penetrations through fire-rated assemblies. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 GENERAL PIPE INSULATION INSTALLATION

A. Requirements in this article generally apply to all insulation materials except where more specific requirements are specified in various pipe insulation material installation articles.

B. Insulation Installation on Fittings, Valves, Strainers, Flanges, and Unions:

1. Install insulation over fittings, valves, strainers, flanges, unions, and other specialties with continuous thermal and vapor-retarder integrity unless otherwise indicated.
2. Insulate pipe elbows using preformed fitting insulation or mitered fittings made from same material and density as adjacent pipe insulation. Each piece shall be butted tightly against adjoining piece and bonded with adhesive. Fill joints, seams, voids, and irregular surfaces with insulating cement finished to a smooth, hard, and uniform contour that is uniform with adjoining pipe insulation.
3. Insulate tee fittings with preformed fitting insulation or sectional pipe insulation of same material and thickness as used for adjacent pipe. Cut sectional pipe insulation to fit. Butt each section closely to the next and hold in place with tie wire. Bond pieces with adhesive.
4. Insulate valves using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. For valves, insulate up to and including the bonnets, valve stuffing-box studs, bolts, and nuts. Fill joints, seams, and irregular surfaces with insulating cement.
5. Insulate strainers using preformed fitting insulation or sectional pipe insulation of same material, density, and thickness as used for adjacent pipe. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker. Fill joints, seams, and irregular surfaces with insulating cement. Insulate strainers so strainer basket flange or plug can be easily removed and replaced without damaging the insulation and jacket. Provide a removable reusable insulation cover. For below-ambient services, provide a design that maintains vapor barrier.
6. Insulate flanges and unions using a section of oversized preformed pipe insulation. Overlap adjoining pipe insulation by not less than two times the thickness of pipe insulation, or one pipe diameter, whichever is thicker.
7. Cover segmented insulated surfaces with a layer of finishing cement and coat with a mastic. Install vapor-barrier mastic for below-ambient services and a breather mastic for above-ambient services. Reinforce the mastic with fabric-reinforcing mesh. Trowel the mastic to a smooth and well-shaped contour.
8. For services not specified to receive a field-applied jacket except for flexible elastomeric and polyolefin, install fitted PVC cover over elbows, tees, strainers, valves, flanges, and unions. Terminate ends with PVC end caps. Tape PVC covers to adjoining insulation facing using PVC tape.
9. Stencil or label the outside insulation jacket of each union with the word "union." Match size and color of pipe labels.

C. Insulate instrument connections for thermometers, pressure gages, pressure temperature taps, test connections, flow meters, sensors, switches, and transmitters on insulated pipes. Shape insulation at these connections by tapering it to and around the connection with insulating cement and finish with finishing cement, mastic, and flashing sealant.

D. Install removable insulation covers at locations indicated. Installation shall conform to the following:

1. Make removable flange and union insulation from sectional pipe insulation of same thickness as that on adjoining pipe. Install same insulation jacket as adjoining pipe insulation.
2. When flange and union covers are made from sectional pipe insulation, extend insulation from flanges or union long at least two times the insulation thickness over adjacent pipe insulation on each side of flange or union. Secure flange cover in place with stainless-steel or aluminum bands. Select band material compatible with insulation and jacket.
3. Construct removable valve insulation covers in same manner as for flanges, except divide the two-part section on the vertical center line of valve body.
4. When covers are made from block insulation, make two halves, each consisting of mitered blocks wired to stainless-steel fabric. Secure this wire frame, with its attached insu-

lation, to flanges with tie wire. Extend insulation at least 2 inches over adjacent pipe insulation on each side of valve. Fill space between flange or union cover and pipe insulation with insulating cement. Finish cover assembly with insulating cement applied in two coats. After first coat is dry, apply and trowel second coat to a smooth finish.

5. Unless a PVC jacket is indicated in field-applied jacket schedules, finish exposed surfaces with a metal jacket.

3.6 INSTALLATION OF CELLULAR-GLASS INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of insulation to pipe with wire or bands and tighten bands without deforming insulation materials.
2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient services, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient services, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with cut sections of cellular-glass block insulation of same thickness as pipe insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available. Secure according to manufacturer's written instructions.
2. When preformed sections of insulation are not available, install mitered sections of cellular-glass insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of cellular-glass insulation to valve body.
2. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
3. Install insulation to flanges as specified for flange insulation application.

3.7 INSTALLATION OF MINERAL-FIBER INSULATION

A. Insulation Installation on Straight Pipes and Tubes:

1. Secure each layer of preformed pipe insulation to pipe with wire or bands and tighten bands without deforming insulation materials.

2. Where vapor barriers are indicated, seal longitudinal seams, end joints, and protrusions with vapor-barrier mastic and joint sealant.
3. For insulation with factory-applied jackets on above-ambient surfaces, secure laps with outward-clinched staples at 6 inches o.c.
4. For insulation with factory-applied jackets on below-ambient surfaces, do not staple longitudinal tabs. Instead, secure tabs with additional adhesive as recommended by insulation material manufacturer and seal with vapor-barrier mastic and flashing sealant.

B. Insulation Installation on Pipe Flanges:

1. Install preformed pipe insulation to outer diameter of pipe flange.
2. Make width of insulation section same as overall width of flange and bolts, plus twice the thickness of pipe insulation.
3. Fill voids between inner circumference of flange insulation and outer circumference of adjacent straight pipe segments with mineral-fiber blanket insulation.
4. Install jacket material with manufacturer's recommended adhesive, overlap seams at least 1 inch, and seal joints with flashing sealant.

C. Insulation Installation on Pipe Fittings and Elbows:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed insulation elbows and fittings are not available, install mitered sections of pipe insulation, to a thickness equal to adjoining pipe insulation. Secure insulation materials with wire or bands.

D. Insulation Installation on Valves and Pipe Specialties:

1. Install preformed sections of same material as straight segments of pipe insulation when available.
2. When preformed sections are not available, install mitered sections of pipe insulation to valve body.
3. Arrange insulation to permit access to packing and to allow valve operation without disturbing insulation.
4. Install insulation to flanges as specified for flange insulation application.

3.8 FIELD-APPLIED JACKET INSTALLATION

A. Where FSK jackets are indicated, install as follows:

1. Draw jacket material smooth and tight.
2. Install lap or joint strips with same material as jacket.
3. Secure jacket to insulation with manufacturer's recommended adhesive.
4. Install jacket with 1-1/2-inch laps at longitudinal seams and 3-inch- wide joint strips at end joints.
5. Seal openings, punctures, and breaks in vapor-retarder jackets and exposed insulation with vapor-barrier mastic.

B. Where PVC jackets are indicated, install with 1-inch overlap at longitudinal seams and end joints; for horizontal applications. Seal with manufacturer's recommended adhesive.

1. Apply two continuous beads of adhesive to seams and joints, one bead under lap and the finish bead along seam and joint edge.

C. Where metal jackets are indicated, install with 2-inch overlap at longitudinal seams and end joints. Overlap longitudinal seams arranged to shed water. Seal end joints with weatherproof sealant recommended by insulation manufacturer. Secure jacket with stainless-steel bands 12 inches o.c. and at end joints.

D. Where PVDC jackets are indicated, install as follows:

1. Apply three separate wraps of filament tape per insulation section to secure pipe insulation to pipe prior to installation of PVDC jacket.
2. Wrap factory-presized jackets around individual pipe insulation sections with one end overlapping the previously installed sheet. Install presized jacket with an approximate overlap at butt joint of 2 inches over the previous section. Adhere lap seal using adhesive or SSL, and then apply 1-1/4 circumferences of appropriate PVDC tape around overlapped butt joint.
3. Continuous jacket can be spiral-wrapped around a length of pipe insulation. Apply adhesive or PVDC tape at overlapped spiral edge. When electing to use adhesives, refer to manufacturer's written instructions for application of adhesives along this spiral edge to maintain a permanent bond.
4. Jacket can be wrapped in cigarette fashion along length of roll for insulation systems with an outer circumference of 33-1/2 inches or less. The 33-1/2-inch- circumference limit allows for 2-inch- overlap seal. Using the length of roll allows for longer sections of jacket to be installed at one time. Use adhesive on the lap seal. Visually inspect lap seal for "fishmouthing," and use PVDC tape along lap seal to secure joint.
5. Repair holes or tears in PVDC jacket by placing PVDC tape over the hole or tear and wrapping a minimum of 1-1/4 circumferences to avoid damage to tape edges.

3.9 FINISHES

A. Pipe Insulation with ASJ,or Other Paintable Jacket Material: Paint jacket with paint system identified below and as specified in Section 09 91 13 "Exterior Painting" and Section 09 91 23 "Interior Painting."

1. Flat Acrylic Finish: Two finish coats over a primer that is compatible with jacket material and finish coat paint. Add fungicidal agent to render fabric mildew proof.

    a. Finish Coat Material: Interior, flat, latex-emulsion size.

B. Flexible Elastomeric Thermal Insulation: After adhesive has fully cured, apply two coats of insulation manufacturer's recommended protective coating.

C. Color: Final color as selected by Architect. Vary first and second coats to allow visual inspection of the completed Work.

D. Do not field paint aluminum or stainless-steel jackets.

3.10 FIELD QUALITY CONTROL

A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

B. Perform tests and inspections.

C. Tests and Inspections:

1. Inspect pipe, fittings, strainers, and valves, randomly selected by Architect, by removing field-applied jacket and insulation in layers in reverse order of their installation. Extent of inspection shall be limited to three locations of straight pipe, three locations of threaded fittings, three locations of welded fittings, two locations of threaded strainers, two locations of welded strainers, three locations of threaded valves, and three locations of flanged valves for each pipe service defined in the "Piping Insulation Schedule, General" Article.

D. All insulation applications will be considered defective Work if sample inspection reveals non-compliance with requirements.

3.11 PROTECTION AND REPLACEMENT

A. Replace damaged insulation which cannot be repaired satisfactorily, including units with vapor barrier damage and moisture saturated units.

B. Protection: Insulation Installer shall advise Contractor of required protection for insulation work during remainder of construction period, to avoid damage and deterioration.

3.12 PIPING INSULATION SCHEDULE, GENERAL

A. Acceptable preformed pipe and tubular insulation materials and thicknesses are identified for each piping system and pipe size range. If more than one material is listed for a piping system, selection from materials listed is Contractor's option.

B. Items Not Insulated: Unless otherwise indicated, do not install insulation on the following:

1. Drainage piping located in crawl spaces.
2. Chrome-plated pipes and fittings unless there is a potential for personnel injury.

3.13 INDOOR PIPING INSULATION SCHEDULE

A. Condensate and Equipment Drain Water below 60 Deg F:

1. All Pipe Sizes: Insulation shall be one of the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 1 inch thick.

B. Chilled Water, 40 Deg F and below:

1. NPS 8 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.

C. Heating-Hot-Water Supply and Return, 90 Deg F to 250 Deg F:

1. NPS 1-1/2 and Smaller: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 1-1/2 inch thick.

2. Larger than NPS 1-1/2: Insulation shall be the following:

a. Mineral-Fiber, Preformed Pipe, Type I: 2 inches thick.

3.14 INDOOR, FIELD-APPLIED JACKET SCHEDULE

A. Install jacket over insulation material. For insulation with factory-applied jacket, install the field-applied jacket over the factory-applied jacket.

B. If more than one material is listed, selection from materials listed is Contractor's option.

C. Piping, Concealed:

1. None.

D. Piping, Exposed:

1. None

E. Piping, Exposed in Mechanical Rooms, etc..:

1. PVC.

END OF SECTION 230719

SECTION 230900 - BUILDING AUTOMATION 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. WEB Based Open Protocol Building Automation System (BAS)

B. Related Requirements:

1. Section 23 05 03 “Submittals for HVAC”.
2. Section 23 09 93 – Sequence of Operations for HVAC Controls

C. General Provisions

1. The general provisions of the Contract, including the General Conditions and supplemental General Conditions, apply to the work specified in this section.
2. This Contract is for all labor, materials and equipment required for the complete construction and installation of an Open Interoperable Web Based Building Automation System.
3. General Provisions and mechanical systems are specified in other Sections of Division 23.
4. The systems shall be complete in all respects, tested and ready for operation.
5. Temperature Controls Contractor (TCC), Building Automation System Contractor (BAS Contractor) or Facility Management System Contractor (FMS Contractor) shall be defined as the same. Additionally, BAS and FMS shall also be defined equally and used interchangeably.

D. General Instructions

1. The BAS, as specified herein, shall be provided in their entirety by the BAS Contractor. The BAS Contractor shall base his Bid on the systems as specified.
2. The BAS Contractor shall submit a (Base) Bid which will include all central processing hardware and software, electronic and control equipment, sensors, valves, dampers and thermostats, as shown on plans and specified.
3. In general, the proposal shall be based on a complete Building Automation and Control system, including controllers, valves damper actuators, relays, wiring and tubing and a full DDC system. The control contractor shall provide full commissioning of his equipment.
4. The BAS Contractor shall be prepared to make a personal presentation of his systems to the Owner or his designated representatives prior to award of Contract should the Owner request it.
5. The existing campus wide controls system is through Siemens. All common areas throughout the residence hall shall have full point by point integration into the existing

campus server. The controls contractor will be responsible for generating all graphics and accessing all available factory points on the new fancoils and unit ventilators in the common areas.

E. Scope

1. The Open Interoperable Web Based BAS shall be supplied and installed completely under the BAS Contract. Components shall be mounted and wired by the BAS Sub-Contractor.
2. The BAS shall graphically display real time control points.
3. The engineering, installation, calibration, software programming, and checkout necessary for complete and fully operational BAS, as specified hereafter, shall be provided by the BAS Contractor.
4. BAS Sub-Contractor shall provide power wiring as required for wiring each individual control panel. Power wiring shall be located within the same room as the BAS equipment or within 20 feet of the connection. BAS sub-contractor shall install wiring according to Division 26.

F. System Description

1. Ethernet (IEEE 802.3), Peer-To-Peer CSMA/CD
2. Furnish all labor, materials, equipment, and service necessary for a complete and operating temperature control system, utilizing a high speed peer to peer network of interoperable Direct Digital Controls (DDC), Graphical User Interface (GUI) with color graphic displays available on at least 24 client computers, simultaneous access from at least 4 computers, and electronic interfaces and actuation devices, as shown on the drawings and as described herein. The Local Area Network (LAN) shall be either a 10 or 100 Mpbs Ethernet network supporting BACnet, Java, XML, HTTP, and CORBA IIOP for maximum flexibility for integration of building data with enterprise information systems and providing support for multiple Universal Network Controllers (UNC's), user workstations and a local host computer system. The Enterprise Ethernet (IEEE 802.3) LAN shall utilize Carrier Sense Multiple/Access/Collision Detect (CSMA/CD), Address Resolution Protocol (ARP) and User Datagram Protocol (UDP) operating at 10 or 100 Mbps.
3. The system will consist of an open architecture that utilizes EIA standard 709.1, the LonTalk™ protocol, as the common communication protocol between all controllers and integral ANSI/ASHRAE™ Standard 135-1995, BACnet functionality to assure interoperability between all system components. Both the LonTalk™ protocol and the ANSI/ASHRAE™ Standard 135-1995, BACnet protocol are required to assure that the project is fully supported by the two leading HVAC open protocols to reduce future building maintenance, upgrade, and expansion costs. Where necessary or desired, LonTalk™ packets may be encapsulated into TCP/IP messages to take advantage of existing infrastructure or to increase network bandwidth. Any such encapsulation of the LonTalk™ protocol into IP datagrams shall conform to existing LonMark™ guidelines for such encapsulation and shall be based on industry standard protocols. The products used in constructing the BAS shall be LonMark™ compliant. In those instances in which LonMark™ devices are not available, the BAS contractor shall provide LonWorks™ devices with application source code, device resource files, and external interface definitions. The software tools required to network manage both the LonTalk™ protocol and the ANSI/ASHRAE™ Standard 135-1995 BACnet protocol must be provided with the system. Drawings are diagrammatic only. Equipment and labor not specifically referred to herein or on the plans, that are required to meet the functional intent, shall be provided without additional cost to the Owner. Minimum BACnet compliance is Level 3; with the ability to support data read and write functionality. Physical connection of BACnet devices shall be via Ethernet/Ethernet IP for BACnet and FTT-10A for LonTalk.

4. Temperature control system to be completely DDC with electronic sensors and electronic actuation of valves and dampers. The Open Interoperable Web Based BAS is intended to seamlessly connect devices throughout the building regardless of subsystem type, i.e. variable frequency drives, low voltage lighting systems, electrical circuit breakers, power metering and card access should easily coexist on the same network channel. The supplied system must incorporate the ability to access all data using Java enabled browsers without requiring proprietary operator interface and configuration programs. An Open DataBase Connectivity (ODBC) or Structured Query Language (SQL) compliant server database is required for all system database parameter storage. This data shall reside on a supplier-installed server for all database access. Systems requiring proprietary database and user interface programs shall not be acceptable. A hierarchical topology is required to assure reasonable system response times and to manage the flow and sharing of data without unduly burdening the customer's internal Intranet network. Systems employing a "flat" single tiered architecture shall not be acceptable.
5. The systems shall include the Tridium/Niagara /Jace products as required for access and communication with the remote Central Operator Work Station (COWS) via computer LAN, WAN or Internet.

G. Work by Others

1. The HVAC Sub-Contractor shall:

   a. Install all line size and non-line size automatic valves and separable wells furnished by the BAS Contractor.
   b. Furnish and install all necessary piping connections, taps and wells required for flow, pressure or temperature devices.
   c. Provide dampers, if so indicated, under Equipment Specifications.

2. The Sheet Metal Sub-Contractor shall:

   a. Install all automatic dampers furnished by the BAS Contractor.
   b. Assemble multiple section dampers with required interconnecting linkages, shafts and brackets and extend the required number of shafts through the ducts for externally-mounted damper motors. Jack shafts will be assembled with sealed roller or ball bearings of stainless steel construction.

3. The Electrical Sub-Contractor shall install conduit and connect power wiring. Power wiring and conduit shall be defined as follows:

   a. Wiring of power feeds through all disconnect starters and variable speed controllers to electric motors.
   b. Wiring of 120 VAC emergency power feeds to junction boxes in locations of temperature control panels.
   c. Power wiring to 120 Volt, single-phase motors shown on Electrical Plans and specified in the Electrical Sections.
   d. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by the BAS Contractor.
   e. Conduit for routing temperature control wiring where shown on electrical plans.
   f. Raceways where shown on electrical plans which shall be utilized for temperature control wiring.

H. Related Work

1. BAS contractor shall coordinate and remain on site with the balancing contractor to operate the facility management system during balancing. The BAS contractor shall manipulate the system as instructed by the balancing contractor. This shall include but not limited to changing damper positions, valve positions, fan speeds, pump speeds and set points as required to complete the balancing procedures.
2. The installation of motor starters that are not factory installed, thermal overload switches, and power wiring to motors, starters, thermal overload switches, contactors, and electric heating coils is specified in another Division. This Section includes installation of controls plus wiring for automatic controls, electric damper and valve operators, terminal control units, interlocks, starting circuits, and wiring to power consuming control devices.
3. Area smoke detectors are provided, installed and wired under another Division. Duct smoke detectors shall be installed under this Division, but furnished and wired into the fire alarm system under another Division. This Section includes wiring alarm signal relays, provided and installed under another Division, to the BAS.

1.3 SYSTEM LAYOUT AND PERFORMANCE

A. The DDC system shall be engineered and equipment selected by the manufacturer as required to meet the performance specified herein.

B. The location and quantity of DDC panels shall be as determined by the DDC system manufacturer except that in no circumstance shall more than 25% of the total number of sensor and control points be connected through a signal panel.

C. Each DDC system component, including the central computer, data transmission system, and each panel shall provide for the future addition of at least 20% of the number of sensor and control points connected to that component.

D. An alarm condition shall be reported to the appropriate operator device no more 10 seconds following the occurrence of that condition.

E. Sensor and control values displayed to the operator in graphics displays shall be dynamically updated within 5 to 15 seconds of significant change of value. Values shall be prioritized.

1.4 SUBMITTALS

A. Specification Compliance Review (Submit with Submittals)

1. Each BAS Contractor shall supply, at the time of submittals, a paragraph by paragraph specification compliance report to the Owner. The report shall indicate for each paragraph, how the Contractor meets the criteria of the paragraph.
2. The following format must be utilized in completing the compliance report:

    a. Comply - without exception.
    b. Qualify - Meet the functional intent. For each paragraph, the Contractor shall identify all differences in specific functions stated in the given paragraph and provide a description of what is excluded or how the qualifying system will meet the function specified.

B. Diagrams:

1. Provide separate diagrams for each system, including piping, motor starting and interlock wiring, push buttons, control wiring, interior electrical circuits of control instruments with terminal designations, control motors, colors of wires, locations of instruments and remote elements, and normal position of valves, dampers and relays.
2. A detailed description of the operation of the control system including device designations shall accompany the drawings. Schedule of dampers including size, leakage, and flow characteristics and a schedule of valves including close-off and flow characteristics shall also be furnished for the entire project.

C. DDC system data:

1. Provide manufacturer's data sheets on the DDC panels, sensors, control interface devices, terminal control units, protection devices, and software.
2. Provide the actual physical proposed room thermostat/temperature sensor and guards, at the time of submittal review, to both the Engineer and Owner for approval.
3. Complete field wiring diagram with terminals labeled as they will be marked on the equipment, including sensors, control and power wiring for each sensor, control and DDC panel.
4. Programmer's manual, flow charts of DDC control programs provided to perform control sequences specified herein.
5. Floor plans locating DDC panels and terminal control units coordinated with work of other trades. The BAS contractor shall provide the actual physical proposed room thermostat and guards, at the time of submittal review, to both the Engineer and Owner for approval.
6. Provide External Interface Files:

    a. XIF files or object diagrams for each DDC system component (Building Controller, Custom Application Controller, and Application Specific Controller) proposed.

7. Provide ANSI/ASHRAE™ Standard 135-1995, BACnet PIC Statement. Proof of Compliance Level 3 or higher is required to protect building owner by reducing future maintenance and expansion costs.

D. DDC central station data:

1. Manufacturer's data sheets on DDC central station equipment including computers, CRT's, printers, disk systems, protection and communications equipment, and software.
2. Complete field wiring diagrams for data communications with DDC panels and interconnection of central station equipment; proposed graphics displays if specified herein, and floor plans showing layout of central station equipment.

E. All submittal information (drawings and cut sheets) shall be furnished in both paper and electronic format.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For building automation system to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Protocol to comply with ASHRAE 135.

B. Refer to Section 23 09 93 and the drawings for all work to be included in the controls work.

C. Bids by wholesalers and non-franchised contractors shall not be acceptable.

D. The system manufacturer shall, as a minimum, manufacture and supply the Custom Application Controller, Application Specific Controller, Graphical User Interface, damper actuators, and valve actuator assemblies.

E. All materials, equipment and apparatus shall be new and of first-class quality.

F. All work described in this section shall be installed, wired, circuit tested and calibrated by factory certified technicians qualified for this work and in the regular employment of the Facility Management System manufacturer's field office. The local installing office shall have a minimum of ten years of installation experience with the manufacturer and shall provide documentation prior to the bid and with the submittal package verifying longevity of the installing company's relationship with the manufacturer. Supervision, calibration and checkout of the system shall be by the employees of the factory authorized field office.

G. The Facility Management System Contractor shall have a full service facility within 50 miles of the project that is staffed with engineers trained in Integrating Interoperable Systems and technicians fully capable of providing LonWorks instructions and routine emergency maintenance service on all system components. The service facility shall stock spare parts inventory and all necessary test and diagnostic equipment.

H. The contractor must be able to respond to any warranty or service call within 8 hours.

I. Electrical Components, Devices, and Accessories shall be listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

J. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilation Systems."

K. Comply with National Electric Code, UL-916 Energy Management Systems, LonMark™, ULC, and FCC Part 15, subpart J, Class B Computing Devices.

L. Comply with EIA Standard 709.1 LonTalk™ protocol for DDC system control components.

1.7 DELIVERY, STORAGE AND HANDLING

A. Factory-Mounted Components: Where control devices specified in this Section are indicated to be factory mounted on equipment, arrange for shipping of control devices to manufacturer of that equipment.

1.8 COORDINATION

A. Coordinate location of thermostats, humidistats, and other exposed control sensors with plans and room details before installation.

B. Coordinate equipment from other divisions including "Intrusion Detection," "Lighting Controls," "Motor-Control Centers," "Panelboards," and "Fire Alarm" to achieve compatibility with equipment that interfaces with those systems.

C. Coordinate supply of conditioned electrical circuits for control units and operator workstation.

D. Coordinate with Owner's IT department for IP addresses and access to Owner's existing high speed Intranet.

1.9 OWNERSHIP OF PROPRIETARY MATERIAL

A. The Owner shall sign a copy of the manufacturer's standard software and firmware licensing agreement as a condition of this contract. Such license shall grant use of all programs and application software to Owner as defined by the manufacturer's license agreement, but shall protect manufacturer's rights to disclosure of trade secrets contained within such software.

B. All project developed software and documentation shall become the property of the Owner. These include, but are not limited to project graphic images, record drawings, project database, project specific application programming code, and all other associated documentation.

1.10 INSTRUCTION OF OPERATING PERSONNEL

A. General:

1. Conduct formal instruction sessions for operating personnel.
2. Prepare and submit a syllabus describing an overview of the program, describing how the program will be conducted, when and where meetings are to be held, names and company affiliations of lecturers, description of contents and outline for each lecture, and recommended reference material and outside reading.
3. Obtain direction from the Owner on which operating personnel shall be instructed in each system.

B. BAS Training

1. Provide 1 formal training session. Such training session shall include but not be limited to:

    a. Basic instruction
    b. Operation and use of advanced features
    c. Creating and adding new graphics
    d. Optimization and energy management features.

2. The session shall be conducted by factory-trained personnel and be a minimum of two (2) eight (8) hour days, for a total of 16 training hours. Provide materials and training for up to 3 operators per session to be designated by the Owner.
3. Provide CD-ROM format recording of training sessions. CD shall include an easy to use index of training segments with extensive description for quick, easy references. CD segments shall be created on the owners actual installed system. CD segments shall be established for each independent task that is covered in the training to reduce the owner's review time.
4. Obtain a receipt acknowledging completion of each item of instruction.

1.11 SEASONAL ADJUSTMENTS

A. Visit each Building during the first heating or cooling season approximately 6 months after the date of substantial completion to make repairs and adjustments to provide uniform conditions throughout. Each visit shall consist of a minimum of one (1) day. Schedule the visit for the heating cycle during the months of December through February, and for the cooling cycle during June through August.

B. During each visit:

1. Check and calibrate temperature control devices and thermostats.
2. Test and verify control sequences for proper operation for the season.
3. Modify the system based on the owner's direction.
4. Assist the owner in understanding and clearing any alarms.

C. Prepare and submit a report for each visit documenting conditions found and corrective action taken.

D. Have the Owner sign the report acknowledging the visit.

1.12 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of building automation system that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: one year(s) from date of Substantial Completion.

B. When warranty begins this contractor shall send a letter to the Owner and copy the architect and engineer stating that the work is complete per the drawings and specifications and the warranty is to start at one date and end at another.

C. Any equipment, software, or labor found to be defective during this period shall be repaired or replaced without expense to the owner.

D. The contractor must respond to any warranty or service call within 24 hours.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Subject to compliance with requirements, provide an OPEN INTEROPERABLE WEB BASED FACILITY MANAGEMENT SYSYTEM (BAS) and Automatic Temperature Control system manufactured and installed by one of the following:

1. Siemens (BACnet)

2.2 GENERAL

A. Provide a complete system of direct digital controls (DDC) and monitoring points as specified herein. The DDC system shall interface with the electric and electronic systems to provide control outputs and monitoring inputs to the DDC systems as specified in other Division 23 sections, and as listed in the I/O summaries.

B. The Building Automation System shall improve HVAC reliability and enhance building efficiency while providing an easy to use interface for monitoring and managing the building. The Building Automation System shall provide the necessary Hardware, Software, and Network Communication abilities to provide Scheduling, Monitoring, Trending, Historical Storage, and alarm functions for the HVAC equipment and systems as describe in this specification. Control capabilities shall include but are not limited to: Time of Day scheduling, Direct Digital Control, Custom Control, Boolean Logic, Optimum Start/Stop, Duty Cycling, Electrical Demand Control, Temperature Control, After Hours Override, Reports and Logs, Trend Prints, Remote Communications, Alarm Logging, Run Time and Maintenance, and Expanded Informational Messages.

C. The Building Automation System shall allow full user operation with a minimum of training. It shall have an English language display, with both user prompts and "help" user tutorial. It shall contain management reports for the monitoring of both current and historical energy usage, heating and cooling degree day, building status and after hours occupancy information.

D. All applications programs shall be pre-engineered and pre-tested.

2.3 SERVER FUNCTIONS AND HARDWARE

A. This system shall communicate with the Campus BAS central server.

B. Local connections shall be via an Ethernet LAN. Remote connections can be via ISDN, ADSL, T1, cable modem, or dial-up connection.

C. It shall be possible to provide access to all Universal Network Controllers via a single connection to the server. In this configuration, each Universal Network Controller can be accessed from a remote Graphical User Interface (GUI) or from a standard Web browser (WBI) by connecting to the server.

D. The server shall provide the following functions, at a minimum:

1. Global Data Access: The server shall provide complete access to distributed data defined anywhere in the system.
2. Distributed Control: The server shall provide the ability to execute global control strategies based on control and data objects in any UNC in the network, local or remote.
3. The server shall include a master clock service for its subsystems and provide time synchronization for all Universal Network Controllers (UNC).
4. The server shall accept time synchronization messages from trusted precision Atomic Clock Internet sites and update its master clock based on this data.
5. The server shall provide scheduling for all Universal Network Controllers and their underlying field control devices.
6. The server shall provide demand limiting that operates across all Universal Network Controllers. The server must be capable of multiple demand programs for sites with multiple meters and or multiple sources of energy. Each demand program shall be capable of supporting separate demand shed lists for effective demand control.

7. The server shall implement the BACnet Command Prioritization scheme (16 levels) for safe and effective contention resolution of all commands issued to Universal Network Controllers. Systems not employing this prioritization shall not be accepted.
8. Each Universal Network Controller supported by the server shall have the ability to archive its log data, alarm data and database to the server, automatically. Archiving options shall be user-defined including archive time and archive frequency.
9. The server shall provide central alarm management for all Universal Network Controllers supported by the server. Alarm management shall include:

    a. Routing of alarms to display, printer, email and pagers
    b. View and acknowledge alarms
    c. Query alarm logs based on user-defined parameters

10. The server shall provide central management of log data for all Universal Network Controllers supported by the server. Log data shall include process logs, runtime and event counter logs, audit logs and error logs. Log data management shall include:

    a. Viewing and printing log data
    b. Exporting log data to other software applications
    c. Query log data based on user-defined parameters

2.4 GRAPHICAL PROGRAMMER (GP)

A. The Graphical Programmer's utility tool is existing on the central server computer.

B. The GP is a graphical object-oriented Visio-based drawing tool that provides an intuitive interface for network design integrating capabilities into Windows NT based applications. The functions shall include Network Management services such as device installation, device configuration, diagnostics, maintenance, and defining network data connections between system controllers, known as "binding".

2.5 OPERATOR INTERFACE (GUI SERVER APPLICATION SOFTWARE)

A. Input/output capability from operator station for monitoring and controlling all of the points listed in the input/output point list. The operator shall be able to monitor and access all points by means of clear concise English names without having to understand or reference hardware point locations or controller programs.

B. Operating System: The GUI shall run on Microsoft Windows NT Workstation 4.0, Service Pack 4, Windows 2000, or later.

C. The GUI shall employ browser-like functionality for ease of navigation. It shall include a tree view (similar to Windows Explorer) for quick viewing of, and access to, the hierarchical structure of the database. In addition, menu-pull downs, and toolbars shall employ buttons, commands and navigation to permit the operator to perform tasks with a minimum knowledge of the HVAC Control System and basic computing skills. These shall include, but are not limited to, forward/backward buttons, home button, and a context sensitive locator line (similar to a URL line), that displays the location and the selected object identification.

D. Real-Time Displays. The GUI, shall at a minimum, support the following graphical features and functions:

1. Graphic screens shall be developed using any drawing package capable of generating a GIF, BMP, or JPG file format. Use of proprietary graphic file formats shall not be acceptable. In addition to, or in lieu of a graphic background, the GUI shall support the use of scanned pictures.
2. Graphic screens shall have the capability to contain objects for text, real-time values, animation, color spectrum objects, logs, graphs, HTML or XML document links, schedule objects, hyperlinks to other URL's, and links to other graphic screens.
3. Graphics shall support layering and each graphic object shall be configurable for assignment to one a layer. A minimum of six layers shall be supported.
4. Modifying common application objects, such as schedules, calendars, and set points shall be accomplished in a graphical manner.

    a. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.
    b. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.

5. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
6. Adjustments to analog objects, such as set points, shall be done by right-clicking the selected object and entering the desired value.

E. System Configuration. At a minimum, the GUI shall permit the operator to perform the following tasks, with proper password access:

1. Create, delete or modify control strategies.
2. Add/delete objects to the system.
3. Tune control loops through the adjustment of control loop parameters.
4. Enable or disable control strategies.
5. Generate hard copy records or control strategies on a printer.
6. Select points to be alarmable and define the alarm state.
7. Select points to be trended over a period of time and initiate the recording of values automatically.

F. On-Line Help. Provide a context sensitive, on-line help system to assist the operator in operation and editing of the system. On-line help shall be available for all applications and shall provide the relevant data for that particular screen. Additional help information shall be available through the use of hypertext. All system documentation and help files shall be in HTML format.

G. Security.

1. Each operator shall be required to log on to that system with a user name and password in order to view, edit, add, or delete data. System security shall be selectable for each operator.
2. The system administrator shall have the ability to set passwords and security levels for all other operators. Each operator password shall be able to restrict the operators' access for viewing and/or changing each system application, full screen editor, and object.
3. Each operator shall automatically be logged off of the system if no keyboard or mouse activity is detected. This auto log-off time shall be set per operator password.
4. All system security data shall be stored in an encrypted format.
5. User access shall be secured using individual security passwords for a minimum of fifty users. It will be partitioned into multiple levels of user access (minimum of seven levels)

with data entry restrictions being assignable by password. User log on/log off attempts will be recorded.

H. System Diagnostics. The system shall automatically monitor the operation of all workstations, printers, modems, network connections, building management panels, and controllers. The failure of any device shall be annunciated to the operator.

2.6 ALARM CONSOLE

A. The system will be provided with a dedicated alarm window or console. This window will notify the operator of an alarm condition, and allow the operator to view details of the alarm and acknowledge the alarm. The use of the Alarm Console can be enabled or disabled by the system administrator.

B. When the Alarm Console is enabled, a separate alarm notification window will supercede all other windows on the desktop and shall not be capable of being minimized or closed by the operator. This window will notify the operator of new alarms and un-acknowledged alarms. Alarm notification windows or banners that can be minimized or closed by the operator shall not be acceptable.

2.7 GUI SYSTEM SECURITY

A. System Security shall be on an application by application basis. System Administrator shall setup and define access privileges per user, per application and per setpoint levels.

B. The Users shall be assigned discrete password names and codes, both of which must be entered in order to have access to any particular application or function within the system.

C. Access privileges shall also be assignable for entry into the standard MS Windows NT or array of applications such as File Manager, Task Manager or others.

D. A minimum of 10,000 levels of assignable access must be provided. Systems not supporting this level of customization and flexibility for system security must define delivered capabilities, and may not be accessible.

2.8 GUI DISPLAY FRAMES

A. The Dynamic Graphic portion of this GUI shall allow the operator to access any system information via a “system penetration” method. “System penetration” shall allow the operator to penetrate into the facility until the detailed color graphic display of a specific area of the facility is represented. All system travel shall be 100% accessible via the mouse, no keyboard commands shall be necessary to edit dynamic data.

B. The ability to import background images for the display frames shall include as a minimum, photos, digital images, bitmaps and standard image formats. Systems that utilize a proprietary background image format are not acceptable.

C. As a minimum, graphic displays shall be provided for overall site, for each subsystem within the site and for all individual locations associated with each subsystem. All graphics shall be logically linked to allow the operator to traverse through the overall system and at any time return immediately to the associated subsystem, or overall site plan, via a graphic element.

D. The system must be set up to have at least 3 access levels: guest, user and administrator. Guest privileges shall be limited to view only. Users shall be able to make setpoint and schedule changes. Administrators shall have all privileges as users in addition to being able to assign passwords.

E. The graphic displays shall have an HTML tree on the left side of the screen and the currently viewed graphic on the right side. Tree views shall be different based on access level and the tree must only show screens that are available based on access privileges.

F. At a minim, each heating water system and cooling system shall have a minimum of 5 graphic screens available from the tree view. One screen shall display the airflow pattern with all dampers, coils and fans shown in their correct schematic location and dynamic data for all input values shown. This main graphic screen shall show the control devices in mechanical flow diagram format with directional arrows to indicate normal flow arrangement. These screens shall be available to anyone with access to the system, and therefore shall be view only. Another screen shall display text information with the following primary categories: unit status, temperatures, heating, cooling, economizer, static pressure, supply fan, and exhaust fan including setpoints of each category. A loop tuning screen shall also be furnished for each control loop, so that people with the appropriate access can change loop tuning parameters from PCs without needing individual programming tools. Override screens shall be furnished for each controller to permit overriding control points without the need for vendor specific software. An alarm screen shall also be furnished each fancoil and unit ventilator in the common areas. Systems that won't permit creating these customized screens as described herein will not be acceptable. Systems that use controllers that won't permit overrides of inputs and outputs and adjusting loop tuning parameters for all control loops from a browser based graphic screen will not be acceptable.

G. All shapes shall be 3-D with a common perspective. All dampers shall have a minimum of 4 animation levels to show partially open, half open, mostly open, fully open, and closed position of dampers. All analog inputs shall show the actual value and engineering units on the graphic screen. Binary inputs shall be linked to flashing animated displays. Safety alarms will flash when in alarm. To prevent clutter on the graphic displays, symbols will only be shown for equipment that is controlled or monitored by the DDC system. Also, normal status for safeties will not be indicated, fans shall rotate when flow is proven by a monitoring device. Coils shall change color when valves are open to permit water flow through the coils.

H. Graphics shall use common color schemes to make the overall system easy to understand. All overall backgrounds shall be white. All text shall be black. Any value that is in alarm shall have a red background. Any value that is overridden shall have a blue background. All like sensors shall be the same color. For example, all temperature devices shall be yellow, all pressure devices shall be purple, all humidity devices shall be teal, all fire alarm devices shall be red and all CO2 devices shall be green.

I. Current setpoints and occupancy status shall be shown at the bottom of each graphic screen.

J. Floor plan drawings shall be provided, and permit access to each zone's individual floor plan sections. On the individual floor plan sections, room numbers and room temperatures shall be displayed. Values that are out of the acceptable range shall appear in a different background color and / or flash. Each fancoil and unit ventilator in the common areas shall have its own graphic that contains the points from within its controller including the flow setpoint, room temperature setpoint, maximum cooling flow setpoint, minimum cooling flow setpoint, and minimum heating flow setpoint, plus the discharge air temperature from the unit. GUI shall permit operator the ability to enable, set or disable high and low occupied and unoccupied limits for each room temperature reading.

K. Text Screens shall be available for all levels of access. Setpoint and output values are changeable from the text screen for users with appropriate access privileges and administrators, but not guests. When a value can be overridden or edited, a red box shall appear around it when the cursor is position on it. A single click of the mouse shall bring up pop up menu that provide options to make a permanent override, change setpoint, or release a previous override of an output point. Analog inputs shall have pop up menus that allow setting high and low alarm limits and the ability to enable and disable alarm limits as appropriate for the sensing device. Pop up menus must be customized to include a description of the point that is being modified. Generic override menus are not permitted because they would not describe to an operator what is about to be modified. The BAS Contractor shall set up all initial alarms as indicated in the point matrix.

L. Text screens shall include schedule information including current state and date and time of next scheduled event. Positioning the mouse over the current state shall permit single click access to the schedule. The schedule screen shall allow the operator to edit a yearly, weekly, daily, holiday or special event schedule for the system being viewed. Temperature values and setpoints shall be displayed below the schedule information, and shall have a minimum of 1 decimal place. Heating, cooling and damper outputs shall be displayed next. The OA temperature for economizer switchover shall be displayed and adjustable from the text screen. Air flow readings shall be shown with setpoint and actual readings. Fan information shall be shown next, followed by static pressure readings and setpoints, which shall have a minimum of 2 decimal places. Miscellaneous setpoints including night setback cooling and heating, average zone temperature, return air warm-up and cool-down, dehumidification, and unoccupied mixed air temperature setpoints shall all be shown and adjustable. All safeties shall be shown, followed by coil pump control information.

M. Each system shall have its own specific alarm screen available to all operators but only editable by operators with user and administration access privileges. From the alarm screen, users and administrators shall be able to enable and disable alarms. Points that are in alarm shall have an alarm symbol highlighted in red. Points that are not in alarm shall be shown in gray. Alarms that are disabled shall have a way to indicate this on the alarm screen graphic.

N. Loop tuning screens shall be available through the web browser interface to save the owner the cost and time associated with using vendor specific software for tuning loops. Access to these screens shall not be provided to guests. Loop tuning screen for discharge air temperature shall include the discharge air temperature, discharge air temperature setpoint, cooling loop throttling range, I-gain and ramp time, heating loop throttling range, I-gain and ramp time, economizer loop throttling range, I-gain and ramp time, unoccupied heating loop throttling range, I-gain and ramp time, cooling valve output, heating valve output, and damper control output. Screens shall also have graphs that show 5 minutes of live data for the discharge air temperature, setpoint, cooling valve, heating valve and mixed air dampers. Each loop tuning screen shall include the appropriate throttling range, I-gain and ramp time.

O. Each non-unitary controller shall have an override screen. These screens shall be available on-site for use during point-to-point check-out and commissioning. The override screen shall show the inputs and outputs for each controller with the points in their wired location. Unused points shall be shown as spares. Points that are in alarm shall have a red background, and points that are overridden shall have a blue background just as on other screens. These screens shall show the actual values that come back from the controller, not the values that may have been typed in for override at the GUI if the controller software is not accepting the override value. The override screen shall also permit timed overrides.

P. Heating systems and cooling systems with multiple pieces of equipment such as pumps with lead-lag control shall display which device is lead and when the other device will become lead on the text screen.

Q. Although only one outside air temperature sensor is needed per building, the GUI shall use independent outside air temperature points, so that during check-out and commissioning, the outside air temperature for a system can be changed without changing the outside air temperature for the whole building. The GUI shall also have a global outside air temperature point that can be overridden from the screen for the controller where the point is physically connected. Overriding this outside air temperature value will change it for all systems, except when outside air temperature has been overridden for an individual system.

R. The system shall allow for the easy development and editing of dynamic graphics. Wizards shall be utilized to assist the operator with their manipulation of the graphic system. The operator shall be able to, through a single mouse function, select between the dynamic display mode and the graphic edit mode for the currently viewed graphic frame, assuming appropriate access level is provided to the operator. Systems requiring multiple mouse or operator keyboard commands to enter the graphic edit mode are not desirable and require thorough definition of steps involved to accomplish function.

S. Animation of system data shall be provided via graphic elements on the display frames. Standard graphic element library shall be provided to assist the operator with their implementation. The ability to define and add new animated graphic elements shall be provided. As a minimum, the ability to move, size, draw, arrange, align, layer, space, rotate, invert, duplicate, cut, copy, paste, erase any animated element shall be provided. System parameters and setpoints shall be assignable and modifiable by the animated graphic elements, relieving the need for keyboard commands for system manipulation.

T. The ability to simultaneously display a dynamic X/Y chart of selected points, shall be provided. The chart shall be an element of the graphic display and shall automatically update with the display data. The chart shall allow for dynamic manipulation to modify the range, rate, and timeframe of view, in both a real-time as well as historical configuration. A minimum of 4 values shall be included on any chart display element. There shall not be a limit to the quantity of chart elements displayed on a graphic frame. Trace colors and X values shall be User configurable. Systems not providing this capability are required to provide an equivalent charting package with the GUI offering.

U. Full on-line system documentation shall be provided. It shall not be necessary to maintain printed copies of user or programming manuals. Context sensitive help files shall be provided for all applications within the FMCS area of the GUI. The ability to update on-line documentation must be provided via electronic updates, definition of update procedure shall be provided.

1. Electronic O&M manual information shall be installed in the web server(s), so that information can be retrieved by logging on to the building's BAS from any web browser. PDF files of control drawings, sequences of operations, and product cut sheets shall be loaded on the web server(s), so they can also be remotely accessed.

V. By pointing and clicking on any individual graphic element, the following shall be available for display or modification, but not be limited to the current value or state may be edited. A self-prompting pop-up window shall be displayed providing the ability to modify the selected point value. Instructions assisting the operator in their use of the pop-up window shall be provided.

W. The ability to provide graphically displayed global scheduling and editing functions shall be provided. The ability to link these functions to the associated equipment or zone frames shall be a standard feature. A calendar shall be provided for display and modification of the SDC time clock functions. The User shall be able to view a daily, weekly, monthly, annual, special or holiday schedule from a defined display frame. A list of served areas shall be displayed on the same screen, this list shall be displayed at all times, pull down menus or other means of accessing these areas shall not be acceptable. The system shall have a master override screen that will allow an operator to change the schedule for every piece of equipment in every building by changing the master schedule. This is often referred to as a “Snow Day” command and does not require the operator to log onto each building’s UNC.

X. All analog values shall be trended every 15 minutes. The trend samples shall be saved in the UNC for at least 36 hours. Access to trended data shall be available by the single click of a mouse on the analog value. Systems that open other windows and require a selection of the desired data are not acceptable.

2.9 GUI ALARMING

A. The GUI shall provide, as standard, alarm annunciation of system data. On every display frame, the ability to view, acknowledge, delete and manipulate real-time and historical alarms shall be provided. The ability to provide a unique and custom alarm display for every display frame shall be provided. The ability to continuously or upon request, view the alarm display, shall be provided.

B. Alarm conditions shall be capable of invoking, as a minimum; a display frame, an email message, a text message sent to a pager or cellular phone.

C. Alarm logging shall be provided in a user definable configuration. All alarms shall be displayed and/or routed as follows, as a minimum; GUI display frame, local printer, server printer, client printer, logged to file, and archived in standard format for information management. Alarm groupings shall be hierarchical in nature allowing up to 8 alarm groups and 16 sub-groups. The GUI shall not possess any limits on the quantity of alarms that can be logged, including historical data archiving. Systems possessing limits must define the restrictions and may not be acceptable.

D. Alarm provide shall provide up to 999 alarm priorities with up to 5 alarm color changes, per priority, according to alarm status.

2.10 GUI TRENDING

A. The GUI shall automatically perform time based, user defined, periodic collection of real time point data. The data shall be presented as an X/Y chart in the display frame. The data shall be stored and archived in a file format that allows for the manipulation and utilization of the data by third party applications.

B. A dynamic trend shall be defined as a group of at least 4 data points, with a circular buffer of 2000 data points. A historical trend shall be defined as a group of at least 8 data points, with the sampled points limited only by archival disk space. Sampling rates shall be user selectable from instantaneous (one per second) to once a week. Collection of data shall be user selectable to start and stop on a specific time and date. There shall be no limit to the number of X/Y charts within a display frame.

C. X/Y charting and column and row reporting shall be an integral part of the HMI. All points shall be chartable or reportable. Analytical data shall be displayed for any of the selected points in a clearly displayed X/Y chart. This analytical data shall consist of at least the following: Average Mean, Standard Deviation, Simple Average, Current Value, Cycle Length, Cycle High and Cycle Low.

D. X/Y charting shall provide for the following chart manipulation: display, zoom, scroll, centering, pen legend and export to Excel, Text via Dynamic Data Exchange.

2.11 WEB BROWSER CLIENTS

A. The system shall provide at this time the ability of supporting at least 64 clients using a standard Web browser such as Internet Explorer™ or Netscape Navigator™. Systems requiring additional software (to enable a standard Web browser) to be resident on the client machine, are only acceptable if 64 licensed copies of the client machine software are provided, installed, and tested.

B. The Web browser software shall run on any operating system and system configuration that is supported by the Web browser. Systems that require specific machine requirements in terms of processor speed, memory, etc., in order to allow the Web browser to function with the FMCS, shall only be acceptable if 64 workstation or workstation hardware upgrades are provided.

C. The Web browser shall provide the same view of the system, in terms of graphics, schedules, calendars, logs, etc., and provide the same interface methodology as is provided by the Graphical User Interface. Systems that require different views or that require different means of interacting with objects such as schedules, or logs, shall not be permitted.

D. The Web browser client shall support at a minimum, the following functions:

1. User log-on identification and password shall be required. If an unauthorized user attempts access, a blank web page shall be displayed. Security using Java authentication and encryption techniques to prevent unauthorized access shall be implemented.
2. Graphical screens developed for the GUI shall be the same screens used for the Web browser client. Any animated graphical objects supported by the GUI shall be supported by the Web browser interface.
3. HTML programming shall not be required to display system graphics or data on a Web page. HTML editing of the Web page shall be allowed if the user desires a specific look or format.
4. Storage of the graphical screens shall be in the Building Control Units (BC), or at the GUI without requiring any graphics to be stored on the client machine. Systems that require graphics storage on each client are not acceptable.
5. Real-time values displayed on a Web page shall update automatically without requiring a manual “refresh” of the Web page.
6. User’s shall have administrator-defined access privileges. Depending on the access privileges assigned, the user shall be able to perform the following:

E. Modify common application objects, such as schedules, calendars, and set points in a graphical manner.

1. Schedule times will be adjusted using a graphical slider, without requiring any keyboard entry from the operator.

2. Holidays shall be set by using a graphical calendar, without requiring any keyboard entry from the operator.
3. Commands to start and stop binary objects shall be done by right-clicking the selected object and selecting the appropriate command from the pop-up menu. No entry of text shall be required.
4. View logs and charts
5. View and acknowledge alarms

F. The system shall provide the capability to specify a user's (as determined by the log-on user identification) home page. Provide the ability to limit a specific user to just their defined home page. From the home page, links to other views, or pages in the system shall be possible, if allowed by the system administrator.

G. Graphic screens on the Web Browser client shall support hypertext links to other locations on the Internet or on Intranet sites, by specifying the Uniform Resource Locator (URL) for the desired link.

2.12 CONTROL UNITS GENERAL

A. Provide an adequate number of control units to achieve monitoring and control of all data points specified and necessary to satisfy the sequence of operation for all mechanical systems shown on the plans. Provide a minimum of one separate LonMark™ or LonWorks™ controller for each AHU or other HVAC system. Multiple DDC controllers may control one system provided that all points associated with individual control loops are assigned to the same DDC controller. If multiple controllers are furnished, the contractor must make sure that corresponding outputs and inputs are on the same controller. Extra controllers will be required to ensure that all control outputs are controlled by a controller that has the control inputs directly connected to it. Points used for control loop reset such as outside air or space temperature are exempt from this requirement. When multiple controllers are used for controlling one system, the controllers shall be identical. To minimize the number of spare parts that the owner will need to stock in the future, the same part number controller shall be used for all major system applications (i.e. AHUs, heating water system, chilled water system, pump systems, etc.). All analog ouputs shall be true AO (0-20mA or 0-10Vdc). Floating, pulse-width or phase-cut modulating outputs will not be acceptable for this project. Each of the following panel types shall meet the following requirements.

B. Controllers shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient conditions shall be mounted within waterproof enclosures, and shall be rated for operation at -40°F to 140°F and 5 to 95% RH, non condensing.
2. Controllers used in conditioned ambient space shall be mounted in dust-proof enclosures, and shall be rated for operation at 32°F to 122°F and 5 to 95% RH, non-condensing.

C. Serviceability: Provide diagnostic LEDs for power, communication, and processor. All wiring connections shall be made to field-removable, modular terminal strips or to a termination card connected by a ribbon cable.

D. Memory: The Control Units shall maintain all BIOS and programming information in the event of a power loss for at least 72 hours.

E. Diagnostics: The Building Controller shall continually check the status of its processor and memory circuits. If an abnormal operation is detected, the controller shall assume a predetermined failure mode and generate an alarm notification.

F. Immunity to power and noise: Controller shall be able to operate at 90% to 110% of nominal voltage rating and shall perform an orderly shutdown below 80% nominal voltage. Operation shall be protected against electrical noise of 5 to 120 Hz and from keyed radios up to 5 W at 3 feet.

G. Automatic staggered restart of field equipment after restoration of power and short cycle protection is required.

2.13 UNIVERSAL NETWORK CONTROLLERS (UNC)

A. The Universal Network Controllers (UNC) shall provide the interface between the LAN or WAN and the field control devices, and provide global supervisory control functions over the control devices connected to the UNC. It shall be capable of executing application control programs to provide:

1. Calendar functions
2. Scheduling
3. Trending
4. Alarm monitoring and routing
5. Time synchronization by means of an Atomic Clock Internet site including automatic synchronization
6. Integration of LonWorks™ controller data and BACnet controller data
7. Network Management functions for all LonWorks™ based devices

B. The Universal Network Controllers must provide the following hardware features as a minimum:

1. One Ethernet Port – 10/100 Mbps
2. One RS-232 port
3. One LonWorks™ Interface Port – 78KB FTT-10A
4. One RS-232/RS-485 port selectable with Invensys ASD Driver for interfacing with existing NW8000 controllers
5. Battery Backup
6. Flash memory for long term data backup (If battery backup or flash memory is not supplied, the controller must contain a hard disk with at least 1 gigabyte storage capacity)
7. The UNC must be capable of operation over a temperature range of 0 to 55°C
8. The UNC must be capable of withstanding storage temperatures of between 0 and 70°C
9. The UNC must be capable of operation over a humidity range of 5 to 95% RH, non-condensing

C. The UNC shall provide multiple user access to the system and support for ODBC or SQL. A database resident on the UNC shall be an ODBC compliant database or must provide an ODBC data access mechanism to read and write data stored within it.

D. The UNC shall support standard Web browser access via the Intranet/Internet. It shall support a minimum of 64 simultaneous users.

E. Event Alarm Notification and actions

1. The UNC shall provide alarm recognition, storage; routing, management, and analysis to supplement distributed capabilities of equipment or application specific controllers.
2. The UNC shall be able to route any alarm condition to any defined user location whether connected to a local network or remote via dial-up telephone connection, or wide-area network.
3. Alarm generation shall be selectable for annunciation type and acknowledgement requirements including but limited to:

    a. To alarm
    b. Return to normal
    c. To fault

4. Provide for the creation of a minimum of eight of alarm classes for the purpose of routing types and or classes of alarms, i.e.: security, HVAC, Fire, etc.
5. Provide timed (schedule) routing of alarms by class, object, group, or node.
6. Provide alarm generation from binary object “runtime” and /or event counts for equipment maintenance. The user shall be able to reset runtime or event count values with appropriate password control.
7. Control equipment and network failures shall be treated as alarms and annunciated.
8. Alarms shall be annunciated in any of the following manners as defined by the user:

    a. Screen message text
    b. Email of the complete alarm message to multiple recipients. Provide the ability to route and email alarms based on:

        1) -Day of week
        2) -Time of day
        3) -Recipient

    c. Pagers via paging services that initiate a page on receipt of email message
    d. Graphic with flashing alarm object(s)
    e. Printed message, routed directly to a dedicated alarm printer

9. The following shall be recorded by the UNC for each alarm (at a minimum):

    a. Time and date
    b. Location (building, floor, zone, office number, etc.)
    c. Equipment (air handler #, accessway, etc.)
    d. Acknowledge time, date, and user who issued acknowledgement.
    e. Number of occurrences since last acknowledgement.

10. Alarm actions may be initiated by user defined programmable objects created for that purpose.
11. Defined users shall be given proper access to acknowledge any alarm, or specific types or classes of alarms defined by the user.
12. A log of all alarms shall be maintained by the UNC and/or a server (if configured in the system) and shall be available for review by the user.
13. Provide a “query” feature to allow review of specific alarms by user defined parameters.
14. A separate log for system alerts (controller failures, network failures, etc.) shall be provided and available for review by the user.
15. An Error Log to record invalid property changes or commands shall be provided and available for review by the user.

F. Data Collection and Storage

1. The UNC shall have the ability to collect data for any property of any object and store this data for future use.
2. The data collection shall be performed by log objects, resident in the UNC that shall have, at a minimum, the following configurable properties:

    a. Designating the log as interval or deviation.
    b. For interval logs, the object shall be configured for time of day, day of week and the sample collection interval.
    c. For deviation logs, the object shall be configured for the deviation of a variable to a fixed value. This value, when reached, will initiate logging of the object.
    d. For all logs, provide the ability to set the maximum number of data stores for the log and to set whether the log will stop collecting when full, or rollover the data on a first-in, first-out basis.
    e. Each log shall have the ability to have its data cleared on a time-based event or by a user-defined event or action.

3. All log data shall be stored in a relational database in the UNC and the data shall be accessed from a server (if the system is so configured) or a standard Web Browser.
4. All log data, when accessed from a server, shall be capable of being manipulated using standard SQL statements.
5. All log data shall be available to the user in the following data formats:

    a. HTML
    b. XML
    c. Plain Text
    d. Comma or tab separated values

6. Systems that do not provide log data in HTML and XML formats at a minimum shall provide as an alternative Microsoft SQL Server®, Oracle 8i or Express®, Hyperion Solutions™ SQL Server.
7. The UNC shall have the ability to archive it's log data either locally (to itself), or remotely to a server or other UNC on the network. Provide the ability to configure the following archiving properties, at a minimum:

    a. Archive on time of day
    b. Archive on user-defined number of data stores in the log (buffer size)
    c. Archive when log has reached it's user-defined capacity of data stores
    d. Provide ability to clear logs once archived

G. Audit Log

1. Provide and maintain an Audit Log that tracks all activities performed on the UNC.
2. Provide the ability to specify a buffer size for the log and the ability to archive log based on time or when the log has reached it's user-defined buffer size.
3. Provide the ability to archive the log locally (to the UNC), to another UNC on the network, or to a server. For each log entry, provide the following data:

    a. Time and date
    b. User ID
    c. Change or activity: i.e., Change setpoint, add or delete objects, commands, etc.

H. Database Backup and Storage

1. The UNC shall have the ability to automatically backup its database. The database shall be backed up based on a user-defined time interval.
2. Copies of the current database and, at the most recently saved database shall be stored in the UNC. The age of the most recently saved database is dependent on the user-defined database save interval.
3. The UNC database shall be stored, at a minimum, in XML format to allow for user viewing and editing, if desired. Other formats are acceptable as well, as long as XML format is supported.

2.14 CUSTOM APPLICATION CONTROL UNITS (CAC)

A. Modular, comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control applications. CAC's shall be provided for Air Handling Units, Roof Top Units, Boiler Plant, Chiller Plant and other applications as shown on drawings and shall have published LonWorks™ application source code, device resource files and external interface definitions

B. Units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control including mathematical equations, boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, enthalpy calculation, counters, interlocks, ramps, drivers, schedules, calendars, OSS, compare, limit, curve fit, and alarms.

C. Stand-alone mode control functions operate regardless of network status.

D. Functions include the following:

1. Peer to peer primary network level communications supporting at least 200 LonMark™ Standard Network Variables (SNVTs) per CAC utilizing at least 100 different SNVT types as documented by the LonMark™ Interoperability Association to assure present and future compatibility with third party LonMark™ devices. The 200 LonMark™ SNVTs, minimum, must be configurable in any combination – all inputs or all outputs or any combination of input/outputs in any combination of the 100 different, minimum, SNVT types. The XIF SNVT order shall be definable, rather than random, to provide logical and effective LonMark™ network management. With the submittal package, contractor shall provide CAC performance data that specifies the exact maximum number of SNVTs available in any combination and a list of all available SNVT types including the LonMark™ Interoperability Association SNVT number.
2. Automatic communications loss detection to maintain normal control functionality regardless of available network communications.
3. Discrete/digital, analog, and pulse input/outputs.
4. Monitoring, controlling, or addressing data points.
5. Local energy management control strategies
6. Incorporate internal customizable safeties and limits to prevent third party LonMark™ tools from providing improper and unrealistic inputs to CAC 's.
7. Local operator interface port provides for download from and connection to portable workstation.

E. Communication: The Custom Application Controller shall communicate via the Primary Controller Network between BMS Controllers and other LonWorks™ devices. CAC's shall communicate with the Building Controller and ASC's at a baud rate of not less than 78.8K baud using LonTalk™ communications protocol (EIA 709.1).

2.15 ALL APPLICATION SPECIFIC CONTROL UNITS (ASC)

A. Single board construction comprising processor board with programmable, nonvolatile, RAM/EEPROM memory for custom control and unitary applications. ASC's shall be provided for Unit Ventilators, Fan Coils, Heat Pumps, VAV Terminal Boxes, Rooftop Units and other applications as shown on the drawings or indicated in the sequences of operation. To assure complete interoperability, all ASC's firmware shall support all mandatory and all optional LonMark™ Standard Network Variables (SNVTs) for their LonMark™ profile as documented by the LonMark™ Interoperability Association. Bidder shall provide proof of ASC compliance for all the mandatory and all optional LonMark™ SNVTs. ASC's shall be based on the Echelon Neuron 3150 microprocessor working with the ASCs stand alone control program.

B. Units monitor or control each input/output point; process information; and download from the operator station.

C. Stand-alone mode control functions operate regardless of network status.

D. Functions include the following:

1. Peer to peer primary network level communications with automatic communications loss detection to maintain normal control functionality regardless of available network communications.
2. Discrete/digital, analog, and pulse input/output.
3. Monitoring, controlling, or addressing data points.
4. Appropriate LonMark™ profiles for specific unitary applications.
5. Support for all mandatory and optional LonMark™ Standard Network Variable Types (SNVTs) for their LonMark™ profile as documented by the LonMark™ Interoperability Association
6. Internal customizable safeties and limits to prevent third party LonMark™ tools from providing improper and unrealistic inputs to ASC's.

E. Local operator interface port located on ASC and ASC sensor provides for download from or upload to portable workstation. All devices on the Lon bus shall be accessible from either port.

F. Communication: ASC's shall communicate with the Building Controller and CAC's at a baud rate of not less than 78.8K baud using LonTalk™ communications protocol (EIA 709.1).

G. ASC units monitor or control each input/output point; process information; and at least 50 expressions for customized HVAC control including mathematical equations, boolean logic, PID control loops with anti-windup, sequencers, timers, interlocks, thermostats, counters, interlocks, compare, limit, and alarms.

H. All ASC Controller setpoints shall be digital display setpoints with dual setpoint limits (integral hard limits which the user cannot exceed above and below and independent soft limits which are hidden from the user). All digital setpoints shall be network retentive after power outages and after replacement of sensor.

2.16 LOCAL AREA NETWORKS (LAN)

A. Capacity for a minimum of 64 client workstations connected to multiuser, multitasking environment with concurrent capability to access DDC network or control units.

B. Enterprise Network LAN

1. Media: Ethernet (IEEE 802.3), peer-to-peer CSMA/CD, operating at 10 or 100 Mbps, cable 10 Base-T, UTP-8 wire, category 5

C. Primary Controller Network LAN

1. Media: LonTalk™ (EIA 709.1), peer to peer, FTT-10 operating at 78.8K.

D. Secondary Network LAN (If Required)

1. Media: LonTalk™ (EIA 709.1), peer to peer, FTT-10 operating at 78.8K

E. Remote Connection

1. ISDN, ADSL, T1 or dial-up connection, monthly charges paid by building owner

2.17 SOFTWARE

A. Controller and System HVAC Applications

1. Update to latest version of software at Project completion. Include and implement the following capabilities from the control units if documented by the specified sequence of operations:

   a. Load Control Programs: Demand limiting, duty cycling, automatic time scheduling, start/stop time optimization, occupied/unoccupied setback/setup, DDC with PID, and trend logging.
   b. HVAC Control Programs: Optimal run time, supply-air reset, and enthalpy/economizer switchover.
   c. Chiller Control Programs: Chilled water plant optimization with condenser water reset, chilled-water reset, chiller and pump equipment selection and sequencing.
   d. Boiler Control Programs: Boiler plant optimization with hot water supply reset, boiler and pump equipment selection and sequencing.

2. Programming Application Features: Include trend point, alarm reporting, alarm lockout, weekly scheduling, staggered start, sequencing, anti-short cycling and calculated point.

B. Controller and Network Setup Software

1. Network management tools for LonTalk™ protocol and the ANSI/ASHRAE™ Standard 135-1995, BACnet protocol shall be provided including a network learn function, LonMark bindings, service pins, winks, and diagnostics.

2.18 INPUT / OUTPUT POINTS

A. Binary outputs shall provide a continuous low voltage signal for on/off control of remote devices. Where specified or indicated on the point list outputs shall have three position manual override switch (On/Off/Auto), a status light, and shall be selectable for either normally open or closed operation.

B. Analog Outputs shall provide a modulating signal for control of remote devices. Outputs shall provide either a 0 to 10 VDC or a 4 to 20 milliamp output signal as required to provide proper control for the output device. Floating control is not acceptable for modulating devices when

noted as an analog output (AO) in the points list or as proportional control in the sequence of operation. Floating control is acceptable only for VAV box actuator and reheat coil control valve control unless otherwise noted, but the graphics must display the valve and damper positions as a percentage.

C. Binary Inputs shall allow the monitoring of on/off signals from remote devices. The Binary Inputs shall be compatible with commonly available signaling devices. All status points shown on points list or mentioned in unit sequence of operation shall be positive proof binary switches, sensing the medium being controlled.

D. Analog Inputs shall allow the monitoring of variable, low voltage, current, or resistance signals and shall have a minimum of a 12-bit resolution. The analog Inputs shall be compatible with, and field configurable to, commonly available sensing devices.

E. All DO's and AO's shall be capable of being overridden through the BAS, either locally or remotely, by a user with the appropriate password protected privileges.

F. Refer to 23 09 93 Sequence of Operation for addition points of control and monitoring

2.19 CUSTOM GRAPHICS SCREENS

A. Custom graphics shall be created specifically for this project. Custom graphics shall be created by the manufacturer's local application engineer who is familiar with the hardware and software for this project. The manufacturer's local application engineer shall be certified for creating graphics. The manufacturer's application engineer shall meet with the owner to review sample and proposed graphics. After the meeting, custom graphics shall be created and submitted for review and comments.

B. Graphics shall include a floor plan of each floor listing every zone temperature setpoint and actual temperature reading in the building. Those zones out of temperature range shall be highlighted in a different color. The floor plan graphics shall be split into multiple zones for each floor as designated by the owner. Each floor may be broken down into multiple screens per wing to avoid overcrowding information on the screens.

C. Graphics shall include one master schedule listing every zone temperature setpoint and actual temperature reading in the building. Those zones out of temperature range shall be highlighted in a different color.

D. Graphics shall have a screen for each HVAC system including a graphic depicting the air handler with supply temperature and each VAV box with supply temperature served by that air handler. All shall be shown on one screen for troubleshooting.

E. Graphics shall be supplied for the overall building, each wing of the building, and each mechanical room as a minimum.

2.20 MISCELLANEOUS

A. Materials

1. All materials and equipment used shall be standard components, of regular manufacture for this application.
2. All systems and components shall have been thoroughly tested and proven in actual use.

B. Control Valves

1. General:

a. Control valves shall be two-way or three-way pattern as required by Sequence of Operation, refer to Specification Section 23 09 93, and shall be constructed for tight shutoff and shall operate satisfactorily against system pressures and differentials.
b. Control Isolation Valves and Control Two Position Valves shall be line size full port valves.
c. Valves with size up to and including 3" shall be screwed connections with 250 psi ANSI pressure body rating. Valves 4" and larger shall be flanged configuration.
d. Two-way control valves shall exhibit equal percentage characteristics. Non-equal percentage valve characteristics shall not be acceptable. Two-position control valves shall be line size and shall be provided with a 250 psi static pressure body rating.
e. Proportional control valves shall be sized for a maximum pressure drop of 4.0 psig at rated flow (except as noted).
f. Control valves on heating coils for air handling units that introduce outside air shall be spring return type, normally open on power failures and freeze conditions.
g. Globe valves are required for HRU and AHU heating and / or cooling applications.

2. Terminal Unit Control Valves:

a. Constructed of 360 psi forged yellow brass body, nickel plated brass ball, with optimizer insert for modulating applications, blow-out resistant stem, two- or three-port as indicated, and threaded ends for chilled or hot water, up to 50% glycol solutions.
b. Spring return is required for all Unit Ventilator heating valves and other terminal equipment that have an outside air source.
c. All non-spring return valves must have manual override ability built in to the actuator.
d. Rating: ANSI class IV, maximum static pressure of 360 psig, minimum fluid temperature of 20ºF and maximum of 250ºF operating conditions.
e. Sizing: 4 psig maximum pressure drop at design flow rate, rated to close against pump shutoff head.
f. Flow Characteristics: Two-way and three-way valves shall have equal percentage characteristics.

3. Actuators:

a. Actuators for AHU, VAV, HRU and FCU valves shall be the same as specified below for dampers and shall have the same warranty.
b. Hydraulic actuators are not acceptable for any application for this project.

4. Manufacturer:

a. Control valves shall be Belimo, Delta or Invensys electronic ball valves and Belimo or Invensys Globe valves for modulating applications. Belimo or Invensys Butterfly valves are acceptable for large flow applications, (ie. cooling tower, chiller).

C. Motorized Control Dampers

1. General:

a. Blades shall be 16 gauge minimum and 6 " wide maximum and frame shall be of welded channel iron. Dampers with both dimensions under 18" may have strap iron frames. Dampers over 48" wide shall be equipped with a jack shaft to provide sufficient force throughout the intended operating range.
b. Dampers shall be black enamel finish or galvanized, with nylon bearings.
c. Blade edge, tip and jamb seals shall be included for all dampers. Leakage through the damper shall not exceed 10 CFM per square foot at 4" w.g. (based on a 48" x 48" test sample).
d. Motorized dampers shall be parallel blade for two-position control and opposed blade for proportional control applications.
e. All motorized dampers throughout the project shall be provided and wired by the BAS contractor. Refer to the fan and mechanical schedules, drawings, and control specifications for quantity of motor operated dampers.

2. Damper Actuators

a. Electronic damper actuators shall be properly sized to provide sufficient torque to position the damper throughout its operating range. All actuators operating in series or parallel to another actuator or in an open loop, such as minimum percentage outside air, shall be equipped with a positive positioning device. Provide spring return type actuators on outside air (close), return air (open), and relief air (close) dampers.
b. Actuators for all dampers and AHU and VAV valves shall be manufactured by Invensys (Duradrive), Siemens (OpenAir) or Belimo. The manufacturer must include a five year warranty from the manufactured date for the actuator. In addition to the 1 year material and labor warranty, the manufacturer shall include a $50 satisfaction guarantee for each actuator to cover the labor cost for the replacement of an actuator if it fails or if the owner is not satisfied with the performance at any time during the 5 year warranty period.

3. Manufacturer:

a. Dampers shall be manufactured by Ruskin, Greenheck or Tamco.

D. Temperature Sensors/Transmitters

1. The temperature sensor shall be located as shown on the drawings. Provide a room sensor with digital readout of temperature with integral room setpoint adjustment. The room sensor shall contain a push-button for override of unoccupied conditions, up and down arrows to scroll through attributes, and enter key to make changes and a plug-in communications jack for connection of the portable editing device to the Lon bus.
2. The sensor display shall be capable of full programmability of the unit controller without the use of a portable editing device. The sensor shall be capable of showing the unit controller time and day of week. The display shall be capable of displaying setpoints & temperatures in either 1-degree increments or 0.1-degree increments and space temperature an accuracy of +/– ½ degrees. The sensor shall provide unoccupied override with cancel. The override time shall be user settable from 1 minute up to 7 days. For 1 minute to 16 hours the user shall be able to select any one minute interval.
3. The sensor shall provide password protection with user access codes and automatic time-out. The access levels of the sensor shall provide 3 levels of access within the system.
4. Sensors shall be RTD or Thermistor type, providing a linear OHM per degree F characteristic change, and shall be housed as required for the application.

5. Averaging sensors shall be used for supply air and mixed air applications and shall be a minimum of 22 feet long for locations greater than 16 square feet and a minimum of 5 feet long for locations less than 16 square feet.
6. Sensor ranges shall be selected as required for the application and all sensors shall be +/-1 deg. F.

E. Sensor/Thermostat Guards

1. Thermostats and room temperature sensors shall have exposed setpoint adjustment +/-3 degees on either side of setpoint established at the BAS. Guards are to be smoked-clear Lexan for all sensors/thermostats located in corridors and common areas. Guards shall be equal to Uni-Gard Inc model UG-2SC or UG-3SC. Provide one guard for all wall mounted sensors in a room.

PART 3 - EXECUTION

3.1 EXAMINATION

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

B. Examine products and material before installation. Reject products or materials that are wet, moisture damaged, or mold damaged.

C. Examine walls, floors, roofs, equipment for suitable conditions where controls will be installed.

D. Prepare written report, endorsed by Installer, listing conditions detrimental to performance.

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

3.2 CONTROL WIRING

A. Low Voltage Thermostats

1. Low voltage thermostats shall be furnished, installed and wired by the HVAC contractor.
2. The electrical contractor shall provide 4” square X 1-1/2” deep wall outlet boxes at 60” above finished floor (with single-gang rings) for all thermostats/sensors. The electrical contractor shall provide one ¾” empty conduit from each thermostat/sensor location, turned out above accessible ceilings (in joist space or against overhead slab/deck).
3. The HVAC/Temperature Control Contractor shall provide all other necessary conduit, raceway and wiring related work. Conduit shall be identified in ceiling cavity and shall be provided with sweep bends, bushings and drag line.
4. The HVAC/Temperature Control Contractor shall coordinate with the General Contractor to ensure thermal envelope is maintained at these locations.

B. Line Voltage Thermostats

1. The electrical contractor shall provide 4” square X 1-1/2” deep wall outlet boxes at 60” above finished floor (with single-gang rings) for all thermostats.
2. The electrical contractor shall provide line voltage power wiring, from thermostat outlet box to equipment that is to be controlled by the thermostat, in ¾” conduit.

3. Provide with a contactor to shut fans and close valve through the DDC system.

C. 120VAC BAS/Temperature Control Circuits

1. Temperature Control Contractor (TCC) shall provide all 120 Volt power wiring as required for temperature control panels and transformers to low voltage. TCC shall connect to existing spare at electrical panel board and provide proper circuit breaker per NEC and label panel board accordingly.
2. All other required 120VAC raceway and wiring related work shall be provided by the Temperature Controls Contractor.
3. The HVAC/Temperature Control Contractor shall coordinate with the General Contractor to ensure thermal envelope is maintained at these locations.

D. General Control Wiring Requirements and Installation Methods

1. Except where specifically indicated otherwise herein or within Division 23 specifications, the HVAC/Temperature Control Contractor shall provide all electrical work as required for all temperature control related wiring (i.e. conduit, raceway, outlet boxes, junction boxes, wiring, etc.) in accordance with Division 26 requirements. All conduit shall be 3/4" minimum.
2. Coordinate all thermostat/sensor locations in field (case by case) with Architect, Owner and Electrical Contractor to ensure that they are placed in locations that will not interfere with furniture, equipment, artwork, wall-hung specialties, room finishes, etc. All thermostat/sensor wall locations indicated on HVAC drawings are schematic only and must be verified case-by-case prior to rough-in.
3. All electrical work as described in this specification shall be per the latest edition of the National Electrical Code (NEC) and per applicable state and local codes. Refer to Division 26 specifications (including Sections 260519 and 260533) for required installation methods and follow Division 26 requirements as related to low voltage and communication technology system cables.
4. Where "free-air" installation methods (either exposed above the ceilings, in bridle rings or in cable trays) are permitted under Division 26 above ceilings, provide plenum-rated cables wherever plenum ceilings (if any) exist and install as defined under Division 26. Install low voltage circuits, located in concrete slabs and masonry walls, or exposed in occupied areas, in electrical conduit regardless of what wiring methods are permitted under Division 26.
5. Where cable trays or bridle rings are provided by the electrical contractor for low voltage cables, these raceways may be utilized for control wiring by this contractor (provide special color coded jackets, label cable jackets per Division 26 and group control wiring cables together). Provide conduit drops from cable tray/bridle ring paths to wall outlet boxes and equipment unless directed otherwise under Division 26.
6. Regardless of permitted methods in Division 26, all cables/wiring installed concealed by gypsum board, masonry or other inaccessible materials in walls or above ceilings shall be installed in conduit, ¾" minimum.
7. All conduit, bridle rings, raceway, outlet boxes, etc. necessary for complete operational installation of control wiring shall be provided (furnished and installed) by the temperature control contractor in strict compliance with Division 26 documents. Coordinate all work with all other applicable trades including the electrical contractor.
8. Provide all required conduit work to and between equipment in a manner compliant with that described above (i.e. between VAV boxes, to boilers, starters, condensing units, etc. as applicable).
9. Install control wiring without splices between terminal points, color-coded. Where a splice is required, install within junction box. Install in neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code and per Division 26.

10. Install circuits over 25 volt with color-coded No. 12 wire in electrical metallic tubing, per Division 26. Install circuits under 25 volt with color-coded No. 18 wire with 0.031" high temperature (105 degrees F) plastic insulation on each conductor and plastic sheath over all. Install electronic circuits with color-coded No. 22 wire with 0.023" polyethylene insulation on each conductor with plastic-jacketed copper shield over all.
11. All control cabling shall be labeled at both ends with descriptive information of control device.

3.3 OPERATING AMBIENTS

A. Electronic controls mounted in unconditioned space shall be rated for ambient operating conditions of –40 degree F to +140 degree F.

B. Controls not meeting these limits shall be mounted in an accessible location within conditioned space.

3.4 COMMISSIONING

A. Automatic Temperature Controls

1. Wiring and tubing shall be identified with the same numbers and symbols as used on the corrected, approved record diagrams.
2. Label control apparatus with nameplates or valve tags bearing the functional designations shown on approved control diagrams.

B. Operation and Maintenance Manuals

1. Submit 3 manuals each, in hardback 3-ring loose-leaf binder, covering details of operation and maintenance for the Facility Management and Fire Alarm System.
2. Submit manuals 1 month before systems start-up and commissioning.
3. General Contents

    a. Title page with project name, contractor's and subcontractors' names, addresses and telephone numbers.

4. Index Sheet

    a. Manufacturers' operating and maintenance manuals, including parts lists for each piece of equipment and accessories requiring service or maintenance, the warranty period, and the name, address, and telephone number of the nearest sales and service organization for each item.
    b. Complete description of functions and operation of each piece of equipment including descriptions of how equipment operates in conjunction with automatic control systems, and instruction for cleaning, lubrication, and maintenance.
    c. Descriptive information:

        1) Function or service.
        2) Classification.
        3) Design capability.
        4) Performance characteristics.
        5) Principal components.
        6) Distribution arrangement.

7) Schematic diagram.
8) Control diagram.

d. Equipment data:

1) Materials of construction.
2) Parts designation.
3) Manufacturer and model number.
4) Size and rating.
5) Pressure, speed, and temperature limitations.

e. Inspection and maintenance information:

1) Inspection schedule and checklist.
2) Schedules and procedures for lubrication, replacement, adjustment, cleaning, painting, protection and testing.
3) Standard forms for compiling inspection and maintenance records.
4) Inspection during operation.
5) Adjustment and regulation.
6) Operational test procedures.
7) Detection of malfunction.
8) Precautions.
9) Troubleshooting.

f. Step-by-step procedure for starting, stopping, an operating each system:

1) Starting and stopping procedures.
2) Adjustment and regulation.
3) Seasonal changeover.
4) Seasonal shut down.
5) Seasonal start-up.
6) Logs and records.

g. Copies of inspection certificates provided by the city, county, state and insurance companies.
h. Approved start and completion dates of the guarantee period.
i. Valve schedules and diagrams.

C. HVAC

1. Building Automation System

a. Control diagrams including electric and interlock wiring.
b. Final installed control software listings and flow charts. Listings shall include English comment lines documenting purpose of each group of executable statements and relationship to control sequence for ease of future troubleshooting and modification.
c. Record data base information.
d. Point identification and sensor characteristics.
e. As-built wiring diagrams.
f. Central station operator's manuals and software documentation.
g. Contents shall be type written.

D. Diagrams

1. Frame and mount the following information:

    a. Automatic temperature control diagrams adjacent to each control sequences panel.
    b. Appropriate control and interface drawings including a simplified guide to local programming of each Facility through the digital display unit, a directory of I/O points connected to that panel, and variables which may be displayed – posted on inside cover of management panel

2. Diagrams shall be typed written or computer generated.
3. Diagrams shall be as-built, and shall include interfaces and interlocks with other equipment.

E. Documentation

1. Submit the following certificates, statements, receipts, and reports as specified herein:
2. Record drawings.
3. Submittals.
4. Operation and maintenance manuals.
5. Certification of BAS calibration and testing.
6. Receipts for BAS training.
7. Receipt acknowledging no BAS failures during test period.

F. Record Drawings

1. Record drawings shall include the manufacture and model number of equipment indicated in schedules on the Drawings.
2. Reproductions of design drawings shall not be used in the preparation of record drawings.
3. All record drawing information (drawings and cut sheets) shall be furnished in an electronic format.

3.5 MAINTENANCE

A. Equipment operated prior to the date of substantial completion shall be maintained in accordance with manufacturer's recommendations.

3.6 EQUIPMENT START-UP AND CHECK-OUT

A. General

1. Verify readiness for start-up of each item of equipment on the basis of inspection.

B. Automatic Temperature Controls

1. The system manufacturer shall provide the services of control technicians at start-up to check-out the system, input data supplied by the Owner, and place the system in operation. Manufacture shall verify proper operation of each item in the sequences of operation, including hardware and software.
2. Check-out each system for control function through the entire sequence. Check actuator travel on dampers and valves for action and extent. Check calibration of instruments.
3. Verify that control dampers open and close completely.

4. Calculate and verify instrument setpoints.

C. BAS Acceptance Conditions

1. Calibration and testing: Calibrate equipment and verify operation before the system is placed on-line. Check each control point, within the system by making a comparison between the control command at the operator console and field-controlled device. BAS control loops, interlocks, sequences, energy management programs, and alarms shall be tested and stable operation verified. Control loop parameters and tuning constants shall be adjusted to produce accurate, stable control system operation. Before obtaining permission to schedule the acceptance test, provide written certification that the installed complete system has been calibrated, tested and is ready to begin acceptance testing.
2. Acceptance test: Conduct final acceptance test, with the Owner on site, on the complete and total installed and operational automation system to demonstrate that it is functioning in accordance with requirements specified herein. Demonstrate the correct operation of monitored and controlled points as well as the operation and capabilities of sequences, reports, specialized control algorithms, diagnostics, and software.
3. Final system acceptance will be based on the following items:

    a. Completion of the installation of hardware and software items. Demonstrate complete operation of the system, including hardware and software, with no failures during a 14 consecutive day period. Obtain receipt from the Owner acknowledging no failures within the test period. Submit a daily log documenting failures.
    b. Satisfactory completion of the record drawings, and operating and maintenance manuals.
    c. Satisfactory completion of training programs.

3.7 BACKUPS

A. At project closeout, this contractor shall turn over to the owner 2 sets of computerized backups of the complete temperature control system.

B. Additionally, this contractor shall store at its main office a backup of the system for a period of not less than 5 years.

C. Within the first year, any changes or modifications which are made to the software shall be backed up and two copies are to be distributed to the owner after each change.

3.8 ACCEPTANCE PROCEDURE

A. Upon completion of the calibration, contractor shall start-up the system and perform all necessary testing and run diagnostic tests to ensure proper operation.

B. Contractor shall be responsible for generating all software and entering all database necessary to perform the sequence of control and specified software routines.

C. An acceptance test in the presence of the Owner's representative or engineer shall be performed.

END OF SECTION 230900

SECTION 230993 - SEQUENCE OF OPERATIONS FOR HVAC CONTROLS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. The BUILDING AUTOMATION SYSTEM (BAS) Contractor shall be bound by the same Specification that the mechanical and electrical trades must follow.

1.2 SUMMARY

A. This Section includes extent of temperature controls work for HVAC systems, subsystems, and equipment in correlation with drawings and schedules.

B. Controls equipment and control panels to provide control sequences as outlined herein.

C. Coordinate control work with controls provided by Equipment Manufacturers.

D. Related Sections include the following:

1. Section 23 05 03 “Submittals for HVAC”.
2. Section 23 09 00 "Building Automation Systems”

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and performance data for control valves, control dampers, control devices, sensors.
2. Include rated capacities, operating characteristics, electrical characteristics (if applicable), and furnished specialties and accessories.

B. Shop drawings: Submit shop drawings for each system automatically controlled, containing the following information:

1. Schematic flow diagram of system showing fans, pumps, coils, boilers, chillers, dampers, valves, terminal units, and other control devices.
2. Label each control device with setting or adjustable range of control.
3. Indicate electric wiring; factory and field wiring.
4. Indicate each control panel required, with internal and external wiring clearly indicated. Provide detail of panel face, including controls, instruments, and labeling.

C. Control Sequences:

1. Provide written sequences of operation for each controlled system and piece of equipment. Sequences shall be written in Contractor’s own words and shall not be a repetition of the sequences contained herein.

1.4 QUALITY ASSURANCE

A. Installer Qualifications: An authorized representative who is trained and approved by manufacturer. Installer must be experienced in HVAC control system installations for not less than 5 years.

B. Pipe and Pressure-Vessel Welding Qualifications: Qualify procedures and operators according to ASME Boiler and Pressure Vessel Code.

C. Electrical Compliance: Provide electrical products which have been tested, listed and labeled by Underwriters' Laboratories (UL) and comply with NEMA standards.

1.5 WARRANTY

A. Manufacturer's Warranty: Manufacturer and Installer agree to repair or replace components of pneumatic control system that fail(s) in materials or workmanship within specified warranty period.

1. Warranty Period: one year(s) from date of Substantial Completion.

1.6 GENERAL CONTROL REQUIREMENTS AND SEQUENCES

A. BAS Contractor shall provide all 120 Volt power wiring as required for temperature control panels, damper actuators and valve actuators, and transformers as required to low voltage. BAS Contractor shall connect to existing spare at electrical panel board and provide proper circuit breaker per NEC and label panel board accordingly.

B. This contractor shall be familiar with and responsible for wiring of all auxiliary equipment (control and power wiring), and controllers required under the mechanical division 23.

C. These additional general requirements shall also apply.

1. All water coils exposed to outside air, shall have serpentined freeze stats. Freeze stats for hot water coils shall be located across the face of the coil, downstream of the heating coil (minimum of 1 for every 20 square feet of coil). Upon alarm, when unit is shutdown or when power outage occurs, outdoor air damper shall shut, heating valve shall open to normal position, fan shall stop. Provide time delay function for freeze stat. Provide hardwire interlocks.
2. All fresh air intakes and relief/exhaust ducts or louvers, gravity roof ventilators, etc. shall have motor operated dampers. Dampers shall be low leak with blade and edge seals.
3. All motor operated dampers shall be furnished and installed by the mechanical contractor, unless otherwise noted. All damper actuators shall be furnished and installed by the BAS Contractor, (unless damper and actuator are provided by equipment manufacturer). All damper actuators shall be wired by BAS Contractor. BAS Contractor shall provide all necessary transformers, contactors, controls and wiring for interlocking equipment to motor operated dampers. Provide end switches as necessary for proper sequencing of damper operation and energizing of fan motor.
4. All water balancing valves shall be automatic pressure independent balancing valves except where specified as manual balance valves. Where manual balance valves are specified for 3 way coil configurations, a manual balance valve shall be provided in the bypass of the 3 way valve piping configuration.

5. Control Isolation Valves and Control Two Position Valves shall be line size full port valves.
6. Three-point floating control valves/actuators are not acceptable for modulating control valve applications.
7. All Programmable Thermostats shall be programmed at startup based on a time of day schedule from the owner. The owner shall be trained on the how to change the setpoints and time of day of the programmable thermostat.
8. All control setpoints shall be graphics on the BAS computer and adjustable thru the BAS. Initial setpoints may be given in this section, but shall be adjusted in the field per actual field conditions or per the owner's recommendations. Abbreviations for the control point type are listed in the key below.

    a. Key

        1) AI: Analog Input
        2) AO: Analog Output
        3) DI: Digital Input
        4) DO: Digital Output
        5) LL: Low Limit Alarm
        6) HL: High Limit Alarm
        7) GA: General Alarm

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 FANCOILS

A. See Drawings for Controls Schematic

3.2 UNIT HEATERS

A. See Drawings for Controls Schematic

3.3 CONTROL WIRING

A. Low Voltage Thermostats

1. Low voltage thermostats shall be furnished, installed and wired by the HVAC contractor.
2. The electrical contractor shall provide 4" square X 1-1/2" deep wall outlet boxes (with single-gang rings) for all thermostats/sensors. The electrical contractor shall provide one ¾" empty conduit from each thermostat/sensor location, turned out above accessible ceilings (in joist space or against overhead slab/deck).
3. The HVAC/Temperature Control Contractor shall provide all other necessary conduit, raceway and wiring related work. Conduit shall be identified in ceiling cavity and shall be provided with sweep bends, bushings and drag line.
4. The HVAC/Temperature Control Contractor shall coordinate with the General Contractor to ensure thermal envelope is maintained at these locations.

B. Line Voltage Thermostats

1. The electrical contractor shall provide 4" square X 1-1/2" deep wall outlet boxes (with single-gang rings) for all thermostats.
2. The electrical contractor shall provide line voltage power wiring, from thermostat outlet box to equipment that is to be controlled by the thermostat, in ¾" conduit.
3. Provide with a contactor to shut fans and close valve through the DDC system.

C. 120VAC BAS/Temperature Control Circuits

1. Temperature Control Contractor (TCC) shall provide all 120 Volt power wiring as required for temperature control panels and transformers to low voltage. TCC shall connect to existing spare at electrical panel board and provide proper circuit breaker per NEC and label panel board accordingly.
2. All other required 120VAC raceway and wiring related work shall be provided by the Temperature Controls Contractor.
3. The HVAC/Temperature Control Contractor shall coordinate with the General Contractor to ensure thermal envelope is maintained at these locations.

D. General Control Wiring Requirements and Installation Methods

1. Except where specifically indicated otherwise herein or within Division 23 specifications, the HVAC/Temperature Control Contractor shall provide all electrical work as required for all temperature control related wiring (i.e. conduit, raceway, outlet boxes, junction boxes, wiring, etc.) in accordance with Division 26 requirements. All conduit shall be 3/4" minimum.
2. Coordinate all thermostat/sensor locations in field (case by case) with Architect, Owner and Electrical Contractor to ensure that they are placed in locations that will not interfere with furniture, equipment, artwork, wall-hung specialties, room finishes, etc. All thermostat/sensor wall locations indicated on HVAC drawings are schematic only and must be verified case-by-case prior to rough-in.
3. All electrical work as described in this specification shall be per the latest edition of the National Electrical Code (NEC) and per applicable state and local codes. Refer to Division 26 specifications for required installation methods and follow Division 26 requirements as related to low voltage and communication technology system cables.
4. Where "free-air" installation methods (either exposed above the ceilings, in bridle rings or in cable trays) are permitted under Division 26 above ceilings, provide plenum-rated cables wherever plenum ceilings (if any) exist and install as defined under Division 26. Install low voltage circuits, located in concrete slabs and masonry walls, or exposed in occupied areas, in electrical conduit regardless of what wiring methods are permitted under Division 26.
5. Where cable trays or bridle rings are provided by the electrical contractor for low voltage cables, these raceways may be utilized for control wiring by this contractor (provide special color coded jackets, label cable jackets per Division 26 and group control wiring cables together). Provide conduit drops from cable tray/bridle ring paths to wall outlet boxes and equipment unless directed otherwise under Division 26.
6. Regardless of permitted methods in Division 26, all cables/wiring installed concealed by gypsum board, masonry or other inaccessible materials in walls or above ceilings shall be installed in conduit, ¾" minimum.
7. All conduit, bridle rings, raceway, outlet boxes, etc. necessary for complete operational installation of control wiring shall be provided (furnished and installed) by the temperature control contractor in strict compliance with Division 26 documents. Coordinate all work with all other applicable trades including the electrical contractor.

8. Provide all required conduit work to and between equipment in a manner compliant with that described above (i.e. between VAV boxes, to boilers, starters, condensing units, etc. as applicable).
9. Install control wiring without splices between terminal points, color-coded. Where a splice is required, install within junction box. Install in neat workmanlike manner, securely fastened. Install in accordance with National Electrical Code and per Division 26.
10. Install circuits over 25 volt with color-coded No. 12 wire in electrical metallic tubing, per Division 26. Install circuits under 25 volt with color-coded No. 18 wire with 0.031" high temperature (105 degrees F) plastic insulation on each conductor and plastic sheath over all. Install electronic circuits with color-coded No. 22 wire with 0.023" polyethylene insulation on each conductor with plastic-jacketed copper shield over all.
11. All control cabling shall be labeled at both ends with descriptive information of control device.

END OF SECTION 230993

SECTION 232113.23 - ABOVEGROUND HYDRONIC PIPING AND SPECIALTIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes pipe and fitting materials, joining methods, special-duty valves, and specialties for the following:

1. Dual-temperature heating and cooling water piping
2. Condensate-drain piping
3. Air Control Devices
4. Hydronic Piping Accessories

B. Related Sections include the following:

1. Section 23 05 03 “Submittals for HVAC”.

1.3 DEFINITIONS

A. PTFE: Polytetrafluoroethylene.

B. RTRF: Reinforced thermosetting resin (fiberglass) fittings.

C. RTRP: Reinforced thermosetting resin (fiberglass) pipe.

1.4 PERFORMANCE REQUIREMENTS

A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature:

1. Dual-Temperature Heating and Cooling Water Piping: 100 psig at 200 deg F.
2. Condensate-Drain Piping: 150 deg F.
3. Blowdown-Drain Piping: 200 deg F.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of the following:

1. Valves. Include flow and pressure drop curves based on manufacturer's testing for calibrated-orifice balancing valves and automatic flow-control valves.
2. Air control devices.
3. Chemical treatment.

4. Hydronic specialties.

B. Shop Drawings: Detail, at 1/4 scale, the piping layout, fabrication of pipe anchors, hangers, supports for multiple pipes, alignment guides, expansion joints and loops, and attachments of the same to the building structure. Detail location of anchors, alignment guides, and expansion joints and loops.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer.

B. Welding certificates.

C. Field quality-control test reports.

1.7 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air control devices, hydronic specialties, and special-duty valves to include in emergency, operation, and maintenance manuals.

1.8 MAINTENANCE MATERIAL SUBMITTALS

A. Differential Pressure Meter: For each type of balancing valve and automatic flow control valve, include flowmeter, probes, hoses, flow charts, and carrying case.

1.9 QUALITY ASSURANCE

A. Installer Qualifications:

B. Steel Support Welding: Qualify processes and operators according to AWS D1.1/D1.1M, "Structural Welding Code - Steel."

C. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX.

1. Comply with provisions in ASME B31 Series, "Code for Pressure Piping."
2. Certify that each welder has passed AWS qualification tests for welding processes involved and that certification is current.

D. ASME Compliance: Comply with ASME B31.9, "Building Services Piping," for materials, products, and installation. Safety valves and pressure vessels shall bear the appropriate ASME label. Fabricate and stamp air separators and expansion tanks to comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1.

PART 2 - PRODUCTS

2.1 COPPER TUBE AND FITTINGS

A. Drawn-Temper Copper Tubing: ASTM B 88, Type L.

B. Wrought-Copper Fittings: ASME B16.22.

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

a. Tour and Andersson
b. Armstrong
c. Bell & Gosset ITT; Fluid Handling Div.
d. Flow Design Inc.
e. Spirax Sarco
f. Taco, Inc
g. Watts
h. Nexus
i. HCi
j. Griswold controls

C. Copper, Mechanically Formed Tee Option: For forming T-branch on copper water tube.

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

a. Tour and Andersson
b. Armstrong
c. Bell & Gosset ITT; Fluid Handling Div.
d. Flow Design Inc.
e. Spirax Sarco
f. Taco, Inc
g. Watts
h. Nexus
i. HCi
j. Griswold controls

D. Wrought-Copper Unions: ASME B16.22. Streamlined pattern

2.2 STEEL PIPE AND FITTINGS

A. Steel Pipe: ASTM A 53/A 53M, black steel with plain ends; type, grade, and wall thickness as indicated in Part 3 "Piping Applications" Article.

B. Malleable-Iron Threaded Fittings: ASME B16.3, Classes 150 and 300 as indicated in Part 3 "Piping Applications" Article.

C. Malleable-Iron Unions: ASME B16.39; Classes 150, 250, and 300 as indicated in Part 3 "Piping Applications" Article.

D. Wrought-Steel Fittings: ASTM A 234/A 234M, wall thickness to match adjoining pipe.

E. Wrought Cast- and Forged-Steel Flanges and Flanged Fittings: ASME B16.5, including bolts, nuts, and gaskets of the following material group, end connections, and facings:

1. Material Group: 1.1.

2. End Connections: Butt welding.
3. Facings: Raised face.
4. Bolts and nuts: ASME B18.2.1, cadmium-plated steel

F. Steel Pipe Nipples: ASTM A 733, made of same materials and wall thicknesses as pipe in which they are installed.

2.3 JOINING MATERIALS

A. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.

1. ASME B16.21, nonmetallic, flat, asbestos free, 1/8-inch maximum thickness unless thickness or specific material is indicated.

a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.

B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

C. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.

D. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.

E. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for joining copper with copper; or BAg-1, silver alloy for joining copper with bronze or steel.

F. Welding Filler Metals: Comply with AWS D10.12/D10.12M for welding materials appropriate for wall thickness and chemical analysis of steel pipe being welded.

2.4 DIELECTRIC FITTINGS

A. General Requirements: Assembly of copper alloy and ferrous materials with separating nonconductive insulating material. Include end connections compatible with pipes to be joined.

B. Dielectric Unions:

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

a. Capitol Manufacturing Company.
b. B & K Industries, Inc.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Perfection Corp.
f. Rockford-Eclipse Div.

2. Description:

a. Standard: ASSE 1079.
b. Pressure Rating: 125 psig minimum at 180 deg F.

c. End Connections: Solder-joint copper alloy and threaded ferrous.

C. Dielectric Flanges:

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

a. Capitol Manufacturing Company.
b. B & K Industries, Inc.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Perfection Corp.
f. Rockford-Eclipse Div.

2. Description:

a. Standard: ASSE 1079.
b. Factory-fabricated, bolted, companion-flange assembly.
c. Pressure Rating: 125 psig minimum at 180 deg F.
d. End Connections: Solder-joint copper alloy and threaded ferrous; threaded solder-joint copper alloy and threaded ferrous.

D. Dielectric-Flange Insulating Kits:

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

a. Capitol Manufacturing Company.
b. B & K Industries, Inc.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Perfection Corp.
f. Rockford-Eclipse Div.

2. Description:

a. Nonconducting materials for field assembly of companion flanges.
b. Pressure Rating: 150 psig.
c. Gasket: Neoprene or phenolic.
d. Bolt Sleeves: Phenolic or polyethylene.
e. Washers: Phenolic with steel backing washers.

E. Dielectric Nipples:

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

a. Capitol Manufacturing Company.
b. B & K Industries, Inc.
c. Eclipse, Inc.
d. Epco Sales, Inc.
e. Perfection Corp.
f. Rockford-Eclipse Div.

2. Description:

a. Standard: IAPMO PS 66
b. Electroplated steel nipple. complying with ASTM F 1545.
c. Pressure Rating: 300 psig at 225 deg F.
d. End Connections: Male threaded.
e. Lining: Inert and noncorrosive, propylene.

2.5 VALVES

A. Globe, Check, Ball, and Butterfly Valves: Comply with requirements specified in Section 23 05 23 "General-Duty Valves for HVAC Piping."

B. Automatic Temperature-Control Valves, Actuators, and Sensors: Comply with requirements specified in Section 23 09 00 "Instrumentation and Control for HVAC."

C. Bronze, Calibrated-Orifice, Balancing Valves:

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

a. Tour and Andersson
b. Armstrong
c. Bell & Gosset ITT; Fluid Handling Div.
d. Flow Design Inc.
e. Spirax Sarco
f. Taco, Inc
g. Watts
h. Nexus
i. HCi
j. Griswold controls

2. Body: Bronze, ball or plug type with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Plug: Resin.
5. Seat: PTFE.
6. End Connections: Threaded or socket.
7. Pressure Gage Connections: Integral seals for portable differential pressure meter.
8. Handle Style: Lever, with memory stop to retain set position.
9. CWP Rating: Minimum 125 psig.
10. Maximum Operating Temperature: 250 deg F.

D. Cast-Iron or Steel, Calibrated-Orifice, Balancing Valves:

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

a. Tour and Andersson
b. Armstrong
c. Bell & Gosset ITT; Fluid Handling Div.
d. Flow Design Inc.
e. Spirax Sarco
f. Taco, Inc

g. Watts
h. Nexus
i. HCi
j. Griswold controls

2. Body: Cast-iron or steel body, ball, plug, or globe pattern with calibrated orifice or venturi.
3. Ball: Brass or stainless steel.
4. Stem Seals: EPDM O-rings.
5. Disc: Glass and carbon-filled PTFE.
6. Seat: PTFE.
7. End Connections: Flanged.
8. Pressure Gage Connections: Integral seals for portable differential pressure meter.
9. Handle Style: Lever, with memory stop to retain set position.
10. CWP Rating: Minimum 125 psig.
11. Maximum Operating Temperature: 250 deg F.

E. Diaphragm-Operated, Pressure-Reducing Valves:

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

a. Tour and Andersson
b. Armstrong
c. Bell & Gosset ITT; Fluid Handling Div.
d. Flow Design Inc.
e. Spirax Sarco
f. Taco, Inc
g. Watts
h. Nexus
i. HCi
j. Griswold controls

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Low inlet-pressure check valve.
8. Inlet Strainer: removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

F. Diaphragm-Operated Safety Valves:

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

a. Tour and Andersson
b. Armstrong
c. Bell & Gosset ITT; Fluid Handling Div.
d. Flow Design Inc.
e. Spirax Sarco

f. Taco, Inc
g. Watts
h. Nexus
i. HCi
j. Griswold controls

2. Body: Bronze or brass.
3. Disc: Glass and carbon-filled PTFE.
4. Seat: Brass.
5. Stem Seals: EPDM O-rings.
6. Diaphragm: EPT.
7. Wetted, Internal Work Parts: Brass and rubber.
8. Inlet Strainer: removable without system shutdown.
9. Valve Seat and Stem: Noncorrosive.
10. Valve Size, Capacity, and Operating Pressure: Comply with ASME Boiler and Pressure Vessel Code: Section IV, and selected to suit system in which installed, with operating pressure and capacity factory set and field adjustable.

G. Automatic Flow-Control Valves:

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

a. Tour and Andersson
b. Armstrong
c. Bell & Gosset ITT; Fluid Handling Div.
d. Flow Design Inc.
e. Spirax Sarco
f. Taco, Inc
g. Watts
h. Nexus
i. HCi
j. Griswold controls

2. Body: Brass or ferrous metal.
3. Piston and Spring Assembly: Stainless steel, tamper proof, self cleaning, and removable.
4. Combination Assemblies: Include bonze or brass-alloy ball valve.
5. Identification Tag: Marked with zone identification, valve number, and flow rate.
6. Size: Same as pipe in which installed.
7. Performance: Maintain constant flow, plus or minus 5 percent over system pressure fluctuations.
8. Minimum CWP Rating: 175 psig.
9. Maximum Operating Temperature: 250 deg F.

2.6 AIR CONTROL DEVICES

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

a. Tour and Andersson
b. Armstrong
c. Bell & Gosset ITT; Fluid Handling Div.
d. Flow Design Inc.

e. Spirax Sarco
f. Taco, Inc
g. Watts
h. Nexus
i. HCi
j. Griswold controls

B. Manual Air Vents:

1. Body: Bronze.
2. Internal Parts: Nonferrous.
3. Operator: Screwdriver or thumbscrew.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/8.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 225 deg F.

C. Automatic Air Vents:

1. Body: Bronze or cast iron.
2. Internal Parts: Nonferrous.
3. Operator: Noncorrosive metal float.
4. Inlet Connection: NPS 1/2.
5. Discharge Connection: NPS 1/4.
6. CWP Rating: 150 psig.
7. Maximum Operating Temperature: 240 deg F.

2.7 HYDRONIC PIPING SPECIALTIES

A. Y-Pattern Strainers:

1. Body: ASTM A 126, Class B, cast iron with bolted cover and bottom drain connection.
2. End Connections: Threaded ends for NPS 2 and smaller; flanged ends for NPS 2-1/2 and larger.
3. Strainer Screen: -mesh startup strainer, and perforated stainless-steel basket with 50 percent free area.
4. CWP Rating: 125 psig.

PART 3 - EXECUTION

3.1 RENOVATIONS

A. Drain System: For all existing piping systems, isolate system wherever possible and drain piping to accommodate new piping connections to existing piping systems. Where no isolation valves are installed, drain system down to hydronic equipment. Install new isolation valves at riser with drain valve for future isolation.

B. Fill System: Fill system at new piping connections and bleed air. Install new vents as required. Flush and clean new piping and replace strainers.

3.2 PIPING APPLICATIONS

A. Dual-temperature heating and cooling water piping, aboveground, 2" and smaller shall be any of the following:

1. Type L, drawn-temper copper tubing, wrought-copper fittings, and soldered joints.
2. Schedule 40 steel pipe; Class 150, malleable-iron fittings; cast-iron flanges and flange fittings; and threaded joints.

B. Dual-temperature heating and cooling water piping, aboveground, 2-1/2" and larger shall be the following:

1. Schedule 40 steel pipe, wrought-steel fittings and wrought-cast or forged-steel flanges and flange fittings, and welded and flanged joints.

C. Dual-temperature heating and cooling water piping installed belowground and within slabs shall be the following pre-insulated underground piping equal to Ric-Wil pre-insulated piping:

1. Type L, annealed-temper copper tubing, wrought-copper fittings, and soldered joints. Use the fewest possible joints.

D. Condensate-Drain Piping: Type M, drawn-temper copper tubing, wrought-copper fittings, and soldered joints

3.3 VALVE APPLICATIONS

A. Install shutoff-duty valves at each branch connection to supply mains, and at supply connection to each piece of equipment.

B. Install throttling-duty valves at each branch connection to return main.

C. Install calibrated-orifice, balancing valves in the return pipe of each heating or cooling terminal.

D. Install check valves at each pump discharge and elsewhere as required to control flow direction.

E. Install safety valves at hot-water generators and elsewhere as required by ASME Boiler and Pressure Vessel Code. Install drip-pan elbow on safety-valve outlet and pipe without valves to the outdoors; and pipe drain to nearest floor drain or as indicated on Drawings. Comply with ASME Boiler and Pressure Vessel Code: Section VIII, Division 1, for installation requirements.

F. Install pressure-reducing valves at makeup-water connection to regulate system fill pressure.

3.4 PIPING INSTALLATIONS

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicate piping locations and arrangements if such were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.

B. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.

D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.

E. Install piping to permit valve servicing.

F. Install piping at indicated slopes.

G. Install piping free of sags and bends.

H. Install fittings for changes in direction and branch connections.

I. Install piping to allow application of insulation.

J. Select system components with pressure rating equal to or greater than system operating pressure.

K. Install groups of pipes parallel to each other, spaced to permit applying insulation and servicing of valves.

L. Install drains, consisting of a tee fitting, NPS 3/4 ball valve, and short NPS 3/4 threaded nipple with cap, at low points in piping system mains and elsewhere as required for system drainage.

M. Install piping at a uniform grade of 0.2 percent upward in direction of flow.

N. Reduce pipe sizes using eccentric reducer fitting installed with level side up.

O. Install branch connections to mains using mechanically formed tee fittings in main pipe, with the branch connected to the bottom of the main pipe. For up-feed risers, connect the branch to the top of the main pipe.

P. Install valves according to Section 23 05 23 "General-Duty Valves for HVAC Piping."

Q. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.

R. Install flanges in piping, NPS 2-1/2 and larger, at final connections of equipment and elsewhere as indicated.

S. Install strainers on inlet side of each control valve, pressure-reducing valve, solenoid valve, in-line pump, and elsewhere as indicated. Install NPS 3/4 nipple and ball valve in blowdown connection of strainers NPS 2 and larger. Match size of strainer blowoff connection for strainers smaller than NPS 2.

T. Install expansion loops, expansion joints, anchors, and pipe alignment guides as specified in Section 23 05 16 "Expansion Fittings and Loops for HVAC Piping."

U. Identify piping as specified in Section 23 05 53 "Identification for HVAC Piping and Equipment."

V. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

W. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeve seals specified in Section 23 05 17 "Sleeves and Sleeve Seals for HVAC Piping."

X. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Section 23 05 18 "Escutcheons for HVAC Piping."

3.5 HANGERS AND SUPPORTS

A. Hanger, support, and anchor devices are specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment." Comply with the following requirements for maximum spacing of supports.

B. Install the following pipe attachments:

1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
2. Adjustable roller hangers and spring hangers for individual horizontal piping 20 feet or longer.
3. Pipe Roller: MSS SP-58, Type 44 for multiple horizontal piping 20 feet or longer, supported on a trapeze.
4. Spring hangers to support vertical runs.
5. Provide copper-clad hangers and supports for hangers and supports in direct contact with copper pipe.

C. Install hangers for piping per section “23 05 29 – Hangers and Supports for HVAC Piping and Equipment”

D. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.6 PIPE JOINT CONSTRUCTION

A. Ream ends of pipes and tubes and remove burrs. Bevel plain ends of steel pipe.

B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.

C. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.

D. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.

E. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:

1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
2. Damaged Threads: Do not use pipe or pipe fittings with threads that are corroded or damaged. Do not use pipe sections that have cracked or open welds.

F. Welded Joints: Construct joints according to AWS D10.12/D10.12M, using qualified processes and welding operators according to Part 1 "Quality Assurance" Article.

G. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.7 HYDRONIC SPECIALTIES INSTALLATION

A. Install manual air vents at high points in piping, at heat-transfer coils, and elsewhere as required for system air venting.

B. Install automatic air vents at high points of system piping in mechanical equipment rooms only. Manual vents at heat-transfer coils and elsewhere as required for air venting.

3.8 TERMINAL EQUIPMENT CONNECTIONS

A. Sizes for supply and return piping connections shall be the same as or larger than equipment connections.

B. Install control valves in accessible locations close to connected equipment.

C. Install bypass piping with globe valve around control valve. If parallel control valves are installed, only one bypass is required.

D. Install ports for pressure gages and thermometers at coil inlet and outlet connections according to Section 23 05 19 "Meters and Gages for HVAC Piping."

3.9 FIELD QUALITY CONTROL

A. Prepare hydronic piping according to ASME B31.9 and as follows:

1. Leave joints, including welds, uninsulated and exposed for examination during test.
2. Provide temporary restraints for expansion joints that cannot sustain reactions due to test pressure. If temporary restraints are impractical, isolate expansion joints from testing.
3. Prior to flushing piping system:

    a. Provide temporary strainers
    b. Bypass heat exchangers, chillers, cooling towers, pumps, coils, etc… to prevent debris from being caught causing damage and avoid contamination.

4. Flush system with clean water and blowdown each valve/strainer until they no longer accumulate debris. This may be a multi-day process and should be verified and schedule with the owner. Replace strainers.
5. Isolate equipment from piping. If a valve is used to isolate equipment, its closure shall be capable of sealing against test pressure without damage to valve. Install blinds in flanged joints to isolate equipment.
6. Install safety valve, set at a pressure no more than one-third higher than test pressure, to protect against damage by expanding liquid or other source of overpressure during test.

B. Perform the following tests on hydronic piping:

1. Use ambient temperature water as a testing medium unless there is risk of damage due to freezing. Another liquid that is safe for workers and compatible with piping may be used.
2. While filling system, use vents installed at high points of system to release air. Use drains installed at low points for complete draining of test liquid.
3. Isolate expansion tanks and determine that hydronic system is full of water.
4. Subject piping system to hydrostatic test pressure that is not less than 1.5 times the system's working pressure. Test pressure shall not exceed maximum pressure for any vessel, pump, valve, or other component in system under test. Verify that stress due to pressure at bottom of vertical runs does not exceed 90 percent of specified minimum yield strength or 1.7 times "SE" value in Appendix A in ASME B31.9, "Building Services Piping."
5. After hydrostatic test pressure has been applied for at least 10 minutes, examine piping, joints, and connections for leakage. Eliminate leaks by tightening, repairing, or replacing components, and repeat hydrostatic test until there are no leaks.
6. Prepare written report of testing.

C. Perform the following before operating the system:

1. Open manual valves fully.
2. Inspect pumps for proper rotation.
3. Set makeup pressure-reducing valves for required system pressure.
4. Inspect air vents at high points of system and determine if all are installed and operating freely (automatic type), or bleed air completely (manual type).
5. Set temperature controls so all coils are calling for full flow.
6. Inspect and set operating temperatures of hydronic equipment, such as boilers, chillers, cooling towers, to specified values.
7. Verify lubrication of motors and bearings.

END OF SECTION 232113.23

SECTION 233113 - METAL DUCTS

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. Single-wall rectangular ducts and fittings.
2. Single-wall round and flat-oval ducts and fittings.
3. Sheet metal materials.
4. Sealants and gaskets.
5. Hangers and supports.

B. Related Sections:

1. Section 23 05 03 “Submittals for HVAC”.
2. Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.

1.3 PERFORMANCE REQUIREMENTS

A. Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of the following products:

1. Liners and adhesives.
2. Sealants and gaskets.

B. Shop Drawings:

1. Fabrication, assembly, and installation, including plans, elevations, sections, components, and attachments to other work.
2. Factory- and shop-fabricated ducts and fittings.
3. Duct layout indicating sizes, configuration, liner material, and static-pressure classes.
4. Elevation of top of ducts.
5. Dimensions of main duct runs from building grid lines.
6. Fittings.
7. Reinforcement and spacing.

8. Seam and joint construction.
9. Penetrations through fire-rated and other partitions.
10. Equipment installation based on equipment being used on Project.
11. Locations for duct accessories, including dampers, turning vanes, and access doors and panels.
12. Hangers and supports, including methods for duct and building attachment and vibration isolation.

C. Ductwork Submittal:

1. Sheet metal thicknesses.
2. Joint and seam construction and sealing.
3. Reinforcement details and spacing.
4. Materials, fabrication, assembly, and spacing of hangers and supports.
5. Design Calculations: Calculations for selecting hangers and supports.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and co-ordinated with each other, using input from installers of the items involved:

1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
2. Suspended ceiling components.
3. Structural members to which duct will be attached.
4. Size and location of initial access modules for acoustical tile.
5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.

B. Field quality-control reports.

1.6 QUALITY ASSURANCE

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

PART 2 - PRODUCTS

2.1 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.

B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.2 SINGLE-WALL ROUND AND FLAT-OVAL DUCTS AND FITTINGS

A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 3, "Round, Oval, and Flexible Duct," based on indicated static-pressure class unless otherwise indicated.

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

    a. McGill AirFlow LLC.
    b. Sheet Metal Connectors, Inc.
    c. Dixie Sheetmetal
    d. Eastern Sheetmetal of Cincinnati
    e. J and I Services
    f. Lindab
    g. Semco Mfg., Inc.
    h. Regional Sheetmetal Manufacturing
    i. Tangent Air
    j. Hranec
    k. S.H.A.P.E. Manufacturing, Inc.

B. Flat-Oval Ducts: Indicated dimensions are the duct width (major dimension) and diameter of the round sides connecting the flat portions of the duct (minor dimension).

C. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Transverse Joints in Ducts Larger Than 60 Inches in Diameter: Flanged.

D. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-2, "Round Duct Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support inter-

vals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

1. Fabricate round ducts larger than 90 inches in diameter with butt-welded longitudinal seams.
2. Fabricate flat-oval ducts larger than 72 inches in width (major dimension) with butt-welded longitudinal seams.

E. Tees and Laterals: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

F. Fabricated ductwork shall comply with AMCA Standard 511 for air leakage.

2.3 SHEET METAL MATERIALS

A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Finishes for Surfaces Exposed to View: Mill phosphatized.

C. Exposed Ductwork Materials: Where ductwork is indicated to be exposed to view in occupied spaces, provide materials which are free from visual imperfections including pitting, seam marks, roller marks, stains and discolorations, and other imperfections, including those which would impair painting. Exposed ductwork which is to be painted shall have paint grip applied.

D. Exposed Ductwork: Provide paint grip on all exposed ductwork that is required to be painted. Refer to architectural drawings for areas where duct is to be painted. Coordinate with all trades prior to installing paint grip.

E. Reinforcement Shapes and Plates: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

1. Where black- and galvanized-steel shapes and plates are used to reinforce aluminum ducts, isolate the different metals with butyl rubber, neoprene, or EPDM gasket materials.

F. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.4 SEALANT AND GASKETS

A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.

B. Two-Part Tape Sealing System:

1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form hard, durable, airtight seal.
2. Tape Width: 3 inches.
3. Sealant: Modified styrene acrylic.
4. Water resistant.
5. Mold and mildew resistant.
6. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
7. Service: Indoor and outdoor.
8. Service Temperature: Minus 40 to plus 200 deg F.
9. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum.

C. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. Base: Synthetic rubber resin.
3. Solvent: Toluene and heptane.
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. Maximum Static-Pressure Class: 10-inch wg, positive or negative.
9. Service: Indoor or outdoor.
10. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

D. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.
3. Grade: NS.
4. Class: 25.
5. Use: O.
6. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.

E. Round Duct Joint O-Ring Seals:

1. Seal shall provide maximum 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for10-inch wg static-pressure class, positive or negative.
2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.

2.5 HANGERS AND SUPPORTS

A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.

B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.

C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."

D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.

E. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.

F. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

G. Trapeze and Riser Supports:

1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates.

PART 3 - EXECUTION

3.1 DUCT INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.

B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.

C. Install round ducts in maximum practical lengths.

D. Install ducts with fewest possible joints.

E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.

F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.

G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.

H. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.

I. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

J. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.

K. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 33 00 "Air Duct Accessories" for fire and smoke dampers.

L. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.

B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead. Do not use two-part tape sealing system.

C. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.

D. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.

E. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCT SEALING

A. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":

1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
2. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
3. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class A.
4. Unconditioned Space, Exhaust Ducts: Seal Class C.
5. Unconditioned Space, Return-Air Ducts: Seal Class B.
6. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
7. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
8. Conditioned Space, Exhaust Ducts: Seal Class B.
9. Conditioned Space, Return-Air Ducts: Seal Class C.

3.4 HANGER AND SUPPORT INSTALLATION

A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."

B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.

1. Where practical, install concrete inserts before placing concrete.
2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.

C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.

D. Hangers Exposed to View: Threaded rod and angle or channel supports.

E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.

F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.

3.5 CONNECTIONS

A. Make connections to equipment with flexible connectors complying with Section 23 33 00 "Air Duct Accessories."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.6 PAINTING

A. All ductwork required to be painted shall be cleaned and oil-free. Mechanical Contractor shall prepare ductwork surfaces accordingly to accept primer and paint.

B. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 099113 "Exterior Painting" and Section 09 91 23 "Interior Painting."

3.7 FIELD QUALITY CONTROL

A. Perform tests and inspections.

B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
2. Test the following systems:

a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections totaling no less than 25 percent of total installed duct area for each designated pressure class.
b. Supply Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
c. Return Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
d. Exhaust Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.
e. Outdoor Air Ducts with a Pressure Class of 3-Inch wg or Higher: Test representative duct sections totaling no less than 50 percent of total installed duct area for each designated pressure class.

3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
4. Test for leaks before applying external insulation.
5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
6. Give seven days' advance notice for testing.

C. Duct System Cleanliness Tests:

1. Visually inspect duct system to ensure that no visible copvcntaminants are present.
2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment, Cleaning and Restoration of HVAC Systems."

a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.

D. Duct system will be considered defective if it does not pass tests and inspections.

E. Prepare test and inspection reports.

3.8 DUCT CLEANING

A. Clean new and existing duct system(s) before testing, adjusting, and balancing.

B. Use service openings for entry and inspection.

1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 33 00 "Air Duct Accessories" for access panels and doors.
2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
3. Remove and reinstall ceiling to gain access during the cleaning process.

C. Particulate Collection and Odor Control:

1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.

D. Clean the following components by removing surface contaminants and deposits:

1. Air outlets and inlets (registers, grilles, and diffusers).
2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
4. Coils and related components.
5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
6. Supply-air ducts, dampers, actuators, and turning vanes.
7. Dedicated exhaust and ventilation components and makeup air systems.

E. Mechanical Cleaning Methodology:

1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under negative pressure.
3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.9 START UP

A. Air Balance: Comply with requirements in Section 23 05 93 "Testing, Adjusting, and Balancing for HVAC."

END OF SECTION 233113

SECTION 233300 - AIR DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Manual volume dampers.
2. Motor operated dampers.
3. Fire dampers.
4. Flange connectors.
5. Turning vanes.
6. Duct-mounted access doors.
7. Flexible connectors.
8. Flexible ducts.
9. Duct accessory hardware.

B. Related Requirements:

1. Section 23 05 03 “Submittals for HVAC”.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. For duct silencers, include pressure drop and dynamic insertion loss data. Include breakout noise calculations for high transmission loss casings.

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

1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:

a. Special fittings.
b. Manual volume damper installations.
c. Motor operated damper installations.
d. Fire-damper, smoke-damper, combination fire- and smoke-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
e. Duct security bars.
f. Wiring Diagrams: For power, signal, and control wiring.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

1.6 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. Fusible Links: Furnish quantity equal to 10 percent of amount installed.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.

1. Galvanized Coating Designation: G90.
2. Exposed-Surface Finish: Mill phosphatized.

B. Reinforcement Shapes and Plates: Galvanized-steel reinforcement where installed on galvanized sheet metal ducts; compatible materials for aluminum and stainless-steel ducts.

C. Tie Rods: Galvanized steel, 1/4-inch minimum diameter for lengths 36 inches or less; 3/8-inch minimum diameter for lengths longer than 36 inches.

2.3 MANUAL VOLUME DAMPERS

A. Standard, Steel, Manual Volume Dampers:

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

    a. Air Balance Inc.; a division of Mestek, Inc.
    b. American Warming and Ventilating; a division of Mestek, Inc.
    c. Flexmaster U.S.A., Inc.
    d. McGill AirFlow LLC.
    e. Nailor Industries Inc.
    f. Pottorff.
    g. Ruskin Company.
    h. Trox USA Inc.
    i. Vent Products Company, Inc.
    j. Greenheck

2. Standard leakage rating.
3. Suitable for horizontal or vertical applications.
4. For units less than 36" wide by 12" high

    a. Frame shall be 22 gage galvanized steel.
    b. Blade shall be single skin, 22 gage galvanized steel with center "V" groove for reinforcement.
    c. Bearings shall be corrosion resistant synthetic sleeve type turning in an extruded hole in the damper frame.
    d. Axles shall be 3/8" square shaft positively locked into damper blade.

5. For units over 36" wide by 12" high

    a. Frame shall be 18 gage galvanized steel formed into a structural hat channel shape with tabbed corners for reinforcement.
    b. Blades shall be single skin 18 gage galvanized steel with three longitudinal grooves for reinforcement.
    c. Bearings shall be corrosion resistant synthetic sleeve type turning in an extruded hole in the damper frame.
    d. Axles shall be hexagonal positively locked into damper blade.

B. Jackshaft:

1. Size: 1-inch diameter.
2. Material: Galvanized-steel pipe rotating within pipe-bearing assembly mounted on supports at each mullion and at each end of multiple-damper assemblies.
3. Length and Number of Mountings: As required to connect linkage of each damper in multiple-damper assembly.

C. Damper Hardware:

1. Zinc-plated, die-cast core with dial and handle made of 3/32-inch- thick zinc-plated steel, and a 3/4-inch hexagon locking nut.
2. Include center hole to suit damper operating-rod size.
3. Include elevated platform for insulated duct mounting.

2.4 MOTOR OPERATED DAMPERS

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

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Lloyd Industries, Inc.
6. McGill AirFlow LLC.
7. Metal Form Manufacturing, Inc.
8. Nailor Industries Inc.
9. NCA Manufacturing, Inc.
10. Pottorff.
11. Ruskin Company.
12. Vent Products Company, Inc.
13. Young Regulator Company.

B. All louvers, gravity roof ventilators, etc. shall have motor operated dampers. Dampers shall be low leak with blade and edge seals.

C. All motor operated dampers shall be furnished and installed by the mechanical contractor, unless otherwise noted. All damper actuators shall be furnished, installed and wired by the TCC, unless damper & actuator are provided by equipment manufacturer. TCC shall provide all necessary transformers, contactors, controls and wiring for interlocking equipment to motor operated dampers. Frames shall be 4" x 1" x 0.081" minimum thickness, 6063T5 extruded aluminum hat channel with hat mounting flanges on both sides of the frame. Each corner shall be reinforced with two die formed internal braces and machine staked for maximum rigidity.

D. All motor operated dampers integral to or utilized as part of an engineered smoke control system shall be listed and comply with UL 555S.

E. Blades shall be airfoil type extruded aluminum, maximum 4" depth, with integral structural reinforcing tube running full length of each blade. Blade edge seals shall be extruded vinyl double edge design with inflatable pocket which enables air pressure from either direction to assist in blade to blade seal off. Blades seals shall be mechanically locked in extruded blade slots, yet shall be easily replaceable in field. Adhesive or clip-on type blade seals are not acceptable.

F. Bearings shall be non-corrosive molded synthetic. Axles shall be hexagonal to provide positive locking connection to blades and linkage. Round axles are not acceptable. Linkage shall be concealed in frame.

G. All dampers shall be tested in accordance with AMCA 500 and shall be rated AMCA Class 1A for 3.5 cfm/sf at 1” wg pressure for all sizes 24” wide and above.

H. Dampers shall be parallel blade for 2-position control and opposed blade for modulating control.

I. Motor operated dampers wired to emergency power shall have spring loaded normally closed actuators.

2.5 FIRE DAMPERS

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

1. Air Balance Inc.; a division of Mestek, Inc.
2. Arrow United Industries; a division of Mestek, Inc.
3. Cesco Products; a division of Mestek, Inc.
4. Greenheck Fan Corporation.
5. Nailor Industries Inc.
6. NCA Manufacturing, Inc.
7. Pottorff.
8. Prefco; Perfect Air Control, Inc.
9. Ruskin Company.
10. Vent Products Company, Inc.
11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Type: Dynamic; rated and labeled according to UL 555 by an NRTL.

C. Fire Rating: 1-1/2 and/or 3 hours.

D. Frame: Curtain type with blades outside airstream Curtain type with blades outside airstream except when located behind grille where blades may be inside airstream; fabricated with roll-formed, galvanized steel; with mitered and interlocking corners.

E. Mounting Sleeve:

1. Each fire damper shall include a steel sleeve and retaining angles furnished by the damper manufacturer to ensure appropriate installation.
2. Exception: Omit sleeve where damper-frame width permits direct attachment of perimeter mounting angles on each side of wall or floor; thickness of damper frame must comply with sleeve requirements.

F. Mounting Orientation: Vertical or horizontal as indicated.

G. Blades: Roll-formed, interlocking, galvanized sheet steel. In place of interlocking blades, use full-length, galvanized-steel blade connectors.

H. Horizontal Dampers: Include blade lock and stainless-steel closure spring.

I. Heat-Responsive Device: Replaceable, 165 deg F rated, fusible links.

2.6 FLANGE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Nexus PDQ; Division of Shilco Holdings Inc.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Description: Add-on or roll-formed, factory-fabricated, slide-on transverse flange connectors, gaskets, and components.

C. Material: Galvanized steel.

D. Gage and Shape: Match connecting ductwork.

2.7 TURNING VANES

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

1. Aero Dyne.
2. Ductmate Industries, Inc.
3. Duro Dyne Inc.
4. Elgen Manufacturing.
5. METALAIRE, Inc.
6. SEMCO Incorporated.
7. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Manufactured Turning Vanes for Metal Ducts: Curved blades of galvanized sheet steel; support with bars perpendicular to blades set; set into vane runners suitable for duct mounting.

1. Acoustic Turning Vanes: Fabricate airfoil-shaped aluminum extrusions with perforated faces and fibrous-glass fill.

C. General Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 4-3, "Vanes and Vane Runners," and 4-4, "Vane Support in Elbows."

D. Vane Construction: Single wall for ducts up to 48 inches wide and double wall for larger dimensions.

2.8 DUCT-MOUNTED ACCESS DOORS

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

1. American Warming and Ventilating; a division of Mestek, Inc.
2. Cesco Products; a division of Mestek, Inc.
3. Ductmate Industries, Inc.
4. Elgen Manufacturing.
5. Flexmaster U.S.A., Inc.
6. Greenheck Fan Corporation.
7. McGill AirFlow LLC.
8. Nailor Industries Inc.
9. Pottorff.
10. Ventfabrics, Inc.
11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."

1. Door:

a. Double wall, rectangular.
b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
c. Vision panel.
d. Hinges and Latches: 1-by-1-inchbutt or piano hinge and cam latches.
e. Fabricate doors airtight and suitable for duct pressure class.

2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
3. Number of Hinges and Locks:

a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
b. Access Doors up to 18 Inches Square: Two hinges Continuous and two sash locks.
c. Access Doors up to 24 by 48 Inches: Three hinges Continuous and two compression latches with outside and inside handles.
d. Access Doors Larger Than 24 by 48 Inches: Four hinges Continuous and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1.
2. Door and Frame Material: Galvanized sheet steel.
3. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.Factory set at 3.0- to 8.0-inch wg.
4. Doors close when pressures are within set-point range.
5. Hinge: Continuous piano.
6. Latches: Cam.
7. Seal: Neoprene or foam rubber.
8. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.9 DUCT ACCESS PANEL ASSEMBLIES

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

1. Ductmate Industries, Inc.
2. Flame Gard, Inc.
3. Morgan Thermal Ceramics.
4. 3M.

B. Labeled according to UL 1978 by an NRTL.

C. Panel and Frame: Minimum thickness 0.0528-inch carbon steel.

D. Fasteners: Carbon steel. Panel fasteners shall not penetrate duct wall.

E. Gasket: Comply with NFPA 96; grease-tight, high-temperature ceramic fiber, rated for minimum 2000 deg F.

F. Minimum Pressure Rating: 10-inch wg, positive or negative.

2.10 FLEXIBLE CONNECTORS

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

1. Ductmate Industries, Inc.
2. Duro Dyne Inc.
3. Elgen Manufacturing.
4. Ventfabrics, Inc.
5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Materials: Flame-retardant or noncombustible fabrics.

C. Coatings and Adhesives: Comply with UL 181, Class 1.

D. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Provide metal compatible with connected ducts.

E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.

1. Minimum Weight: 26 oz./sq. yd..
2. Tensile Strength: 480 lbf/inch in the warp and 360 lbf/inch in the filling.
3. Service Temperature: Minus 40 to plus 200 deg F.

F. Thrust Limits: Combination coil spring and elastomeric insert with spring and insert in compression, and with a load stop. Include rod and angle-iron brackets for attaching to fan discharge and duct.

1. Frame: Steel, fabricated for connection to threaded rods and to allow for a maximum of 30 degrees of angular rod misalignment without binding or reducing isolation efficiency.
2. Outdoor Spring Diameter: Not less than 80 percent of the compressed height of the spring at rated load.
3. Minimum Additional Travel: 50 percent of the required deflection at rated load.
4. Lateral Stiffness: More than 80 percent of rated vertical stiffness.
5. Overload Capacity: Support 200 percent of rated load, fully compressed, without deformation or failure.
6. Elastomeric Element: Molded, oil-resistant rubber or neoprene.
7. Coil Spring: Factory set and field adjustable for a maximum of 1/4-inch movement at start and stop.

2.11 FLEXIBLE DUCTS

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

1. Flexmaster U.S.A., Inc.
2. McGill AirFlow LLC.
3. Ward Industries, Inc.; a division of Hart & Cooley, Inc.

B. Noninsulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.

C. Insulated, Flexible Duct: UL 181, Class 1, 2-ply vinyl film supported by helically wound, spring-steel wire; fibrous-glass insulation; polyethylene vapor-barrier film.

1. Pressure Rating: 10-inch wg positive and 1.0-inch wg negative.
2. Maximum Air Velocity: 4000 fpm.
3. Temperature Range: Minus 10 to plus 160 deg F.
4. Insulation R-value: Comply with ASHRAE/IESNA 90.1.

D. Flexible Duct Connectors:

1. Clamps: Stainless-steel band with cadmium-plated hex screw to tighten band with a worm-gear action or Nylon strap in sizes 3 through 18 inches, to suit duct size.

2.12 DUCT ACCESSORY HARDWARE

A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.

B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.

B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.

C. Install motor operated dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.

D. Install volume dampers at points on supply, return, and exhaust systems where branches extend from larger ducts. Where dampers are installed in ducts having duct liner, install dampers with hat channels of same depth as liner, and terminate liner with nosing at hat channel. These dampers, whether shown or the drawings or not, shall be installed at no additional cost to the Owner. Consult with Testing, Adjusting, and Balancing Agency prior to ductwork installation to establish damper locations

1. Install steel dampers in steel ducts.

E. Set dampers to fully open position before testing, adjusting, and balancing.

F. Install test holes at fan inlets and outlets and elsewhere as indicated.

G. Install fire and smoke dampers according to UL listing.

H. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:

1. At outdoor-air intakes and mixed-air plenums.
2. Downstream from manual volume dampers, motor operated dampers, backdraft dampers, and equipment.
3. Adjacent to and close enough to fire or smoke dampers, to reset or reinstall fusible links. Access doors for access to fire or smoke dampers having fusible links shall be pressure relief access doors and shall be outward operation for access doors installed upstream from dampers and inward operation for access doors installed downstream from dampers.
4. At each change in direction and at maximum 50-foot spacing.
5. Upstream and downstream from turning vanes.
6. Upstream or downstream from duct silencers.
7. Control devices requiring inspection.
8. Elsewhere as indicated.

I. Install access doors with swing against duct static pressure.

J. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
2. Two-Hand Access: 12 by 6 inches.
3. Head and Hand Access: 18 by 10 inches.
4. Head and Shoulders Access: 21 by 14 inches.
5. Body Access: 25 by 14 inches.
6. Body plus Ladder Access: 25 by 17 inches.

K. Label access doors according to Section 23 05 53 "Identification for HVAC Piping and Equipment" to indicate the purpose of access door.

L. Install flexible connectors to connect ducts to equipment.

M. For fans developing static pressures of 5-inch wg and more, cover flexible connectors with loaded vinyl sheet held in place with metal straps.

N. Connect flexible ducts to metal ducts with draw bands.

O. Install duct test holes where required for testing and balancing purposes.

P. Install thrust limits at centerline of thrust, symmetrical on both sides of equipment. Attach thrust limits at centerline of thrust and adjust to a maximum of 1/4-inch movement during start and stop of fans.

3.2 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Operate dampers to verify full range of movement.

2. Inspect locations of access doors and verify that purpose of access door can be performed.
3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
4. Inspect turning vanes for proper and secure installation.

END OF SECTION 233300

SECTION 233713 - DIFFUSERS, REGISTERS AND LOUVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Rectangular and square ceiling diffusers.
2. Exhaust grilles.

B. Related Sections:

1. Section 23 05 03 “Submittals for HVAC”.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product indicated, include the following:

1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
2. Diffuser, Register, and Grille Schedule: Indicate drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from Installers of the items involved:

1. Ceiling suspension assembly members.
2. Method of attaching hangers to building structure.
3. Size and location of initial access modules for acoustical tile.
4. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
5. Duct access panels.

B. Source quality-control reports.

PART 2 - PRODUCTS

2.1 CEILING DIFFUSERS

A. Rectangular and Square Ceiling Diffusers:

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

    a. Krueger.
    b. METALAIRE, Inc.
    c. Nailor Industries Inc.
    d. Price Industries.
    e. Titus.

2. Material: Steel.
3. Finish: Baked enamel, white.
4. Face Size: 24 by 24 inches.
5. Face Style: Plaque.
6. Mounting: Surface or T-bar.
7. Pattern: Fixed.
8. Dampers: Butterfly in drywall applications. Not required if equalizing grid is provided.
9. Accessories:

    a. Plaster ring.

B. Exhaust Grilles

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

    a. METALAIRE, Inc.
    b. Nailor Industries Inc.
    c. Price Industries.
    d. Titus.

2. Material: Aluminum.
3. Finish: Baked enamel, white.
4. Face Size: On Drawings
5. Mounting: Surface.
6. Pattern: Fixed Louver, 45 deg deflection.
7. Accessories: Opposed Blade Damper

2.2 SOURCE QUALITY CONTROL

A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment.

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

3.2 INSTALLATION

A. Install diffusers, registers, and grilles level and plumb.

B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.

C. Install diffusers, registers, and grilles with airtight connections to ducts and to allow service and maintenance of dampers, air extractors, and fire dampers.

3.3 ADJUSTING

A. After installation, adjust diffusers, registers, and grilles to air patterns indicated, or as directed, before starting air balancing.

END OF SECTION 233713

SECTION 238219 - FAN COIL UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. This Section includes fan-coil units and accessories for.

1. Fan coil units.
2. Ducted fan coil units.

B. Related Sections:

1. Section 23 05 03 “Submittals for HVAC”.

1.3 DEFINITIONS

A. BAS: Building automation system.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.

C. Samples for Initial Selection: For units with factory-applied color finishes.

D. Samples for Verification: For each type of fan-coil unit indicated.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Ceiling suspension components.
2. Structural members to which fan-coil units will be attached.
3. Method of attaching hangers to building structure.

4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

    a. Lighting fixtures.
    b. Air outlets and inlets.
    c. Speakers.
    d. Sprinklers.
    e. Access panels.

6. Perimeter moldings for exposed or partially exposed cabinets.

B. Field quality-control test reports.

C. Warranty: Special warranty specified in this Section.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fan-coil units to include in emergency, operation, and maintenance manuals. In addition to items specified in Section 01 78 23 "Operation and Maintenance Data," include the following:

1. Maintenance schedules and repair part lists for motors, coils, integral controls, and filters.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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. Fan-Coil-Unit Filters: Furnish 1 spare filter for each filter installed.
2. Fan Belts: Furnish 1 spare fan belt for each unit installed.

1.8 QUALITY ASSURANCE

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

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

1.9 COORDINATION

A. Coordinate layout and installation of fan-coil units and suspension system components with other construction that penetrates or is supported by ceilings, including light fixtures, HVAC equipment, fire-suppression-system components, and partition assemblies.

B. Coordinate size and location of wall sleeves for outdoor-air intake.

1.10 WARRANTY

A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.

1. Failures include, but are not limited to, the following:

a. Compressor failure.

2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 FAN-COIL UNITS

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

1. Carrier Corporation.
2. Environmental Technologies, Inc.
3. International Environmental Corporation.
4. Daikin Applied.
5. Trane; a division of Ingersoll Rand.

B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

C. Coil Section Insulation: 1/2-inch thick, matte-finish, closed-cell foam complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Main and Auxiliary Drain Pans: Insulated galvanized steel with plastic liner. Fabricate pans and drain connections to comply with ASHRAE 62.1. Provide high condensate in primary condensate pan to de-energize unit upon detection of high condensate levels.

E. Chassis: Galvanized steel where exposed to moisture. Floor-mounting units shall have leveling screws.

F. Cabinet: Steel with baked-enamel finish in manufacturer's standard paint color as selected by Architect

1. Vertical Unit Front Panels: Removable, steel, with integral stamped discharge grille and channel-formed edges, cam fasteners, and insulation on back of panel.

G. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.

H. Face Velocity: Maximum air velocity across evaporator coil shall be 500 fpm unless noted otherwise on schedules.

I. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain valve.

J. Fan and Motor Board: Removable.

1. Fan: Forward curved, double width, centrifugal on reinforced fiberglass; directly connected to motor. In galvanized-steel fan scrolls.
2. Motor: EC (Electronically Commutated) motor; resiliently mounted on motor board. Comply with requirements in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."
3. Wiring Termination: Connect motor to chassis wiring with plug connection.

K. Factory, Hydronic Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.

1. Three-way, modulating control valve for heating coil.
2. Hose Kits: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.

    a. Length: 36 inches maximum.
    b. Minimum Diameter: Equal to fan-coil-unit connection size.

3. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
4. Calibrated-Orifice Balancing Valves: Bronze body, ball type; 125-psig working pressure, 250-deg F maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
5. Automatic Flow-Control Valve: Brass or ferrous-metal body; 300-psig working pressure at 250 deg F, with removable, corrosion-resistant, tamperproof, self-cleaning piston spring; factory set to maintain constant indicated flow with plus or minus 10 percent over differential pressure range of 2 to 80 psig.
6. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig working pressure; with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 hose-end, full-port, ball-type blowdown valve in drain connection.
7. Wrought-Copper Unions: ASME B16.22.
8. Risers: ASTM B 88, Type L copper pipe with hose and ball valve for system flushing.

L. Control devices and operational sequences are specified in Section 23 09 00 "Instrumentation and Control for HVAC" and Section 23 09 93 "Sequence and Operations for HVAC Controls."

M. BAS Interface Requirements:

1. Interface relay for scheduled operation.
2. Interface relay to provide indication of fault at the central workstation.

N. Electrical Connection: Factory wire motors and controls for a single electrical connection.

2.2 DUCTED FAN-COIL UNITS

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

1. Carrier Corporation.
2. Environmental Technologies, Inc.
3. International Environmental Corporation.
4. Daikin Applied.
5. Trane; a division of Ingersoll Rand.

B. Description: Factory-packaged and -tested units rated according to ARI 440, ASHRAE 33, and UL 1995.

C. Coil Section Insulation: 1/2-inch thick foil-faced glass fiber complying with ASTM C 1071 and attached with adhesive complying with ASTM C 916.

1. Fire-Hazard Classification: Insulation and adhesive shall have a combined maximum flame-spread index of 25 and smoke-developed index of 50 when tested according to ASTM E 84.
2. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

D. Drain Pans: Insulated galvanized steel with plastic liner. Fabricate pans and drain connections to comply with ASHRAE 62.1.

1. For horizontally mounted units above ceilings or in attic spaces, provide high water level detection in primary drain pan that will shut down unit on alarm to prevent overflow.

E. Chassis: Galvanized steel where exposed to moisture, with baked-enamel finish and removable access panels.

F. Cabinets: Steel with baked-enamel finish in manufacturer's standard paint color.

1. Mixing Plenum on units with economizer function: Sheet metal plenum finished and insulated to match the chassis with outdoor- and return-air, formed-steel dampers.
2. Dampers: Galvanized steel with extruded-vinyl blade seals, flexible-metal jamb seals, and interlocking linkage.

G. Filters: Minimum arrestance according to ASHRAE 52.1, and a minimum efficiency reporting value (MERV) according to ASHRAE 52.2.

1. Pleated Cotton-Polyester Media: 90 percent arrestance and 7 MERV.

H. Hydronic Coils: Copper tube, with mechanically bonded aluminum fins spaced no closer than 0.1 inch, rated for a minimum working pressure of 200 psig and a maximum entering-water temperature of 220 deg F. Include manual air vent and drain.

I. Direct-Driven Fans: Double width, forward curved, centrifugal; with EC (Electronically Commutated) motor resiliently mounted in the fan inlet. Aluminum or painted-steel wheels, and painted-steel or galvanized-steel fan scrolls.

J. Factory, Hydronic Piping Package: ASTM B 88, Type L copper tube with wrought-copper fittings and brazed joints. Label piping to indicate service, inlet, and outlet.

1. Three-way, modulating control valve for dual-temperature coil.
2. Hose Kits: Minimum 400-psig working pressure, and operating temperatures from 33 to 211 deg F. Tag hose kits to equipment designations.

    a. Length: 36 inches maximum.
    b. Minimum Diameter: Equal to fan-coil-unit connection size.

3. Two-Piece Ball Valves: Bronze body with full-port, chrome-plated bronze ball; PTFE or TFE seats; and 600-psig minimum CWP rating and blowout-proof stem.
4. Calibrated-Orifice Balancing Valves: Bronze body, ball type; 125-psig working pressure, 250 deg F maximum operating temperature; with calibrated orifice or venturi, connections for portable differential pressure meter with integral seals, threaded ends, and equipped with a memory stop to retain set position.
5. Automatic Flow-Control Valve: Brass or ferrous-metal body; 300-psig working pressure at 250 deg F; with removable, corrosion-resistant, tamperproof, self-cleaning piston spring; factory set to maintain constant indicated flow with plus or minus 10 percent over differential pressure range of 2 to 80 psig.
6. Y-Pattern Hydronic Strainers: Cast-iron body (ASTM A 126, Class B); 125-psig working pressure, with threaded connections, bolted cover, perforated stainless-steel basket, and bottom drain connection. Include minimum NPS 1/2 hose-end, full-port, ball-type blow-down valve in drain connection.
7. Wrought-Copper Unions: ASME B16.22.

K. Control devices and operational sequence are specified in Section 23 09 93 "Sequence of Operations for HVAC Controls."

L. Electrical Connection: Factory wire motors and controls for a single electrical connection.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive fan-coil units for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before fan-coil-unit installation.

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

3.2 INSTALLATION

A. Install fan-coil units level and plumb.

B. Install fan-coil units to comply with NFPA 90A.

C. Suspend fan-coil units from structure with elastomeric hangers. Vibration isolators are specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

D. Verify locations of thermostats, humidistats, and other exposed control sensors with Drawings and room details before installation.

E. Install new filters in each fan-coil unit within two weeks after Substantial Completion.

3.3 CONNECTIONS

A. Piping installation requirements are specified in other Sections. Drawings indicate general arrangement of piping, fittings, and specialties. Specific connection requirements are as follows:

1. Install piping adjacent to machine to allow service and maintenance.
2. Connect piping to fan-coil-unit factory hydronic piping package. Install piping package if shipped loose.
3. Connect condensate drain to indirect waste.

    a. Install condensate trap of adequate depth to seal against the pressure of fan. Install cleanouts in piping at changes of direction.

B. Connect supply and return ducts to fan-coil units with flexible duct connectors specified in Section 23 33 00 "Air Duct Accessories." Comply with safety requirements in UL 1995 for duct connections.

C. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect, test, and adjust field-assembled components and equipment installation, including connections. Report results in writing.

B. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

C. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain fan-coil units. Refer to Section 01 79 00 "Demonstration and Training."

END OF SECTION 238219

SECTION 238239 - UNIT HEATERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Propeller unit heaters with hot-water coils.
2. Section 23 05 03 “Submittals for HVAC”.

1.3 DEFINITIONS

A. BAS: Building automation system.

B. CWP: Cold working pressure.

C. PTFE: Polytetrafluoroethylene plastic.

D. TFE: Tetrafluoroethylene plastic.

1.4 ACTION SUBMITTALS

A. Product Data: Include rated capacities, operating characteristics, furnished specialties, and accessories for each product indicated.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Plans, elevations, sections, and details.
2. Location and size of each field connection.
3. Details of anchorages and attachments to structure and to supported equipment.
4. Equipment schedules to include rated capacities, operating characteristics, furnished specialties, and accessories.
5. Location and arrangement of piping valves and specialties.
6. Location and arrangement of integral controls.
7. Wiring Diagrams: Power, signal, and control wiring.

1.5 INFORMATIONAL SUBMITTALS

A. Coordination Drawings: Floor plans, reflected ceiling plans, and other details, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:

1. Suspended ceiling components.
2. Structural members to which unit heaters will be attached.
3. Method of attaching hangers to building structure.
4. Size and location of initial access modules for acoustical tile.
5. Items penetrating finished ceiling, including the following:

a. Lighting fixtures.
b. Air outlets and inlets.
c. Speakers.
d. Sprinklers.
e. Access panels.

6. Perimeter moldings for exposed or partially exposed cabinets.

B. Field quality-control test reports.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For cabinet unit heaters to include in emergency, operation, and maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

1.8 QUALITY ASSURANCE

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

B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

C. ASHRAE/IESNA 90.1 Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

PART 2 - PRODUCTS

2.1 PROPELLER UNIT HEATERS

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

1. Airtherm; a Mestek Company.
2. Engineered Air Ltd.
3. McQuay International.

4. Trane; a division of Ingersoll Rand.
5. Modine
6. Rittling
7. Marlo

B. Description: An assembly including casing, coil, fan, and motor in vertical and horizontal discharge configuration with adjustable discharge louvers.

C. Comply with UL 2021.

D. Cabinet: Removable panels for maintenance access to controls.

E. Cabinet Finish: Manufacturer's standard baked enamel applied to factory-assembled and -tested propeller unit heater before shipping.

F. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

G. Discharge Louver: Adjustable fin diffuser for horizontal units.

H. General Coil Requirements: Test and rate hot-water propeller unit heater coils according to ASHRAE 33.

I. Hot-Water Coil: Cupronickel tube, minimum 0.031-inch wall thickness, with mechanically bonded aluminum fins spaced no closer than 0.1 inch and rated for a minimum working pressure of 400 psig and a maximum entering-water temperature of 450 deg F, with manual air vent. Test for leaks to 600 psig underwater.

J. Fan: Propeller type with aluminum wheel directly mounted on motor shaft in the fan venturi.

K. Fan Motors: Comply with requirements in Section 23 05 13 "Common Motor Requirements for HVAC Equipment."

1. Motor Type: Permanently lubricated, multispeed.

L. Control Devices:

1. Unit-mounted thermostat.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Examine areas to receive unit heaters for compliance with requirements for installation tolerances and other conditions affecting performance.

B. Examine roughing-in for piping and electrical connections to verify actual locations before unit heater installation.

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

3.2 INSTALLATION

A. Install cabinet unit heaters to comply with NFPA 90A.

B. Install propeller unit heaters level and plumb.

C. Suspend propeller unit heaters from structure with all-thread hanger rods and elastomeric hangers spring hangers spring hangers with vertical-limit stop. Hanger rods and attachments to structure are specified in Section 23 05 29 "Hangers and Supports for HVAC Piping and Equipment." Vibration hangers are specified in Section 23 05 48 "Vibration and Seismic Controls for HVAC Piping and Equipment."

3.3 CONNECTIONS

A. Piping installation requirements are specified in Section 23 21 13 "Hydronic Piping"." Drawings indicate general arrangement of piping, fittings, and specialties.

B. Install piping adjacent to machine to allow service and maintenance.

C. Comply with safety requirements in UL 1995.

D. Unless otherwise indicated, install union and gate or ball valve on supply-water connection and union and calibrated balancing valve on return-water connection of unit heater. Hydronic specialties are specified in Section 23 21 13 "Hydronic Piping."

E. Ground equipment according to Section 26 05 26 "Grounding and Bonding for Electrical Systems."

F. Connect wiring according to Section 26 05 19 "Low-Voltage Electrical Power Conductors and Cables."

3.4 FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
2. Test and adjust controls and safety devices. Replace damaged and malfunctioning controls and equipment.

B. Remove and replace malfunctioning units and retest as specified above.

3.5 ADJUSTING

A. Adjust initial temperature set points.

B. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.

3.6 DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain cabinet unit heaters. Refer to Section 01 79 00 "Demonstration and Training."

END OF SECTION 238239

SECTION 26 05 01.00 – COMMON REQUIREMENTS FOR ELECTRIC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including General and Supplemental Conditions and Division-1 Specification sections, apply to work of Division 26 sections.

B. E-series drawings apply to work of Division 26 sections and vice versa.

1.2 SPECIAL CONDITIONS

A. Owner's representative or engineer may relocate luminaire(s), wiring device(s) or equipment outlet(s) prior to installation within a 15 foot limit at no additional charge.

B. Complete work, or part(s) thereof, at such time as may be designated by the owner's representative, so that it can be used for temporary or permanent use. Do not construe such use of the system as an acceptance of same by Owner.

C. Review load summaries of power distribution equipment prior to rough-in or installing conductors, and after coordinating with suppliers and other trades, including relevant submittals. Bring abnormal conditions to the attention of the design professional, such as significant load conditions, and unusual phase imbalances.

1.3 GENERAL STANDARDS

A. Provide work in compliance with applicable provisions of the following standards. Provide UL listing and UL label for electrical materials, equipment luminaires, devices, etc.

B. Provide work in strict accordance with the latest edition of applicable codes including (but not limited to) the following codes and standards.
1. National Electrical Code (NEC), NFPA 70
2. Life Safety Code, NFPA 101
3. Other Provisions of NFPA as applicable
4. Local Electrical Codes
5. Local utility company requirements
6. ADA/ADAAG requirements
7. ASME
8. International Building Code
9. IECC 2009
10. Ohio Building Code

1.4 PERMITS AND REGULATIONS

A. Provide written notification to Engineer's office with list of inspection agency choices if multiple electrical plan review or inspection agencies are permitted in the jurisdiction of the project. The final agency selection belongs to the Engineer.

B. Provide electrical materials, installation methods, workmanship, testing, etc., unless otherwise specified, that conforms with the latest rules, regulations and specifications of the National Electrical Code, the National Board of Fire Underwriters, local and state codes having jurisdiction and applicable utility companies.

C. If a discrepancy between Division 26 drawings and specifications, and codes, laws, ordinances, rules and regulations is discovered, immediately notify the engineer and proceed no further with related work until response is received.

D. Obtain and pay for permits, certificates of inspection and approval, etc. required for this branch of the work.

E. Furnish owner with certificates of final inspection and approval prior to final acceptance of this branch of the work.

1.5 SPECIFICATIONS AND TERMINOLOGY

A. Unless otherwise indicated in specifications or on drawings, wherever the term "furnish" appears in documents, interpret to mean "supply and deliver to project site, ready for installation, and install". See definition of “install” in paragraph below.

B. Wherever the term "install" appears in documents, or is intrinsically included as part of “furnish” and/or “provide” in paragraphs above and below, interpret to mean "Assemble, wire and connect loose-shipped components on site. Place in position for service or use, including material, labor, accessories, services, and testing. Wire, connect, and render fully operational for intended use ". Note that most products to be installed shall also be furnished under Division 26, though some products require only installation under Division 26 - depending on context and application.

C. Wherever the terms "provide", "include”, “shall be”, “to be", “equip with”, “consisting of”, or similar terms appear in documents, interpret to mean "Furnish and Install".

D. Wherever the word "work" appears in documents, interpret to mean “material, labor, accessories, services, testing, etc. as required to render respective work fully operational”.

E. Wherever the words “equal” or “equivalent” or similar terms are used in documents in reference to products other than basis-of-design, equivalency shall be as determined by Design Professional.

F. Wherever the word “flush” appears, interpret to mean “recessed in respective surface with visible face flush and even with respective surface”.

G. Wherever the words "(the) (this) contractor", "(the) (this) subcontractor", "E.C./EC", “electrical contractor”, “electrical subcontractor” or similar terms appear in Division 26 specifications or on electrical drawings, they refer the entity responsible for providing electrical work indicated on electrical drawings, and in Division 26 Project Manual sections.

H. Interpret the term "Architect" to mean "Engineer's Representative".

1.6 EXPLANATION AND PRECEDENCE OF DRAWINGS

A. For the purposes of clearness and legibility, drawings are essentially diagrammatic and although size and locations of equipment are drawn to scale wherever possible, make use of data on drawings and verify information at building site.

B. The drawings indicate required size and points of termination of conduit and partially suggest proper routes to conform to the structure, avoid obstructions and preserve clearances. However, it is not intended that drawings indicate necessary offsets. Install conduit and equipment in such manner as to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear without further instructions.

C. Coordinate work with affected entities and installers. Locate and install equipment and devices accordingly. Refer to coordination drawings of other trades.

D. Locate apparatus be located symmetrical with architectural elements and install at exact height and locations as shown on architectural drawings.

E. Fully research peculiarities and limitations of space available for installation of work along with materials to be furnished and installed. Exercise due and particular caution to ensure that parts of the installed work are made quickly and easily accessible. Although the locations of the equipment and conduit may be shown on the drawings in certain positions, be guided by the architectural details and conditions existing at the job site, correlating electrical work with that of others. Provide offsets as required to provide a neat workmanlike arrangement.

F. Where connecting lines are shown outside the confines of a building, serving indoor or exterior wall-mounted luminaires, devices, outlets, etc., they are shown for circuiting clarification and are not intended to be installed outside of the building. Provide such conduit, raceway and cabling work within the confines of the building, concealed wherever possible.

1.7 SUBMITTALS

A. Refer to Section 260503, Submittals for Electrical Systems.

B. Provide Equipment List for items of material and equipment, which must be reviewed by the Engineer prior to the start of work. Provide submittals in a timely manner allowing for long lead items. No item of equipment will be permitted on the site until acceptance of that equipment has been given. Provide copies of drawings and manufacturer cuts and performance data for Engineer's review. Organized in same order as listed in equipment list and include reference to page and paragraph numbers of the specifications. Do not purchase material until the final versions of the submittals are reviewed by the Design Professionals as "No Exceptions" or as "Exceptions Noted".

C. Clearly indicate sufficient definition in submittals so they can be properly reviewed for compliance with documents.

1.8 MATERIALS AND EQUIPMENT

A. Unless specifically indicated otherwise provide (furnish and install) all specified and drawn equipment, raceway, boxes, luminaires, controls, wiring, cabling, supports and other materials as required to render all electrical and electrically operated equipment, luminaires, devices, etc. fully

operational. Unless specifically indicated otherwise provide (furnish and install) all materials that are specified under Division 26. Discrepancies or uncertainties perceived by a bidder, or other questionable interpretations by a bidder, are subject to final interpretations and decisions by the owner's representative unless addressed before bidding by addendum or unless qualified or excepted within bids.

B. Provide material manufacturers equivalent in quality, performance, aesthetics, and product support (factory and local) to that specified as basis of design. Other products, materials, articles, devices, luminaires or forms of construction not mentioned as basis of design, required or acceptable is subject to review by the Design Professional and possible rejection. Listing of a manufacturer by name alone as an acceptable product within these specifications shall not necessarily equate another manufacturer or model to what is specified. Provide materials with manufacturing, aesthetic, durability, duty, dimensional and performance characteristics equal to or exceeding the quality, performance and characteristics of the basis-of-design specifications and products.

C. Provide materials that are new, full weight, of the best quality. Provide similar materials that are of the same type and manufacturer. Provide materials, apparatus and equipment with Underwriter's Laboratory, Inc. label where regularly supplied.

D. Maintain safety and good condition of the materials and equipment installed until final acceptance by the Owner. Store materials to prevent damage and weathering prior to installation.

E. When several materials, products or items of equipment are specified by name for one use, select one of those specified.

F. Bear costs, if any, incurred from deviation from basis-of-design equipment, luminaires, materials, methods, etc. Use of equipment, luminaires, materials, methods, etc. that deviate from the basis of design will be considered as a statement that clearances, arrangements, performance, etc. have been checked, found satisfactory, and is compliant with applicable codes and regulations.

G. Wire and connect electrical equipment furnished under this branch of work, other branches of work and by the owner. Review documents of other trades to identify electrically operated/controlled equipment that is furnished or installed by the owner, or by other trades. Provide power connections and local disconnects for same. Provide control wiring (including relays, starters, etc.), as required to render equipment fully operable unless indicated otherwise on drawings or in project manual. Determine exact requirements in field from respective equipment installer.

H. Test and field-verify the following conditions prior to applying power to any luminaires, equipment, etc. Take corrective action if necessary to ensure systems and equipment are energized safely and to proper and properly configured power sources.
   1. Proper and expected voltages and service configurations exist at service entrance(s).
   2. Proper and expected voltages and configurations exist at all facility power sources.
   3. Current-carrying conductors are connected to the correct lines/phases.
   4. Grounded (neutral) conductors are properly referenced and connected.
   5. Grounding electrode and equipment grounding conductors are properly referenced and connected.
   6. Ground resistance complies with NFPA 70 and other specified requirements.

I. In cases where luminaires, devices, equipment, or other electrical materials are furnished by Owner or others, provide the following services: receive, transport and securely store materials on site; remove materials and components from packaging; assemble all materials and

components per factory instructions; install, wire and connect materials and components as recommended by manufacturer for a fully operational installation.

J. Except where otherwise indicated, provide fully-rated or series-rated overcurrent protection (OCP). If fault current values are not indicated at nodes on drawings, also provide fault current calculations and furnish results with equipment submittals. Provide equipment and OCP rated to meet or exceed the calculated available series-rated fault current at the respective node in the power distribution system. Furnish electronic copies of the electrical documents to the manufacturer's representative and/or equipment supplier so that properly rated and braced equipment is provided under base bid.

1.9 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Deliver equipment and materials according to factory shipping requirements. Pack components in factory-fabricated protective containers. Deliver units in sections of such size as will pass through available openings.

B. Store equipment and materials in clean dry place and protect from weather and construction traffic. When stored inside, do not exceed structural capacity of the floor.

C. Handle and rig work for equipment and products as recommended by the manufacturer. Do not install components and equipment damaged during shipment or handling - return damaged components to the manufacturer and replace with new.

1.10 QUALITY ASSURANCE

A. Provide references on request that demonstrate ability to perform work of this division, including list of past projects similar in size, scope of work and complexity.

B. Interpret specifications in connection and conjunction with the drawings. If work is shown on drawings and not mentioned in the specifications, or vice versa, provide the work as though clearly set forth by both.

C. Provide materials and labor required to fully complete the work even though each item necessarily involved may not be specifically mentioned or shown. Provide such work and materials of the same grade or quality as the parts actually specified and shown.

D. Provide the quantity and quality levels indicated as a minimum. In complying with these requirements, indicated numeric values are minimum or maximum, as appropriate for the context of the requirements. Should there be a conflict between the plans and specifications, provide the greater quantity and better quality.

E. Install equipment and materials in strict accordance with manufacturer's written instructions.

F. Tighten electrical connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified by applicable UL Standards. Accomplish tightening by utilizing proper torquing tools, including torque screwdriver, beam-type torque wrench, and ratchet wrench with adjustable torque settings. Ensure that sealing grommets expand to form watertight seal.

G. Upon completion of installation of equipment and electrical circuitry, energize circuitry and demonstrate capability and compliance with requirements. Where possible, correct malfunctioning units at site, then retest to demonstrate compliance; otherwise, remove and replace with new units, and proceed with retesting.

H. Prior to energizing, check installed wires and cables with megohm meter to determine insulation resistance levels to assure requirements are fulfilled. Prior to energizing, test wires and cables for proper phase to phase connections, for electrical continuity and for short-circuits. Ensure that direction of rotation of each motor fulfills requirement.

I. Furnish the service of an experienced superintendent who is constantly in charge of the work, together with qualified journeymen, wiremen and specialists as required to properly install, connect, adjust, start, operate and test the work involved.

J. The superintendent's qualifications are subject to the review and acceptance by the owner's representative. Unless the owner's representative grants prior special permission, utilize the same electrical superintendent throughout the duration of the project.

1.11 CLEANING EQUIPMENT AND PREMISES

A. Clean parts of the apparatus and equipment. Clean exposed parts of cement, plaster and other materials. Remove oil and grease spots. Carefully wipe such surfaces and neatly scrape out corners and cracks.

B. Brush down exposed metal work with steel brushes to remove rust and other spots and leave them smooth and clean. Remove trapped elements during cleaning and flushing period, after which replace and adjust them.

C. During the progress of the work, clean up and leave the premises and portions of the building in which work has occurred in a clean and safe condition. Provide this cleaning on a per-shift basis.

1.12 PROGRAMMABLE AND SOFTWARE OPERATED EQUIPMENT

A. This subsection applies for systems that incorporate microprocessor based equipment and components. The systems themselves are specified elsewhere within Project Manual.

B. Provide detail design, accessories, equipment, devices, wiring, and programming as required to render systems fully operable. Program, check, and test each system using respective certified factory technician. After making tests and corrections, demonstrate systems to owner's representatives and authorities having jurisdiction.

C. Provide complete design and installation drawings using information supplied by respective system supplier. Show layouts, conduit sizes, number and types of cables/conductors required to components, and detailed wiring connections required at each type of device. Provide these submittals, as part of the submittals of the respective specification section, in full compliance with requirements of authorities having jurisdiction.

D. Provide latest release of system software (furnished, installed and adapted). Provide upgrade(s) at final close-out of project, where system software originally installed has been upgraded since it was originally installed.

E. Provide custom programming described below for programmable systems, and for systems with room number identifications that are required for successful system operation. Wherever the term "programming" is used below, interpret it to mean "programming, configuration and identification".
   1. Provide custom programming. Room names and numbers may change from architectural drawing names and numbers to actual operational room names and numbers. Contact Design Professionals and Owner to determine actual operating room names, room numbers, etc. and program using actual operational information. Provide interim and permanent programming and configuration work as required to render and maintain systems in full operation.
   2. Provide programming related services (including machine language, English language, etc.) associated with rendering work fully operational, and neatly document in detail. Archive intermediate and final programming work.
   3. Provide custom and detailed programming to a level satisfactory to the Owner, including correct operational room numbers, and room names. Provide neatly typed orderly and logical submittal of proposed programming for review; prior to entering data; revise this submittal as much as required to satisfy the Owner. Determine project-specific requirements in field.
   4. Provide programming for auxiliary control and interface functions. Provide custom programming for address labels. Provide detailed English language print statements for each system point/address, and for each respective auxiliary control sequence. Include in these print statements as many characters, sentences, lines, or paragraphs required to provide extremely detailed descriptions of system status including alarm or trouble condition, and status of related auxiliary controls. Provide level of detail acceptable to the Owner. Provide clear specific English language descriptions for remote annunciators.

F. Become familiar with existing characteristics, devices, equipment, cabling, configuration, components and programming of affected systems so that expansions, extensions, and retrofits are fully compatible with the existing conditions. Provide a complete fully operable systems accordingly.

G. Provide programming services for new work, for retrofit work, and for interfaces with new and existing systems. Provide schedule for cross-reference of new system labels to nomenclature used to enter them into existing systems.

H. Verify that the system is in proper working order prior to beginning work on an existing system. If not, bring defects to the attention of the owner’s representative. If no notification occurs, it is assumed that the system was in working order. Provide remedial work for subsequent system problems that occur, if any.

1.13 PROJECT CLOSEOUT

A. General
   1. Refer to Section 260503.00, Submittals for Electrical Systems.
   2. Final payment will not be made until receipt, review and acceptance, by the owner's representative, of documentation defined under Project Closeout and in Section 260503.00, Submittals for Electrical Systems.
   3. Test electrical work and ensure that it rings entirely free from ground.
   4. Provide proper instruction of equipment and systems to the satisfaction of the owner's representative.

5. Make arrangements for meetings at such times as will be convenient to entities concerned for the purpose of instructing the designated personnel on the correct operation and maintenance of each individual system furnished and each system installed.

B. Record Documents
1. Obtain two complete sets of electrical prints and use them to provide progress record drawings which are separate, clean, prints reserved for the purpose of showing a complete picture of the work as actually installed (including routing of conduit and cables). These drawings also serve as work progress report sheets. Make notations, neat and legible thereon daily as work proceeds. Make these drawings available for inspection at all times and keep them at the job at a location designated by the owner's representative.
2. Maintain the clean, undamaged set of prints of drawings as well as a set of submittal drawings and coordination drawings. Mark the sets to show the actual installation where the installation varies from the Documents as originally shown. Include locations of underground and concealed items if placed other than shown on the Documents. Do not permanently conceal construction until this required information is recorded. Mark which drawing is most capable of showing conditions fully and accurately. Where shop drawings are used, record a cross-reference at the corresponding location on the Drawings. Give particular attention to concealed elements that would be difficult to measure and record at a later date.
3. Show changes in: size, type, capacity, etc., of material, device or piece of equipment, location of device or piece of equipment; location of outlet or source of building service systems; routing of piping, conduit, or other building services. Record location of concealed equipment, electrical service work, conduits and other piping/work by indication of measured dimensions to each line from readily identifiable and accessible walls or corners of building. Indicate approved substitutions, modifications, and actual equipment and materials installed.
4. Affix near the titleblock on each drawing the Contractor’s Company Name(s), signature of Contractor’s Representative(s) and current date.

1.14 WARRANTY/GUARANTEE

A. General
1. Provide a warranty/guarantee in written form stating that work, materials, equipment and parts are warranted to be free of defect for a period of one year from the date of owner's final acceptance, and defects will be repaired, revised or replaced (owner’s option) at no cost to the owner if such defects occur within the guarantee period. Also state in written form that occurrences arising during the warranty/guarantee period will be attended to in a timely manner and will in no case exceed four (4) working days from date of notification by owner. Replace defective items to the satisfaction of the owner's representative and the Engineer.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION (NOT USED)

END OF SECTION 260501.00

SECTION 260502 - COMMON ELECTRIC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 GENERAL

A. Furnish and install all labor and material, tools and equipment necessary to render all systems complete and operational, and ready for turnover to Owner.

1.2 ACTION SUBMITTALS

A. Refer to Section 260503, Submittals for Electrical Systems.

B. Product Data: For lock-out/tag-out devices, access doors, sealants and fire/smoke stopping products.

1.3 INFORMATIONAL SUBMITTALS

A. Refer to Section 260503, Submittals for Electrical Systems.

B. Welding Certificates.

1.4 WELDING

A. Qualify welding processes and welding operators in accordance with AWS D1.1 "Structural Welding Code - Steel." Certify that each welder has satisfactorily passed AWS qualification tests for welding processes involved and, if pertinent, has undergone recertification.

1.5 HEIGHT OF BOXES

A. Outlet mounting heights as indicated on the plans are approximate. Determine the exact mounting heights (and locations) of outlets in the field with relation to architectural detail and equipment being served. Coordinate outlet location with equipment, with furniture plans and with architectural elevation plans. Where mounting heights are not detailed or dimensioned, contact the owner's representative for direction.

B. Prior to rough-in, coordinate final mounting heights of system outlet boxes in field with Owner's representative. Install boxes at heights as follows, to center of box, unless directed otherwise in field or otherwise noted on E-series drawings or architectural plans. In cases where using center of box for measurement would result in a switch-height device having an operable component higher than 48 inches above finished floor, install boxes lower as needed so that uppermost part of operable component is no higher than 48 inches. Height of boxes dimensioned from ceiling apply to rooms having ceilings 9' or less; in rooms having higher ceilings, locate these as directed in the field.

Switches – Elsewhere:	46”
Occupancy Sensors – Wallbox:	46”
Occupancy Sensors – Elsewhere:	As recommended by manufacturer
Receptacles – Counters:	44” (field-verify)

Receptacles – Elsewhere:	18”
Disconnects:	46”
Wall Mounted Luminaires:	As noted on plans or as directed by Architect
Fire Alarm Door Holders	84”
Other Outlets/Fixtures/Equipment	As directed by Architect

1.6 ACCESS DOORS

A. Do not use access doors unless special prior written permission is granted from the Owner's representative. Install pull boxes, junction boxes, etc. in areas which are accessible after completion of construction. Do not install pull boxes or junction boxes above gypsum board or similar inaccessible ceiling systems. Where there is no other recourse but to provide an access door/panel, and where approval of Owner’s representative has been obtained, provide required access doors/panels as required for a complete code-compliant electrical installation as defined below.

B. For installation in masonry, concrete, ceramic tile and wood paneling provide 1 inch-wide-exposed perimeter flange and adjustable metal masonry anchors. For gypsum wallboard and plaster provide perforated flanges with wallboard bead. For full-bed plaster applications provide galvanized expanded metal lath and exposed casing bead, welded to perimeter of frame.

C. Set frames accurately in position and securely attached to supports, with face panels plumb and level in relation to adjacent finish surfaces. Adjust hardware and panels after installation for proper operation. Provide locking devices that are flush screwdriver-operated cam locks.

D. Provide factory-fabricated and assembled units, complete with attachment devices and fasteners ready for installation. Provide continuously welded steel joints and seams, with welds ground smooth and flush with adjacent surfaces. Provide frames that are 16-gage steel, with a 1-inch-wide exposed perimeter flange for units installed in unit masonry, pre-cast or cast-in-place concrete, ceramic tile and wood paneling. Provide Standard Flush Panel Doors that are 14-gage sheet steel, with concealed spring hinges or concealed continuous piano hinge set to open 175 degrees; factory-applied prime paint. Provide Fire-Rated Units that are insulated flush panel doors, with continuous piano hinge and self-closing mechanism.

E. Provide unit assemblies that are rated for the respective fire and/or smoke rating of the surface to which they are installed.

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

1. Bar-Co., Inc.
2. J.L. Industries.
3. Karp Associates, Inc.
4. Milcor Div. Inryco, Inc.
5. Nystrom, Inc.

1.7 LOCK-OUT TAG-OUT DEVICES

A. Provide permanently installed lock-out tag-out devices compliant with NFPA 70 and OSHA, with padlocking provisions, at source overcurrent devices for the following applications.

1. Where the normal NFPA 70-compliant location of the disconnecting means is impracticable or introduces additional or increased hazards to persons or property.

2. Where otherwise required by NFPA 70.
3. Where required by OSHA.
4. Where otherwise required by any other authority having jurisdiction.
5. Where indicated in specifications.
6. Where indicated on drawings.

1.8 ELECTRICAL INSTALLATIONS

A. Install work conduit, wiring, outlet box type work in finished areas concealed. Such work installed in unfinished areas may be exposed at the discretion of the Owner's representative.

B. Arrange for chases, slots, and openings in other building components during progress of construction, to allow for electrical installations. Sequence, coordinate, and integrate installations of electrical materials and equipment for efficient flow of the work.

C. Provide systems, materials, and equipment to conform with approved submittal data, including coordination drawings, to greatest extent possible.

D. Install systems, materials, and equipment level and plumb, parallel and perpendicular to other building systems and architectural/structural components.

E. Install electrical equipment to facilitate servicing, maintenance, and repair and replacement of equipment components. Install equipment for ease of disconnecting, with minimum of interference with other installations. Install systems, materials, and equipment giving right-of-way priority to systems required to be installed at a specified slope. Protect the structure, furnishings, finishes, and adjacent materials.

F. Verify dimensions by field measurements. Take measurements and be responsible for exact size and locations of openings required for the installation of work. Figured dimensions are reasonably accurate and should govern in setting out work. Where detailed method of installation is not indicated or where variations exist between described work and approved practice, follow direction of the owner's representative.

G. Provide branch subfeeder circuits as shown on the plans. The symbols used to indicate the purpose of which the various outlets are intended are identified in the Electric Legend. Where outlets are indicated by letters on plans, provide corresponding switches to control them.

H. Provide no wire size smaller than No. 12 for branch circuits unless otherwise noted on plans for control circuits. Provide larger sizes where required by prevailing codes or indicated on contract documents. Provide neutral conductor for all multi-pole feeders. Provide neutral conductor(s) for all multi-pole feeders and branch circuits unless this contractor determines in field that the affected load(s) will never have need for a neutral conductor and NEC does not mandate otherwise. Provide minimum 3/4” conduit size.

I. Do not install device wall outlets directly back to back, where located on opposite sides of common walls. Offset outlets by at least two feet for applications in fire rated walls and smoke rated walls and applications in acoustically treated walls. Offset outlets by at least one foot for other applications.

J. Provide wires continuous from outlet to outlet and properly splice joints. Provide insulation value for joints 100% in excess of that of the wire. Mechanical wire splicers may be used. Where friction and rubber tape is used, provide tape conforming to Federal Specifications HH-T-11 and HH-T-111. Where plastic electrical tape is used, provide Scotch #33, or approved

equal. Provide minimum 8” tail for conductors terminating at each wired outlet at their outlet fittings to facilitate installment of devices, luminaires, etc.

K. If during construction it becomes apparent that some specific minor changes in layout will effect a neater job or better arrangement, make such alterations without additional compensation and without having to offer credit.. Obtain Engineer's review before making such changes.

L. Provide workmanship throughout that conforms to the standards of best practice. Marks, dents and finish scratches are prohibited on exposed materials, luminaires, fittings, etc. Clean inside of panels and equipment boxes.

1.9 CONNECTORS

A. Provide complete assembly of materials for each type of required electrical connection, including but not limited to, pressure connectors, terminals (lugs), electrical insulating tape, heat-shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.

B. Unless otherwise indicated, provide wires/cables (conductors) for electrical connections that match, including sizes and ratings, of wires/cables that are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 90 degrees C.

C. Provide electrical connectors and terminals that mate and match, including sizes and ratings, with equipment terminals, and that are recommended by equipment manufacturer for intended applications.

D. Provide electrical insulating tape, heat-shrinkable insulating tubing and boots, wirenuts, cable ties, etc. as recommended for use by accessories manufacturers for intended applications.

E. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment. Cover splices with electrical insulating material to achieve insulation at least 100 percent in excess of electrical insulation rating of those conductors being spliced. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Do not "ring" copper conductors while skinning wire.

F. There may be cases where circuit or feeder conductor sizes are too large or too small to fit into the lugs normally supplied with the end-use equipment, due to circumstances such as increasing conductor sizes to offset voltage drop, unusual breaker frame sizes, etc. In such cases provide appropriate factory lug kits for affected equipment if recommended by manufacturer; elsewhere provide insulated butt-splices with tails sized to fit respective lugs.

G. Provide connectors that are specifically UL listed and labeled for the exact splicing/termination application, including for instances where solid conductors are spliced/connected to stranded conductors.

H. Ground metal frames of portable and stationary direct-wired electrically operated equipment by connecting frames to the circuit equipment grounding conductor and to grounded metal raceway. Provide necessary electrical connections between the specified equipment and

junction boxes, disconnect switches, and starters near equipment with flexible metallic conduit and matched connectors. Do not expose flexible conduit in finished areas.

I. Connect electrical equipment furnished under this branch of work, other branches of work and by the owner. Review documents of other trades to identify electrically operated/controlled equipment that is furnished or installed by the owner, or by other trades. Provide power connections and local disconnects for same. Provide control wiring (including relays, starters, etc.), as required to render equipment fully operable unless indicated otherwise on drawings or in project manual. Determine exact requirements in field from respective equipment installer.

1.10 COORDINATION

A. Commence with coordination in a timely manner. Subsequent additional compensation, special allowances, additional construction time, etc. will not result from failure to coordinate (including providing related information to other trades for review) in a timely manner. Do not fabricate or install work before properly coordinating with other trades.

B. Plans are diagrammatic indicating design intent and indicating required size, points of termination and, in some cases, suggested routes of raceways, etc. However, it is not intended that drawings indicate fully coordinated conduit routing, necessary offsets, etc. The drawings are an outline to indicate the approximate location and arrangement of ductwork, piping, equipment, outlets, raceways, cables, etc. Install piping, conduit, raceways, cable assemblies, etc. as straight as possible and symmetrical (perpendicular to or parallel with) with architectural items. Work in and on the building installed diagonal to building members is prohibited.

C. Consult the plans of other trades while planning installations and before installing work so that work will not interfere with that of other trades.

D. Refer to Section 260533.00, Raceways and Boxes for Electrical Systems, for special material and installation requirements that relate to coordination.

E. Participate in multi-trade coordination efforts. Participate in preparation of coordination drawings by other trades, prior to fabrication or installation of equipment, materials, etc. Coordinate actual clearances of installed equipment. Coordinate exact location of electrical outlets, lighting fixtures, conduits, raceways, equipment, cable assemblies, applicable devices, etc. well in advance of installation so there will be no interferences at installation between the various trades.

F. Ensure that work and working clearances in electrical rooms and similar spaces complies with NEC Article 110. This also applies to finalizing locations of disconnects, starters, contactors and other electrically operated equipment that may require testing or maintenance while energized. Layout all affected equipment on paper, and meet with electrical inspector on-site as needed, prior to ordering related materials or commencing with installations, to ensure compliance with NEC Article 110.

G. Coordinate and correct conflicts in equipment and materials prior to installation. If a conflict cannot be resolved, refer the matter to the owner's representative for a final decision as to method and material.

1.11 CUTTING, PATCHING AND SEALING

A. Related Requirements:

1. Section 260544.00 "Sleeve and Sleeve Seals for Electrical Raceway and Cabling" for penetrations.

B. General

1. Provide cutting and patching for the admission of work. Perform cutting, fitting, and patching for electrical equipment and materials as required to:

    a. Uncover Work to provide for installation of ill-timed Work.
    b. Remove and replace defective Work.
    c. Remove and replace Work not conforming to requirements of the Contract Documents.
    d. Remove samples of installed Work as specified for testing.
    e. Install equipment and materials in existing buildings.

2. Upon written instructions from the owner's representative, uncover and restore work to provide for observation of concealed work by owner's representative or by inspection authority having jurisdiction.
3. During cutting and patching operations, protect adjacent installations (structure, finishes, furnishings, etc.). Where applicable, provide and maintain temporary partitions or dust barriers adequate to prevent the spread of dust and dirt to system components and components of other trades.
4. Patch surfaces and building components using new materials matching existing materials as applicable and using experienced Installers. Refer to Division 1 for definition of experienced "Installer" or determine qualifications as directed in field by owner's representative.
5. Patch through fire rated walls and enclosures in a manner that does not diminish the rating of that wall or enclosure. Provide materials used for patching to meet or exceed the smoke and fire rating of the respective surface being patched.
6. Neatly cut and drill openings in walls and floors required for the installation. Secure approval of Owner's Representative before cutting and drilling in work that is already in place. Neatly patch openings cut.
7. Hold cutting and patching to a minimum by arranging with other trades for sleeves and openings before construction is started.
8. Provide factory-assembled watertight wall and floor seals, of types and sizes required; suitable for sealing around conduit, pipe, and tubing passing through concrete floors and walls. Construct seals with steel sleeves, malleable iron body, neoprene sealing grommets and rings, metal pressure rings, pressure clamps, and cap screws.
9. Fabricate pipe sleeves from Schedule 40 rigid, heavy wall, full weight galvanized steel pipe; remove burrs. Use sleeves which are two standard sizes larger than conduit passing through respective sleeve.
10. Provide sleeve seals for piping which penetrates foundation walls below grade, exterior walls and roofs, caulk between sleeve and pipe with non-toxic, UL-classified caulking material to ensure watertight seal. Elsewhere modular provide mechanical type seals, consisting of interlocking synthetic rubber links shaped to continuously fill annular space between pipe and sleeve, connected with bolts and pressure plates which cause rubber sealing elements to expand when tightened, providing watertight seal and electrical insulation.
11. Provide standard Schedule 40 black steel pipe sleeves two sizes larger than pipes passing through floors, bearing walls and masonry construction. Cut sleeves through walls flush with both faces. Extend sleeves through floors one inch above floor top elevation. Provide a pipe curb assembly equal to Pate Co. for piped penetrating roof. Furnish and set forms required in masonry walls and foundations to accommodate pipes.
12. Seal all new floor, ceiling, wall, slab, etc. penetrations to match or exceed existing assembly fire ratings. Provide sleeve seals for all sleeves, provide sleeves for all

penetrations. All penetrations of fire-rated or smoke-rated wall, floors ceilings, etc. shall be sealed immediately after raceways are installed. All new electrically related work shall be supported directly from building structural members. New electrically related work shall not be supported from ductwork, ductwork hanger, ceiling supports, existing conduit support, etc. All conduits (and cable assemblies, where applicable) shall be routed parallel to building structural members. Any and all noncomplying work installed by the electrical contractor shall be removed and reinstalled to the satisfaction of the owner's representative and the engineer, at the expense of the electrical contractor.

C. Grout

1. Provide non-shrink, nonmetallic grout, premixed, factory-packaged, nonstaining, noncorrosive, nongaseous grout, recommended for interior and exterior applications.

D. General Joint Sealer Application

1. Provide joint sealers, joint fillers, and other related materials compatible with each other and with joint substrates under conditions of service and application.
2. Apply joint sealers under temperature and humidity conditions within the limits permitted by the joint sealer manufacturer. Do not apply joint sealers to wet substrates.
3. Clean affected surfaces, joints, etc. immediately before applying joint sealers to comply with recommendations of joint sealer manufacturer.
4. Apply sealant primer to substrates as recommended by manufacturer. Protect adjacent areas from spillage and migration of sealant, using masking tape. Remove tape immediately after tooling without disturbing seal.
5. Comply with joint sealer manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
6. Comply with recommendations of ASTM C 962 for use of elastomeric joint sealers.
7. Comply with recommendations of ASTM C 790 for use of acrylic-emulsion joint sealants.
8. Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.
9. Provide colors for exposed seals that are selected by the Owner's representative from manufacturer's standard colors.

E. Elastomeric Joint Sealers

1. Provide one-part, nonacid-curing, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for masonry, glass, aluminum, and other substrates recommended by the sealant manufacturer.
2. Provide one-part, mildew-resistant, silicone sealant complying with ASTM C 920, Type S, Grade NS, Class 25, for uses in non-traffic areas for glass, aluminum, and nonporous joint substrates; formulated with fungicide; intended for sealing interior joints with nonporous substrates; and subject to in-service exposure to conditions of high humidity and temperature extremes. Provide silicone sealant equal to the following:

    a. "Dow Corning 790", Dow Corning Corp.
    b. "Gesil N SCS 2600", General Electric Co.
    c. "Dow Corning 786", Dow Corning Corp.

F. Acrylic-Emulsion Sealants

1. Provide one-part, non-sag, mildew-resistant, paintable complying with ASTM C 834 recommended for exposed applications of interior and protected exterior locations involving joint movement of not more than plus or minus 5 percent. Subject to compliance with requirements, provide one of the following:

    a. "Chem-Calk 600", Bostik Construction Products Div.
    b. "AC-20", Pecora Corp.
    c. "Sonolac", Sonneborn Building Products Div.
    d. "Tremco Acrylic Latex 834", Tremco, Inc.

G. General Fire Stopping Material Application

1. Fire stopping requirements/locations are not indicated on electrical drawings. Review architectural and other drawings to determine fire/smoke rated walls and floors and rating requirements of same. Provide required fire stopping work associated with electrically related penetrations. Provide fire stop pillows, putty or sealant, as applicable, with minimum UL classification for 3 hour fire and cold side temperature ratings.
2. Clean affected surfaces, joints, etc. immediately before applying fire stopping to comply with recommendations of manufacturer.
3. Comply with fire stop material manufacturers' printed application instructions applicable to products and applications indicated, except where more stringent requirements apply.
4. Install fire stop materials, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide fire-stops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs. Comply with installation requirements established by testing and inspecting agency.
5. Caulk between sleeves and pipes with rockwool and caulk around sleeves with sealing compound that meets applicable fire ratings required.
6. Provide patch equal to rockwool, firestop, caulk or approved "rated" patch.
7. Where a smoke or fire-resistance classification is indicated on architectural drawings or otherwise, provide the following as applicable.

    a. Fire stop pillows, putty or sealant with minimum UL classification for 3 hour fire and cold side temperature ratings for electrically related penetrations.
    b. Access door assembly with panel door, frame, hinge, and latch from manufacturer listed in the UL "Building Materials Directory" for rating required; Provide UL Label on each fire-rated access door.

H. Wall/Floor Opening Fire Stopping for Work Likely to Need Ongoing Moves/Adds/Changes

1. Provide Fire Stop Putty equal to Nelson FSP #AA400 series, UL Classified for 3 hour fire and cold side temperature ratings, reusable when penetrating items are removed or added and requiring no special tools, mixing, curing or drying time.

I. Fire Stopping for Other Wall and Floor Openings

1. Provide Fire Stop Sealant equal to Nelson #AA491 series, UL Classified for 3 hour fire and cold side temperature ratings, non-sagging, permanently flexible, non-toxic, non-shrinking, water/air/smoke-tight and easily re-penetrated. Provide firestopping materials for the following locations:

    a. For Floor Openings
    b. For Wall Openings
    c. For Insulated Pipes
    d. For Fill Areas

2. Apply sealant primer to substrates as recommended by manufacturer. Protect adjacent areas from spillage and migration of primers, using masking tape. Remove tape immediately after tooling without disturbing joint seal.
3. Immediately after sealant application and prior to time shinning or curing begins, tool sealants to form smooth, uniform beads; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents that discolor sealants or adjacent surfaces or that are not approved by sealant manufacturer.

PART 2 - PRODUCTS (INCLUDED IN PART 1 ABOVE AS APPLICABLE)

PART 3 - EXECUTION (INCLUDED IN PART 1 ABOVE AS APPLICABLE)

END OF SECTION 260502

SUBMITTAL FORM - 260502.00 – COMMON ELECTRICAL MATERIALS AND METHODS

PROVIDE AND COMPLETE THIS SHEET AND SUBMIT AS A COVER SHEET FOR SUBMITTALS REQUESTED WITHIN THIS SECTION.

ELECTRICAL CONTRACTOR: _____ ELECTRICAL SUPPLIER: _____

ELECTRICAL CONTRACTOR REP: _____ ELECTRICAL SUPPLIER REP: _____

ELECTRIC CONTRACTOR PH. NUMBER: _____ ELECTRIC SUPPLIER PH. NUMBER: _____

ELECTRIC CONTRACTOR REP EMAIL: _____ ELECTRIC SUPPLIER REP EMAIL: _____

SUBMITTED ACCESS DOOR MANUFACTURER:_____

SUBMITTED SEALANT MANUFACTURER: _____

SUBMITTED FIRE/SMOKE STOPPING PRODUCT MANUFACTURER(S): _____

_____

	YES	NO
MANUFACTURERS LISTED AS BASIS OF DESIGN OR LISTED EQUIVALENT MANUFACTURERS?	☐	☐
IF NO, EXPLAIN _____		
WELDER CERTIFICATES INCLUDED?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURER'S WARRANTIES MEET OR EXCEED THE WARRANTY PERIOD SPECIFIED?	☐	☐
IF NO, EXPLAIN _____		
LOCK-OUT/TAG-OUT DEVICES, SEALANTS, FIRE/SMOKE-STOPPING AND ACCESS DOORS INCLUDED?	☐	☐

IF NO, EXPLAIN _____

SECTION 260503 - SUBMITTALS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, Division 01 Specification Sections and Division 26 Common Requirements for Electric.

B. Submittal Forms are included at the end of most Division 26 specification sections, addressing action submittals and applicable information submittals. Include the form as the secondary cover sheet for action submittals and applicable information submittals of each affected section. Note that other submittals are also required as part of the project, even though they may not be addressed in these Submittal Forms.

1.2 SUMMARY

A. Section Includes: Administrative, content and format requirements for preparation and submission of submittals.

B. Work of this Section is supplemental and additive to the requirements of Section 013300 where included in the Project Manual.

1.3 PRICE AND PAYMENT PROCEDURES

A. Payment in full or in part may be withheld from the Contractor for failure to comply with submittal requirements articulated in the Contract Documents.

1.4 SUBMITTALS

A. Submittals shall be furnished for each Section that includes one or more of the following elements of work:

1. Supply of one or more products.
2. Installation of one or more products.
3. Integration of one or more products.
4. Programming of one or more products.
5. Creation of one or more deliverable products.
6. Labeling of one or more products.
7. Contractor-based design or engineering of one or more products or systems.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 GENERAL

A. Submittals shall be routed through established Project channels as identified by the Owner's representative.

B. Coordinate, assemble, title, transmit and track Project submittals.

C. Label each submittal of each type similarly for consistency and so they appear as if prepared by the same entity. Like-type submittals (e.g., Product Data) from different Sections shall have the same appearance and organization as those of other Sections.

D. Submittals prepared by subcontractors or vendors shall not be accepted unless prepared in compliance with the Contract Documents.

E. Submittal items listed in this Section represent the common items required to be supplied for the various specification Sections throughout the duration of the Project. Individual Sections will vary and may include additional or lesser requirements.

F. Design Professional reserves the right to require additional submittals or to waive select submittal requirements on a Section-by-Section basis.

G. The cost for preparation and transportation of submittals is Work of the Contract.

H. Bind physical/hardcopy submittals together. Do not submit loose or paper clipped documents.

I. Supply separate submittals for each Section. Do not combine multiple Sections together into a single submittal, except where expressly directed within the Contract Documents.

J. Where electronic submittals are required or permitted, comply with the requirements for electronic submittals as identified in the Contract Documents.

K. Organize submittals as identified in the Contract Documents.

L. Furnish submittals for different Sections each with its own transmittal form. A single transmittal shall not be used to identify submittals for more than one (1) Section at a time. This allows for tracking and processing efficiency, so that:

1. Each Section may be reviewed simultaneously by different individuals, as appropriate.
2. Individual Sections may be processed and returned more quickly than others when some Sections require longer review times.
3. Submittals that are returned and marked as "Revise and Resubmit" do not cause submittals for other Sections to be also be resubmitted due to the fact that they were bound together as a single unit.

M. Use of Electronic Drawings from the Owner's Design Team:

1. Plan drawings for the Project were created with AutoCAD .
2. If expressly permitted by the Owner and the terms of the Contract, editable electronic versions of standard-scale, AutoCAD-based plan drawings may be made available for the creation of shop and as-built drawings.

3. Due to the proprietary nature of internal design systems, editable native-software versions of some drawings, including but not limited to system diagrams and details will not be made available in an editable form. In these cases, electronic versions of the drawings may be made available only in PDF, JPG or similar non-editable electronic form, at the sole discretion of the Design Professional.
4. The Request Drawings form can be accessed, filled out and submitted at the following internet address (scroll down to bottom of home page): http://www.klhengrs.com.

3.2 SUBMITTAL TYPES

A. The following are the common submittal types referenced in this Section:

1. Quality Assurance (QA).
2. Quality Control (QC).
3. Product Data (PD).
4. Shop Drawing (SD).
5. Samples (SS).
6. Training (TG).
7. Field Observation Response (FO).
8. Closeout Submittal (CO).

3.3 SEQUENCE

A. Quality Assurance Submittal:

1. When not expressly requested to be supplied with bid, the Quality Assurance submittal(s) shall be supplied upon request. When requested the submittal shall be delivered to the Design Professional within 16 business hours.

B. Product Data Submittal:

1. Submit following contract award or notice of intent to award a contract. Product data shall be submitted and reviewed prior to procurement of materials.

C. Shop Drawing Submittal:

1. Submit for review prior to commencement of fabrication and installation.
2. Submit concurrently with Section-specific Product Data submittals.

D. Samples Submittal:

1. Submit concurrent with, or soon after, product data and shop drawings and prior to installation of Work.

E. Training Submittal:

1. Submit thirty (30) days prior to the first training session.

F. Field Observation Report Submittal:

1. Submit five (5) business days prior to punch list walkthrough.

G. Closeout Submittal:

1. Submit following completion of onsite work but not more than ten (10) business days following successful Acceptance Testing.

3.4 IDENTIFICATION

A. Identify each submittal uniquely.

B. Identify each submittal by specification Section number, submittal type, and submittal iteration.

C. The format for labeling the submittals shall be as follows:

1. Section Number–Submittal Type Abbreviation–Submittal Iteration.
2. Examples:

a. First Product Data Submittal for section 261513: “261513-PD-00.”
b. Revised Product Data Submittal for section 261513: “261513-PD-01.”
c. Second Revised Product Data Submittal for 261513: “261513-PD-02.”

3.5 CONTENTS

A. General:

1. Transmittal:

a. Supply a dedicated transmittal for submittals for each individual Section.
b. Itemize the specific submittals included by Section, submittal type, and iteration.

2. Title Sheet:

a. Include a separate title sheet with each submittal, of each type.
b. Title sheets for each Section, for each submittal type, shall have the same appearance.
c. Title sheets for product data submittals shall be 8-1/2 inches x 11 inches.
d. Title sheets for drawings shall be the same size as the associated drawings.
e. Create title sheets to have the appearance and information identified on the sample title sheet published at the end of this Section.

3. Index:

a. Include an index outlining and identifying the contents of the submittal.
b. The index for drawing submittals shall be incorporated onto the title sheet of the corresponding drawing set.

4. Checklists:

a. Include the checklist(s) published in the Contract Documents corresponding to the type of submittal being supplied. Applicable checklists are found at the end of this Section and within individual Sections.

5. Title Blocks:

a. Drawing submittals shall be created on the Contractor's, manufacturers, or vendor's own title block. The title blocks of the Owner, Architect, Engineer, Design Professional or their Consultants shall not be reproduced on any document (electronic or hardcopy) that is prepared or altered by the Contractor.

6. Legend:

a. Drawing submittals shall include a legend of symbology.

7. Resubmittals:

a. Resubmittals shall include a replica of the reviewer's comments that necessitated the resubmittal, along with an accompanying item-by-item explanation of the actions taken and changes that will be found within the resubmittal.

B. Quality Assurance:

1. List of Subcontractors to be used on the Project along with a description of the role each shall play on the Project.
2. The last six (6) projects that the Contractor (and each proposed Subcontractor) has completed that are of similar scope, size and contract value. References shall include:

a. Owner's name and current contact information.
b. Project address.
c. Description of the system(s) and scope of actual work performed.
d. Monetary contract value of the Work performed.

3. Financial Disclosure of the Contractor: Prior to contract award, upon request.

C. Product Data Submittals:

1. Bill of Materials (BOM):

a. Separate list for each system:

1) When a Section covers products for use in multiple systems, supply separate BOM for each unique system covered by the Section. Label each with the system name, space/room name, and room number.

b. Include the following:

1) Make, model, and description of each product.
2) Quantity estimates for each product.
3) Section paragraph number from which the product requirement is derived. Use drawing and detail references when the requirement is derived from the Drawings.

c. Organize the BOM to follow the order in which products appear within the Section. Products shown on the Drawings but not enumerated within the Specifications shall be placed at the end of the list and include a reference to the Drawing from which the product requirement was derived.

2. Product Datasheets:

a. Separate manufacturer datasheets for each product.
b. Datasheets shall be manufacturer originals or first generation printed versions (i.e., from PDF) of the manufacturer's official electronic datasheet:

1) Distributor modified, distributor branded, and/or html based "web" datasheets are not acceptable.
2) Datasheets shall include size and technical support data.

c. Where manufacturer's datasheets depict multiple products, versions and options, indicate via highlighting, underlining, or with bold visible arrows the model(s), version(s) and option(s) being supplied. Exact catalog number(s) shall be indicated.
d. Each datasheet shall be labeled with the Section paragraph reference number. Datasheets shall include the Drawing reference when no specific paragraph reference exists within the Section.

D. Shop Drawing Submittals:

1. General:

a. Drawing descriptions identify the required contents of common drawings required under the Contract.
b. Drawings identified within individual Sections, along with any additional drawings deemed necessary by the Design Professional, are required.
c. Drawing Scales:

1) Floor plans shall be drawn to scale.
2) Section drawings shall be drawn to scale.
3) Elevation drawings shall be drawn to scale.
4) Details of physical items shall be drawn to scale.
5) Rack layouts and custom furniture and console drawings shall be drawn to scale.
6) System drawings and schematic drawings shall be drawn 1:1 (no scale).

d. Sizes:

1) Sheet sizes shall match the size of the Contract Drawings sheets, except where otherwise expressly requested or approved in advance by the Design Professional.

2. Floor Plans:

a. Location of system devices and faceplates.
b. Primary and secondary system cabling pathway(s).
c. Location of equipment racks.
d. Location of equipment-housing furniture.
e. Location of equipment enclosures.
f. Location of major system components.
g. Location of equipment that is Work of another Section to which Work interconnects.

3. Reflected Ceiling Plans:

a. Location of ceiling devices, coordinated with devices that are Work of others, and existing devices (where applicable).

4. System Diagrams:

a. Hybrid schematic / block wiring diagram.
b. System products depicted.
c. Product inputs, outputs and other ports depicted.
d. System cables depicted.
e. Product brand, model, description, options, and accessories declared.
f. Interconnections depicted between system products.
g. Interconnections depicted between system products and related system products.
h. Declaration of the cable types, including brand, model, description and color. An accurate cable key is acceptable.
i. Unique identification (e.g., number) assignment for each cable.
j. Cable color coding schema.
k. Termination typicals, keyed to diagram interconnections.

5. Custom Assemblies and Products:

a. Manufacturer.
b. Materials.
c. Finish and color(s).
d. Parts list.
e. Nomenclature sizes, colors.
f. Dimensions.
g. Schematic diagram(s), where applicable.

6. Mounting Details:

a. Depicting the materials and means of securing installed products.
b. Finishes and colors of exposed parts.

E. Training Submittals:

1. Proposed schedule.
2. Training agendas for each session.
3. Identification of personnel that will conduct training.
4. Handouts proposed for distribution during training.

F. Field Observation Reports Submittals:

1. Written responses to Field Observation Reports supplied to the Contractor during the course of the Project:

a. The response shall include a copy of the original Field Observation Report.
b. The response shall include detail of the corrective action taken, the date the action was taken and the identity of the individual who took the action.

G. Closeout Submittals:

1. Certificates of Final Inspection and Approval:

a. Furnish certificates of final inspection and approval prior to final acceptance of this branch of the work.

2. As-Built Drawings:

a. General:

1) Requirements for Shop Drawings apply to “As-Built” drawings.

b. Required Drawings:

1) Title Sheet.
2) Floor Plans.
3) Power Distribution Diagrams.
4) Mounting Details.
5) Labeling Schema.
6) As-built version of each Project shop drawing.
7) Coordination drawings and similar construction-related documentation.

c. Drawing Formats:

1) Electronic Editable: Editable version using the native application used to create the file (e.g., Revit, AutoCAD, Star-Draw, Visio, VidCAD).
2) Non-Editable: PDF file format.
3) Printed Hardcopy.
4) Sheets shall be the same size and feature consistent title block information in the lower-right corner.

d. Drawing Organization:

1) Hardcopy drawings shall be bound together into logical sets, bound along the left edge of the sheets.
2) The first page of the set shall include a detailed index and sheet-by-sheet description of each drawing sheet.

3. Operation and Maintenance Manuals:

a. Manual Format:

1) Hard-cover 3-ring type binder.
2) Front clear plastic cover pocket complete with Project and system Information insert.
3) Clear plastic spine pocket with Project and system Information insert.
4) Binder sized to suit the contents only, neither oversized nor undersized.
5) Maximum binder thickness: 3 inches.

b. Manual Contents and Organization:

1) General:

i) Separate binder (or binder set) for each system, labeled. Provide no more than one system per binder (or binder set).
ii) Separate CD-ROM (or CD-ROM set) for each system, labeled. Provide no more than one system per CD-ROM (or CD-ROM set).

iii) Do not overfill. Binders shall not be filled beyond an easily usable capacity.
iv) Insert labeled tabs within binder to identify separate contents of the manual.
v) Labeled sub-directories shall be created on the CD-ROM to label and separate contents for the manual.

2) Project Information Cover:

i) Title of Project.
ii) Name and address of Owner, Design Professional, Architect, Contractor of Record and Subcontractor.
iii) System name and specification references.

3) Index:

i) Contents of the manual.

4) Warranty Statement:

i) A warranty statement shall be included for each system. The warranty statement shall reiterate the terms of warranty identified within the Contract Documents, as well as identify how the Owner is to obtain warranty service.
ii) The warranty statement shall clearly identify which products are covered by Manufacturer warranties beyond the Contractor required minimum warranty period. The term of manufacturer warranty shall also be identified (e.g., 1 year parts and labor).
iii) A separate warranty statement shall be supplied for each system.
iv) Identify the date that the warranty for the system starts. This date shall be the date listed on the Certificate of Substantial Completion (if one was issued to the contractor specifically for the system) or the date listed on the Notice of Final Completion.
v) Supply standard out-of-warranty service rates and service contact information.

5) Bill of Materials:

i) List of products supplied.
ii) Serial numbers of each product.
iii) IP addresses of those products configured to have static IP addresses.
iv) MAC addresses of products featuring network communication ports (wired and/or wireless).
v) Network device names for those products configured for DHCP.

6) Product Datasheets (supply only in the electronic version of Operation and Maintenance Manual):

i) Manufacturer datasheets for each product supplied.

7) Manufacturer Owner / User Manuals:

i) Manufacturer’s Owner’s or User’s manual for each product.

ii) Manufacturer's Installation instructions and other documentation supplied with the product.

8) Spare and Replacement Parts Schedule:

i) Complete spare parts schedule for components of equipment furnished, which are not factory generic information, but accurate for the equipment actually provided.
ii) Itemized list of each piece of mechanical equipment having electrical connections with circuit and panelboard locations; also list with each item related expendable equipment required such as fuse size and type, pilot lights, catalog numbers of fuses, overloads, etc. as applicable.
iii) Itemized list of each luminaire type with catalog number of replacement lamps, ballasts, trims, lenses and accessories.

9) Maintenance Procedures:

i) Maintenance procedures for routine preventative maintenance and troubleshooting; disassembly, repair, and reassembly; aligning and adjusting instructions.

10) Function and Operating Descriptions:

i) Description of function, normal operating characteristics and limitations, performance curves, engineering data and tests, and complete nomenclature and commercial numbers of replacement parts.

11) Operating Procedures:

i) Manufacturer's printed operating procedures including start-up, break-in, normal operating instructions, regulation, control, stopping, shutdown, and emergency instructions.

12) Test Reports and Checklists:

i) Test reports, checklists, and other forms generated and completed during the course of the Project.

13) Training Information:

i) Photocopy of training outlines / agendas.
ii) Photocopy of training session handouts.
iii) Photocopy of training sign-in sheets.
iv) Photocopy of signed delivery receipt for each training session recording (applicable to those Sections/systems requiring recording).
v) Separate CD-ROM (or CD-ROM set), labeled, for audio/video-recorded instructions to owner, for operations and maintenance for each system.

14) As-Built Drawings:

i) The hardcopy manual shall contain reduced scale printed version (11x17) of system-specific drawings.
ii) The electronic manual shall contain electronic PDF version of the as-built drawings.

15) Software (electronic manual only):

i) Editable configuration files for system equipment.
ii) Software source code use in supplied products.
iii) Compiled versions of configuration files and source code.
iv) Software required for reviewing and editing supplied files.

3.6 QUANTITY

A. General:

1. The quantity of submittals required shall be the greater of the following:

a. Quantity identified within Division 01.
b. Quantity identified within the individual Section.
c. Quantity identified herein.

2. In addition to the Contract required quantity, the Contractor shall also submit any additional quantities required for its own use and records, and for distribution to other trades.
3. The Design Professional shall retain a copy of each submittal received. Others in the submittal communication chain may also retain copies.

B. Product Data Submittals:

1. One (1) Hardcopy.
2. One (1) Electronic.

C. Shop Drawings Submittals:

1. One (1) Hardcopy.
2. One (1) Electronic.

D. Training Submittals:

1. One (1) Hardcopy.
2. One (1) Electronic.

E. Field Observation Reports Submittals:

1. One (1) Hardcopy.
2. One (1) Electronic.

F. Samples Submittals:

1. One (1) Hardcopy.
2. One (1) Electronic.

G. Closeout Submittals:

1. One (1) Hardcopy.
2. One (2) Electronic.

3.7 REJECTION

A. The following items are representative reasons that submittals may need to be revised and resubmitted:

1. Binding submittals for multiple Sections together.
2. Failing to supply separate transmittal for submittals for each Section.
3. Failing to include a submittal title sheet.
4. Failing to use and accurately complete the published title sheet.
5. Failing to supply and accurately complete the submittal checklists.
6. Failing to supply product data and shop drawings at the same time.
7. Failing to include a detailed BOM with the product data.
8. Failing to supply product data sheets.
9. Failing to supply product data sheets with the correct product and required accessories enumerated.
10. Failing to supply shop drawings.
11. Failing to supply shop drawings with required information.
12. Failing to supply accurate information.
13. Failing to supply relevant information required by the Specifications.
14. Failing to supply products that are in compliance with the Specifications.
15. Failing to supply the required information in the required format.

3.8 RESUBMITTALS

A. Revise and Resubmit:

1. When a submittal is rejected and flagged as “Revise and Resubmit,” the entire submittal shall be reviewed, revised and resubmitted in totality.
2. Resubmittals shall be checked for compliance with the Contract Documents, inclusive of requirements for submittals. In addition, any comments and deficiencies identified by the reviewer shall be appropriately acted upon.

B. Exceptions Noted:

1. When a submittal is flagged as “Exceptions Noted,” the specific actions identified shall be taken.
2. If the reviewer’s comments include selective rejection of products, the resubmittal shall be limited to include those items commented upon.

C. Resubmittals shall:

1. Include a copy of the reviewer’s previous comments.
2. Include a written description of the action(s) taken.
3. Be labeled chronologically.
4. Be inclusive of all corrective action identified by the previous reviewer.

3.9 ELECTRONIC SUBMITTALS

A. Electronic submittals shall only be permissible where electronic submittals are expressly required and where express approval for such has been granted.

B. Electronic submittal files shall be compatible for opening and viewing with electronic PDF file readers that fully support and recognize the Adobe PDF Portable Document Format Standard.

C. Major text within the files shall be electronically searchable using the search-for-text features of current generation Adobe PDF reader software. Files shall be prepared in such manner that reviewers will have the option to search for and find words and phrases that appear within the document, electronically. Documents featuring raster-based text and text that is otherwise not searchable shall not be acceptable. This precludes the use of documents that have been electronically scanned and then converted to or embedded within an electronic file.

D. The organization, contents, and labeling of information along with other requirements for submittals apply also to electronic versions of the submittals.

E. Single File Submission:

1. Option 1 – Single File, PDF Format:

    a. Single PDF file submittals shall be assembled from a series of individual files that are organized, indexed, bound together as one composite file that is bookmarked to aid the reviewer in navigating the content.
    b. The file shall feature a navigational tree of contents, organized by content groups (e.g., Title Page, Index, BOM, Datasheets, Shop Drawings). Content groups shall be organized in the same relative order identified within the Contract Documents.
    c. Within each content group shall be the supporting elements of the group (e.g., product datasheets under the Datasheets group). Each element of the content group shall appear separately as a subordinate element of the group (e.g., separate entry for each product datasheet, separate entry for each shop drawing), and viewable from the navigational contents tree.
    d. Under the Datasheets content group, individual product datasheet entries shall be identified by Make/Brand and Model. Entries shall be organized in a sorted manner, first by make, then by model.
    e. If the resulting size of the composite PDF file exceeds 10 Megabytes, supply the submittal using the Single Zip File method instead, as described in this Section.
    f. The file name used to label the submittal shall be the section number followed by the submittal instance number for that Section (e.g., <xx>1513-PD-01.pdf).

        1) Where the Design Professional directs the supply of multiple zip files for a submittal, add additional text to the file name to identify that the file is part of a multi-file set of submittals, as per the following examples:

            i) 261513-PD-01 (1 of 3).pdf
            ii) 261513-PD-01 (2 of 3).pdf
            iii) 261513-PD-01 (3 of 3).pdf

2. Option 2 – Single File, Zip Format:

    a. Single Zip File submittals shall be assembled from a series of individual PDF files and file directories that are contained with a single compressed WinZip compatible ".zip" file.

b. The file shall contain separate top-level directories that are used to group related content (e.g., 00-Title Page, 01-Index, 02-BOM, 03-Datasheets, 04-Shop Drawings), with each directory appearing in the same relative order as that identified in the Contract Documents.
c. Within each content group directory shall be separate PDF-compliant files featuring the information required (e.g., separate datasheet file for each product, separate file for each drawing, separate file for each BOM).
d. Product datasheet files shall be named using a consistent naming convention that enables those files to appear sorted and grouped when the file is opened for navigation, viewing or extraction by the reviewer.
e. Product datasheet files shall be consistently named with the make/brand of the product, followed by model number, followed by any additional information beneficial.
f. Consult the Design Professional for supplement instructions should the WinZip file exceed 50 Megabytes in size.
g. The file name used for the submittal shall be the Section number followed by the submittal instance number for that Section (e.g., <xx>1513-PD-01.zip).

    1) Where the Design Professional directs the supply of multiple zip files for a submittal, add text to the file name that identifies the file is part of a multi-file set as per the following examples:

        i) 261513-PD-01 (1 of 3).zip
        ii) 261513-PD-01 (2 of 3).zip
        iii) 261513-PD-01 (3 of 3).zip

END OF SECTION 260503

XXXXXXXXXX
SHOP DRAWING CHECKLIST
(Form: Sub-8)

SUBMITTAL TITLE SHEET
EXAMPLE
(Form: Sub-1)

PROJECT TITLE:
Project Name Line 1
Project Name Line 2
Project Name Line 2

SUBMITTAL TYPE:
Product Data

SECTION SUBMITTAL NUMBER
260000-PD-00

SECTION TITLE:
Section Name

Date Prepared:
yyyy-mm-dd

CONTRACTOR OF RECORD:
Firm Name
Address1
Address 2
City, State, Zip
Phone (000) 000-0000, Fax (000) 000-0000
Project Manager: Full Name
PM E-Mail: xxxxxxxx@xxxx.xxx

SECTION SUBCONTRACTOR(S):

Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: xxxxxxxxx@xxxx.xx	Firm Name Address 1 Address 2 City, State Zip Phone (000) 000-0000 Fax (000) 000-0000 PM Name: Full Name PM E-Mail: xxxxxxxxx@xxxx.xx

XXXXXXXXXX
SHOP DRAWING CHECKLIST
(Form: Sub-8)

PRODUCT DATA SUBMITTAL

CHECKLIST
(Form: Sub-2)

Each line below featuring text shall be supplied with an answer.

	No	Yes
Transmittal		
Title Sheet		
Project Name		
Spec Section number		
Submittal iteration number. *(0 for first iteration, 1 + for each subsequent iteration (e.g. 261513-0 ,261513-1))*		
Contractor of Record identified		
Sub-contractor / vendor / supplier name identified		
Title Sheet appearance consistent with sample title sheet		
Bill of Materials		
Section paragraph and/or drawing reference identified		
Make		
Model		
Product Description		
Quantity		
Separate lists included for each system.		
Checklists included		
This checklist		
Previous submittal review, with contractor actions and comments		
Product Datasheets included		
Datasheets are manufacturer originals		
Datasheets for each product included		
Section paragraph and/or drawing reference on each datasheet		
Product accessories and options identified		
Products organized by paragraph (or alphabetically by brand)		
No photocopies, faxes and other illegible datasheets included.		
Shop Drawings included		
Shop drawings accompany this product data submittal		
This submittal contains product data for one section only		

This checklist serves as simple and abbreviated reminder of the contents and format of the aforementioned submittal. Refer to the 260503 "Submittals for Electric" and each specific Section for additional submittal requirements. Submittals are subject to rejection if this checklist is not accurately completed and supplied along with the specified information. Reproduce this checklist and submit with each submittal for each Section.

SECTION 260505 - EXISTING CONDITIONS

PART 1 - GENERAL

1.1 GENERAL REQUIREMENTS

A. Perform a detailed pre-bid walk-through field inspection to review the existing structures and premises, to determine existing conditions, and to determine scope of required electrically related work. Include applicable accessible ceiling cavity areas in this inspection.

B. It is not the intent of this section, or of drawings, that existing conditions be accurately shown. Existing electrical work is shown to a very limited extent on drawings and is shown for general planning reference only. Locations and information were derived from cursory visual observations or from portions of documents that were prepared for previously installed work (not from record drawings or "as-builts").

C. Do not reuse removed electrical materials unless specifically indicated in project manual or on drawings. Existing wiring systems may be utilized only to the extent indicated in project manual, or on drawings, or as directed by Owner's representative in field.

D. Hold routing of new raceways in existing buildings as tightly as possible to the structure above. Obtain approval of owner's representative prior to installation.

E. If required to accommodate construction related activities temporarily remove, store in protected location on site, and reinstall conflicting electrical equipment, luminaires, or devices that are to remain or to be relocated.

F. The following applies to electrical materials that will remain or be reused under this project.

1. Protect during construction activities.
2. Clean and re-lamp luminaires immediately prior to occupancy of the finished construction area.
3. Clean and service (if service is required) equipment in the construction area immediately prior to occupancy of the area.

1.2 AFFECT ON ADJACENT OCCUPIED AREAS

A. Maintain existing electrical service and feeders to occupied areas and operational facilities, unless otherwise indicated, or when authorized otherwise in writing by owner’s representative. Provide temporary service during interruptions to existing facilities. Schedule momentary outages when necessary for replacing existing wiring systems with new wiring systems. When that "cutting-over" has been successfully accomplished, remove related wiring that has been abandoned.

B. Carefully coordinate work and system shutdowns in advance with owner's representative, and with affected trades so that normal building activities and other construction trades are minimally affected. Perform electrically related construction work, which will affect an occupied area (including those which are located outside the immediate area of project work) at special times as directed by owner's representative in field.

C. Provide work in a manner that ensures existing systems and components remain fully operational in occupied spaces during occupied periods.

D. Provide and maintain temporary partitions and dust barriers adequate to prevent the spread of dust and dirt to adjacent finished areas and other system components. Protect adjacent installations during cutting and patching operations. Remove protection and barriers after demolition operations are complete.

1.3 EXISTING POWER DISTRIBUTION EQUIPMENT

A. This subsection applies for adding components to existing power distribution equipment.

B. Unless specifically indicated otherwise on drawings or in specifications provide new breaker in instances where new circuits or feeders are shown connected to existing circuit breaker type power distribution equipment.

1. Provide factory-assembled, molded-case circuit breakers of frame sizes, characteristics, and ratings including RMS symmetrical interrupting ratings required. Provide breakers with permanent thermal and instantaneous magnetic trip, and with fault-current limiting protection, ampere ratings as indicated. Construct breakers for mounting and operating in any physical position, and operating in a minimum ambient temperature of 40 deg C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated. All branch circuit breakers shall be full ambient compensated thermal magnetic molded case with quick-make and quick-break action and positive handle trip indication, both on manual and on automatic operation.
2. Breakers shall be of the over-the-center toggle operating type with the handle going to a position between "on" and "off" to indicate automatic tripping. All circuit breakers shall be full size. Do not use “tandem" or "split" breakers. All multi-pole breakers shall have internal common trip with all load side box lugs of one breaker in the same gutter. All circuit breakers shall have sealed cases to prevent tampering.
3. All 15 and 20 ampere branch circuit breakers shall be UL Listed as SWD (switching duty). All 15-70 ampere branch circuit breakers shall be HACR Type. All branch circuit breakers serving all ballasted (fluorescent/HID) lighting loads shall be HID rated. Provide handle lock-on devices of the non-padlocking type for life safety, special systems and other essential circuits.

C. Provide components that are manufactured by the same manufacturer as the existing equipment in which they will be installed, and that are intended by the manufacturer to be installed in said equipment. Provide components with fault current (A.I.C.) ratings that meet or exceed the ratings of the existing power distribution equipment.

D. Update and fill out the panelboard's circuit directory card upon completion of installation work. Directories shall be neatly typewritten. All panelboard directories shall include the actual room names/numbers that are selected for interior signage/designation.

E. All specific scheduling shown on drawings is shown to indicate new branch circuiting requirements. Exact numbering sequence of circuits shall be determined by this contractor in field after this contractor has performed final balancing.

F. Determine which existing branch circuits must remain active. Reconnect (or maintain in operation as applicable) and schedule them. Completely re-type panelboard directories for panelboards affected by this project using accurate “as-built” information. Where applicable for multi-wire branch circuits that are reused to feed new or replacement equipment designated on

drawings, replace existing single-pole breakers with multi-pole breakers compliant with NFPA 70. Where applicable ensure that reconnected shared neutrals are properly balanced with the correct phase conductors. Where applicable, provide correct color-coding for insulation of reconnected conductors in a manner compliant with NEC.

1.4 PRE-EXISTING CODE VIOLATIONS

A. Inspect existing electrical work in areas accessed under this project and bring into compliance with current NEC. This applies only to the extent that such work is uncovered in the immediate project areas affected by construction activities, and only to the limited extent that it applies to pre-existing general installation methods such as missing J.B. plate, open J.B. knockout, minor conduit re-anchoring and minor exposed wiring/connections.

B. If more extensive code or safety violations are discovered, immediately bring them to the attention of the Owner's representative (detailed in writing) along with proposed cost for corrections and impact (if any) on the construction schedule.

1.5 DEMOLITION

A. Where the term “demolition” is used herein, interpret it to mean “demolition” or “selective demolition” as applicable.

B. Provide electrical demolition work as required to accommodate project demolition and as required to accommodate new construction.

C. Disconnect and remove work to be abandoned, and as required to accommodate work of other trades, in areas affected by this project unless specifically noted otherwise on plans or determined otherwise during pre-demolition survey.

D. Remove accessible abandoned, inactive and obsolete raceway systems. Remove abandoned, inactive and obsolete wiring and controls. Remove abandoned, inactive and obsolete equipment, luminaires and devices. Abandoned raceways embedded in floors, walls, and ceilings may remain if such materials do not interfere with new installations. Remove abandoned electrical materials above accessible ceilings.

E. Remove related abandoned unused raceway back to the nearest respective "upstream" junction box that remains active even if outside of the confines of the project area.

F. Extend raceway and wiring as required to accommodate new or relocated electrical work.

G. It is recognized that there may be some conduit systems rendered inactive by demolition, causing disconnection of "downstream" outlets, etc. Investigate these types of conditions (for all systems) prior to demolition. Provide necessary corrective electrical work prior to demolition to ensure that such "downstream" devices remain permanently active throughout demolition, during new construction, and after project completion.

H. Perform cutting and patching required for demolition.

I. Coordinate work carefully with owner prior to beginning electrical demolition work.

J. Maintain (or reconnect if applicable) remaining wiring.

K. Remove and relocate wiring, devices, conduit, etc. that conflict with construction related work of other trades as necessary to accommodate new work of respective trade.

L. Provide electrical disconnections, and reconnections where applicable, for equipment to be removed (or relocated) by other trades.

M. Existing branch circuit and systems conduit, not conflicting with new construction and not conflicting with overhead or ceiling cavity requirements, may be re-used at the discretion of the electrical installer after all abandoned conductors and cables have been removed from them. Do not exceed NEC required conduit fill and do not install wiring fed from different sources in common conduit (see Section 26 05 33).

N. Refer to owner’s representative for disposal instructions for abandoned electrical materials removed during demolition and thereafter. Neatly store electrical materials that the Owner elects to retain at the site as designated by the owner's representative. Legally dispose of materials that the Owner elects not to retain.

O. Disconnect and remove electrical materials designated for salvage (removal and reuse, or for turning over to Owner) undamaged. Disconnect and remove wiring and "whips" from equipment terminal points.

P. Clean components to be reused inside and out, and reinstall where indicated on drawings. Modify and extend related existing wiring in conduit accordingly.

Q. Carefully transport salvaged electrical materials to a protected on-site storage location as directed in field and neatly store them grouped by system type.

END OF SECTION 260505

SECTION 260519 - 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 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below. If not listed, submit as substitution.

1. Alcan Products Corporation; Alcan Cable Division.
2. Alpha Wire.
3. Belden Inc.
4. Encore Wire Corporation.
5. General Cable Technologies Corporation.
6. Southwire Incorporated.
7. American Insulated Wire Corp
8. Carol Cable Co., Inc

B. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658. Refer to Part 3 of this section for allowable types specific to this project.

C. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658. Refer to Part 3 of this section for allowable types specific to this project.

D. AC/MC Cable:

1. Provide Type AC/MC Cables that are minimum 90 degrees C rated, with components and fittings listed for grounding, and compliant with the following.

a. NEC Articles 250 and 330.

2. Provide cable formed from continuous length of spirally wound, interlocked zinc coated or galvanized (inside and outside) strip steel. Provide cables with full parity insulated equipment ground conductor.
3. Provide compatible steel fittings with integral red plastic insulated throat bushings, compliant with NEC 330.

2.2 CONNECTORS AND SPLICES

A. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below. If not listed, submit as substitution.

1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.
6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.
9. Tyco Electronics.
10. Square D, a Schnieder Electric Company
11. Thomas & Betts
12. Arrow-Hart Div, Crouse-Hinds Co

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated. Use connectors with temperature ratings equal to or greater than those of the wires upon which used.

2.3 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 NFPA 70.

C. Provide wire, cable and connectors suitable for the temperature, conditions and location where installed.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Stranded Copper .

B. Branch Circuits: Stranded conductors.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Provide conductor insulation rated at 600VAC and 90 degrees C.

B. Provide THHN/THWN insulation for conductors size 500 kcmil (MCM) and larger, and for conductors # 8 AWG and smaller. Provide THW or THHN/THWN insulation for other sizes as appropriate for the locations where installed.

C. Provide XHHW-2 insulation for wiring below grade and for wiring subject to moisture conditions.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Provide grounded (“neutral”) conductor in all lighting control device (switch, dimmer, occupancy sensor, etc.) wall outlet boxes, even if not immediately used.

B. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

C. 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.

D. Use manufacturer UL 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.

E. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips, that will not damage cables or raceway.

F. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

G. Support cables according to Section 260529 "Hangers and Supports for Electrical Systems."

H. Install wire in raceway unless specifically permitted otherwise in this specification section, under other Division 26 sections, or on electrical drawings.

I. Provide dedicated parity sized neutral conductor for each branch circuit phase conductor fed from 15 ampere and 20 ampere branch circuit breakers.

J. Provide grounded (“neutral”) conductor for all multi-pole feeders. Provide grounded (“neutral”) conductor(s) for all multi-pole feeders and branch circuits unless this contractor determines in field that the affected load(s) will never have need for a grounded (“neutral”) conductor and NEC does not mandate otherwise.

K. Provide grounded (“neutral”) conductor in all lighting control device (switch, dimmer, occupancy sensor, etc.) wall outlet boxes, even if not immediately used.

L. Connect wires #6 AWG and larger to panels and apparatus by means of approved lugs or connectors large enough to enclose all strands of the conductors. Provide solderless type connectors

M. Do not pull wire until raceways are complete, plastering is complete, and raceways are free of moisture. Install joints and splices only at NEC approved panels, accessible junction boxes, or accessible outlet boxes. Pull conductors simultaneously where more than one is being installed in same raceway. Use UL listed pulling compound or lubricant, where necessary to prevent damage to conductors. Use pulling means, including fish tape, cable, rope, and basket weave wire/cable grips that will not damage cables and raceways. Do not use rope hitches for pulling attachment to wire or cable. Conceal work in finished spaces.

N. Neatly dress work. Install work parallel and perpendicular to surfaces and exposed structural members, and follow surface contours where possible. Keep conductor splices to minimum. Install splice and tap connectors that possess equivalent, or better, mechanical strength and insulation rating than conductors being spliced. Use splice and tap connectors that are compatible with conductor material. Install wires continuous from outlet to outlet. Provide insulation value of joints at least 100 percent in excess of wire. Provide adequate length of conductors within electrical enclosures, and train the conductors to terminal points with no excess. Bundle multiple conductors, with conductors larger than #10 AWG cabled in individual circuits. Make terminations so there is no bare conductor at the terminal.

O. Derate cables per NFPA 70 where bundled, where passing through insulation, and where otherwise required to be compliant with NFPA 70 based on field conditions and/or means and methods that will be used.

P. Derate conductors per NFPA 70 where required based on quantities of conductors within raceways, and where otherwise required to be compliant with NFPA 70 based on field conditions and/or means and methods that will be used.

Q. Provide factory splice kits (U.L. approved for submersion in water and direct burial) for wire splicing in outdoor grade, or slab on grade, junction boxes and for all other wet locations.

R. Type AC/MC cable may be utilized only if NEC approved and if approved by local authority having jurisdiction and if included in the limited applications defined below.

1. Provide for final connections to luminaires that are installed in accessible tile ceiling systems (limited to 6' maximum in length and limited to “whips” from building electrical system junction boxes down to luminaires). Do not install Type AC/MC cable from fixture to fixture unless a special properly listed and labeled UL approved system is specifically indicated.

3.4 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 unspliced conductors.

C. Wiring at Outlets: Install conductor at each outlet, with at least 8 inches of slack.

D. Provide complete assembly of materials for each type of required electrical connection, including but not limited to, pressure connectors, terminal (lugs), electrical insulating tape, heat shrinkable insulating tubing, cable ties, solderless wire-nuts, and other items and accessories as needed to complete splices and terminations of types indicated.

E. Unless otherwise indicated, provide wires/cables (conductors) for electrical connections that match, including sizes and ratings, of wires/cables that are supplying electrical power. Provide copper conductors with conductivity of not less than 98% at 90 degrees C.

F. Provide electrical connectors and terminals that mate and match, including sizes and ratings, with equipment terminals, and that are recommended by equipment manufacturer for intended applications.

G. Connect electrical power supply conductors to equipment conductors in accordance with equipment manufacturer's written instructions and wiring diagrams. Mate and match conductors of electrical connections for proper interface between electrical power supplies and installed equipment. Cover splices with electrical insulating material to achieve insulation at least 100 percent in excess of electrical insulation rating of those conductors being spliced. Prepare cables and wires, by cutting and stripping covering armor, jacket, and insulation properly to ensure uniform and neat appearance where cables and wires are terminated. Exercise care to avoid cutting through tapes which will remain on conductors. Do not "ring" copper conductors while skinning wire.

H. There may be cases where circuit or feeder conductor sizes are too large or too small to fit into the lugs normally supplied with the power distribution equipment or end-use equipment, due to circumstances such as increasing conductor sizes to offset voltage drop, unusual breaker frame sizes, type of conductors used, etc. In such cases provide appropriate factory lug kits for affected equipment if recommended by manufacturer; elsewhere provide insulated butt-splices with tails sized to fit respective lugs.

I. Ground metal frames of portable and stationary direct-wired electrically operated equipment by connecting frames to the circuit equipment grounding conductor and to grounded metal raceway. Provide necessary electrical connections between the specified equipment and junction boxes, disconnect switches, and starters near equipment with flexible metallic conduit and matched connectors. Do not expose flexible conduit in finished areas.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section 260553 "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 CONDUCTOR SIZING

A. Conductor sizes indicated are based on copper unless specifically indicated otherwise on single-line diagram on drawings.

B. Provide minimum #12 AWG conductor size.

C. Provide the following minimum wire sizes based on distances from panel to first device of a 15 or 20 ampere general lighting or receptacle branch circuit. In addition to upsizing conductors as required for voltage drop, provide minimum #10 AWG conductors to the last device for branch circuits more than 150 feet in length.

Distance	AWG Wire Sizes
Up to 60 feet	#12
61 to 90 feet	#10
91 to 150 feet	#8
151 to 240 feet	#6

D. Provide the following minimum AWG conductor sizes for general branch circuiting that are not indicated on drawings, based on using copper conductors. Where applicable increase as required to accommodate voltage drop and to accommodate special conditions. Do not derate any grounded (neutral) conductors. Temperature ratings listed below pertain to both wire and terminations.

Source Breaker/Fuse	AWG Wire Size	Eqt. Grounding AWG Wire Size
15 Ampere	#12	#12
20 Ampere	#12	#12
25 Ampere	#10	#10
30 Ampere	#10	#10
35 Ampere	# 8	#10
40 Ampere	# 8	#10
45 Ampere	# 8	#10
50 Ampere	# 6	#10
60 Ampere	# 6	#10
70 Ampere	# 4	# 8
80 Ampere	# 4	# 8
90 Ampere	# 2	# 8
100 Ampere	# 2	# 8

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."

END OF SECTION 260519

SUBMITTAL FORM – 260519.00 – LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PROVIDE AND COMPLETE THIS SHEET AND SUBMIT AS A COVER SHEET FOR SUBMITTALS REQUESTED WITHIN THIS SECTION.

ELECTRICAL CONTRACTOR: _____ ELECTRICAL SUPPLIER: _____

ELECTRICAL CONTRACTOR REP: _____ ELECTRICAL SUPPLIER REP: _____

ELECTRIC CONTRACTOR PH. NUMBER: _____ ELECTRIC SUPPLIER PH. NUMBER: _____

ELECTRIC CONTRACTOR REP EMAIL: _____ ELECTRIC SUPPLIER REP EMAIL: _____

SUBMITTED CONDUCTOR MANUFACTURERS (LIST CONDUCTOR TYPE AND MANUFACTURER): _____		
_____		
SUBMITTED CABLE MANUFACTURERS (LIST CABLE TYPE AND MANUFACTURER): _____		
_____ _____		
	YES	NO
MANUFACTURERS LISTED AS BASIS OF DESIGN OR LISTED EQUIVALENT MANUFACTURERS?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' QUALIFICATIONS MEET OR EXCEED THOSE REQUIRED UNDER QUALITY ASSURANCE SECTION WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' WARRANTY MEETS OR EXCEEDS THE WARRANTY PERIOD SPECIFIED	☐	☐

WITHIN THIS SPECIFICATION?		
IF NO, EXPLAIN _____		
SUBMITTED COMPONENTS MEET ALL REQUIREMENTS LISTED WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
TYPE AC/MC CABLE INCLUDES CONTINUOUS LENGTH OF SPIRALLY WOUND, INTERLOCKED ZINC COATED OR GALVANIZED (INSIDE AND OUTSIDE) STRIP STEEL?	☐	☐
IF NO, EXPLAIN _____		
TYPE AC/MC CABLE INCLUDES PARITY-SIZED INSULATED EQUIPMENT GROUNDING CONDUCTOR?	☐	☐
IF NO, EXPLAIN _____		

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes: Grounding systems and equipment.

1.2 RELATED DOCUMENTS

A. Division 27, Section 270526.00 “Grounding and Bonding for Communications” for communications grounding busbars and conductors.

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.5 QUALITY ASSURANCE

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.

C. Comply with ANSI/TIA/EIA-607, “Commercial Building Grounding and Bonding Requirements for Telecommunications.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Except as otherwise indicated, provide copper electrical grounding and bonding systems and materials with assembly of materials including but not limited to cables/wires, connectors, solderless lug terminals, grounding electrodes and plate electrodes, bonding jumper braid, and additional accessories needed for a complete installation. Where materials or components are not indicated, provide products that comply with NEC, UL, and IEEE requirements, and with established industry standards for those applications indicated. Utilize compatible metallic materials throughout system to eliminate galvanic action.

B. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide conductors and connectors as specified in Section 260519. Subject to being equivalent and subject to compliance with requirements, provide other grounding related

materials by Erico (as a standard of quality), or other equivalent available manufacturers where not otherwise specified in Division 26.

2.2 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper 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.

2.3 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, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

2.4 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel (copper molecularly bonded to nickel-sealed high-strength steel core); 3/4 inch in diameter by 10 feet in length. Sectional rods may be used when rods are longer than 10 feet.

B. Copper Plates: Sheet copper plate electrodes that are 20-gage by 36" by 36", made from high-conductivity sheet, with cable attachments (minimum quantity of 2), sized for cables as necessary to fulfill project grounding requirements.

2.5 INSPECTION WELLS

A. Provide inspection well for each connection to underground grounding electrodes.

1. In paved areas provide inspection well equal to Erico Eritech Inspection Well 416D or 416F series depending on application, with the following characteristics.

a. Constructed of polymer concrete.
b. 10,000 lb. load rating.
c. Bolt-down cover.
d. Skid-resistant surface.
e. Gray color.

f. “Ground” embossed in the lid.

2. In unpaved areas provide inspection well equal to Erico Eritech Inspection Well 416B or 416C series depending on application, with the following characteristics.

a. Constructed of high density polyethylene.
b. Acid and chemical resistant.
c. Green or black color.
d. “Ground” embossed in the lid.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Grounding Conductors: Install bare copper conductor, No. 2/0 AWG minimum. Where to be installed underground, bury at least 36 inches below grade.

C. Grounding Conductors in corrosive areas: Install tinned copper conductor, No. 2/0 AWG minimum. Where to be installed underground, bury at least 36 inches below grade.

D. 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: Minimum two hole bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 EQUIPMENT GROUNDING

A. Install insulated equipment grounding conductors as required by NFPA 70 and as otherwise required. Install insulated equipment grounding conductors with the following items, in addition to those required by NFPA 70:

1. All feeders.
2. All branch circuits.
3. Flexible raceway runs.

3.3 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. 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.

3.4 LABELING

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

B. Install labels at the telecommunications bonding conductor and grounding equalizer and at the grounding electrode conductor where exposed.

1. Label Text: "GROUND SYSTEM - If this connector or cable is loose or if it must be removed for any reason, notify the facility manager."

3.5 FIELD QUALITY CONTROL

A. Perform the following tests and inspections and prepare test reports:

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, and at ground test wells. Make tests at ground rods before any conductors are connected.

END OF SECTION 260526

SUBMITTAL FORM – 260526.00 – GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PROVIDE AND COMPLETE THIS SHEET AND SUBMIT AS A COVER SHEET FOR SUBMITTALS REQUESTED WITHIN THIS SECTION.

ELECTRICAL CONTRACTOR: _____ ELECTRICAL SUPPLIER: _____

ELECTRICAL CONTRACTOR REP: _____ ELECTRICAL SUPPLIER REP: _____

ELECTRIC CONTRACTOR PH. NUMBER: _____ ELECTRIC SUPPLIER PH. NUMBER: _____

ELECTRIC CONTRACTOR REP EMAIL: _____ ELECTRIC SUPPLIER REP EMAIL: _____

SUBMITTED MANUFACTURERS: BUSBARS: _____		
CONDUCTORS: _____ CONNECTORS: _____		
ELECTRODES: _____ INSPECTION WELLS: _____		
	YES	NO
MANUFACTURERS LISTED AS BASIS OF DESIGN OR LISTED EQUIVALENT MANUFACTURERS?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' QUALIFICATIONS MEET OR EXCEED THOSE REQUIRED UNDER	☐	☐

QUALITY ASSURANCE SECTION WITHIN THIS SPECIFICATION?		
IF NO, EXPLAIN _____		
MANUFACTURERS' WARRANTY MEETS OR EXCEEDS THE WARRANTY PERIOD SPECIFIED WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
SUBMITTED COMPONENTS MEET ALL REQUIREMENTS LISTED WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS/WORK

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

B. It shall be the responsibility of the electrical contractor to supervise the installation of and pay for all additional members, wood or metal and labor which may be required to support any type of permanent or temporary electrical apparatus employed in the execution of the electrical contractor's work. Provide supports, anchors, sleeves and seals furnished as part of factory-fabricated equipment as required.

1.2 SUMMARY

A. This Section includes the following:

1. Hangers and supports for electrical equipment and systems.

1.3 DEFINITIONS

A. EMT: Electrical metallic tubing.

B. IMC: Intermediate metal conduit.

C. RMC: Rigid metal conduit.

1.4 PERFORMANCE REQUIREMENTS

A. Provide supports for multiple raceways capable of supporting combined weight of supported systems and its contents.

B. Provide equipment supports capable of supporting combined operating weight of supported equipment and connected systems and components.

C. 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 five times the applied force.

1.5 ACTION SUBMITTALS

A. Product Data: For the following:

1. Metal support systems and assemblies
2. Conduit/raceway and cable support components
3. Equipment supports

4. Plywood equipment boards

1.6 INFORMATIONAL SUBMITTALS

A. Welding certificates upon request, if applicable.

1.7 QUALITY ASSURANCE

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

B. Comply with NFPA 70.

1.8 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.

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. Construct with 9/16" dia. holes, 8" o.c. on top surface, with standard factory finish, and with the all necessary fittings which mate and match with U-channel.

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:

a. Allied Tube & Conduit
b. Cooper B-Line, Inc.; a division of Cooper Industries
c. ERICO International Corporation
d. GS Metals Corporation
e. Thomas & Betts Corporation
f. Unistrut; Tyco International, Ltd.
g. Wesanco, Inc.
h. Perma-Cote

2. Metallic Coatings: Hot-dip galvanized after fabrication and applied according to MFMA-4.
3. Channel Dimensions: Selected for applicable load criteria.

B. Raceway and Cable Supports: As described in NECA 1 and NECA 101.

C. Conduit and Cable Support Devices: Steel hangers, clamps, and associated fittings, designed for types and sizes of raceway or cable to be supported.

1. Riser clamps for supporting rigid metal conduit; galvanized steel; with 2 bolts and nuts, and 4" ears.
2. Clevis hangers: For supporting rigid metal conduit; galvanized steel; with 1/2" dia. hole for round steel rod.
3. Galvanized steel clamps; 1/2" rod size.
4. Galvanized steel clamps, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2".
5. One-hole conduit straps for supporting 3/4" rigid metal conduit; galvanized steel.
6. Two-hole conduit straps for supporting 3/4" rigid metal conduit, galvanized steel; 3/4" strap width; and 2-1/8" between center of screw holes.
7. Offset conduit clamps for supporting rigid metal conduit; galvanized steel.

D. 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.

E. Structural Steel for Fabricated Supports and Restraints: ASTM A 36/A 36M, steel plates, shapes, and bars; black and galvanized.

F. 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; a division of Illinois Tool Works, Inc.
        3) MKT Fastening, LLC.
        4) Simpson Strong-Tie Co., Inc.; Masterset Fastening Systems Unit.

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. Where specified on drawings as a corrosive area, expansion anchors shall be stainless steel.

    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.; a division of Cooper Industries.
        2) Empire Tool and Manufacturing Co., Inc.
        3) Hilti Inc.
        4) ITW Ramset/Red Head; a division of 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 galvanized springhead type, 3/16” x 4”.
7. Hanger Rods: Threaded steel, Galvanized steel rods; 1/2" dia min.
8. Clevis hangers: For supporting rigid metal conduit; galvanized steel; with 1/2" dia. hole for round steel rod.
9. Galvanized steel rod reducing couplings, 1/2" x 5/8”.
10. Galvanized steel clamps; 1/2" rod size.
11. Galvanized steel clamps, 1-1/4" x 3/16" stock; 3/8" cross bolt; flange width 2".
12. Hexagon nuts for 1/2" rod size; galvanized steel.
13. Lead expansion anchors, 1/2".

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. All electrically related work shall be supported directly from building structural members. Electrically related work shall not be supported from ductwork, ductwork hangers, ceiling supports, existing conduit supports, etc.

C. All conduits, raceways and cables (where applicable) shall be routed parallel and perpendicular to building structural members. Any and all noncompliant work installed by the electrical contractor shall be removed and reinstalled by the electrical contractor to the satisfaction of the Owner's representative and the Engineer, at the expense of the electrical contractor.

D. Install hangers, supports, clamps and attachments to support piping properly from building structure. Install supports with spacing’s indicated and in compliance with NEC requirements. Cut, fit, and place miscellaneous metal fabrications accurately in location, alignment, and elevation to support and anchor electrical materials and equipment.

E. Stem lengths of all pendant fixtures shall be as directed by the owner's representative.

F. All fasteners, hangers and method of hanging exposed work in finished areas shall be submitted to the owner's representative for review before installation. Fasteners shall be zinc-coated, type, grade, and class as required for a neat finished installation.

G. Maximum Support Spacing and Minimum Hanger Rod Size for Raceway: Space supports for EMT, IMC, and RMC as required by NFPA 70 as a minimum. Minimum rod size shall be 1/4 inch in diameter.

H. Multiple Raceways or Cables: Install trapeze-type supports fabricated with steel slotted, sized so capacity can be increased by at least 50 percent in future without exceeding specified design load limits.

1. Secure raceways and cables to these supports with two-bolt conduit clamps, single-bolt conduit clamps, or single-bolt conduit clamps using spring friction action for retention in support channel as applicable.

3.2 SUPPORT INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except as specified in this Article.

B. Do not suspend overhead hangers, or support any other overhead electrical work, from roof decks.

C. Install work so that no raceway or cable is within six inches below roof deck(s).

D. Suspend and support overhead electrical from roof trusses and joists/joist girders only at panel points, at top cord only, unless otherwise indicated.

E. 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.

F. 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. Provide Standard Grade, light-framing-size lumber of any species. Number 3 Common or Standard Grade boards complying with WCLIB or AWPA rules, or Number 3 boards complying with SPIB rules. Lumber shall be preservative treated in accordance with AWPB LP-2, and kiln dried to a moisture content of not more than 19 percent. Provide marine grade products where subject to moisture conditions. Provide Simpson Strong Tie (or equal) expansion screw anchors. Cut, fit, and place wood grounds, nailers, blocking, and anchorage accurately in location, alignment, and elevation to support and anchor electrical materials and equipment. Select fastener sizes that will not penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood members. Attach to substrates as required to support applied loads.
2. Attachments to Wood Structural Members: Provide bolts installed through members.
3. To New Concrete: Provide channel-type concrete inserts and bolt to inserts, or provide expansion anchors for applications where inserts are not practical.
4. To Existing Concrete: Expansion anchor fasteners.
5. Holes for Expansion Anchors in Concrete: Drill at locations and to depths that avoid reinforcing bars.
6. To Masonry: Approved toggle-type bolts on hollow masonry units and expansion anchor fasteners on solid masonry units.
7. 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 thick or greater. Do not use for anchorage to lightweight-aggregate concrete or for slabs less than 4 inches thick. Do not use for work anchored to newly installed concrete. Only use this method where other methods cannot or should not be used, and only after receiving case-by-case permission from Owner and design professionals.
8. To Steel: Welded threaded studs complying with AWS D1.1/D1.1M, with lock washers and nuts, or beam clamps (MSS Type 19, 21, 23, 25, or 27) complying with MSS SP-69, clamped to flanges of beams or on upper truss chords of bar joists.
9. To Light Steel: Sheet metal screws.

10. 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.

G. Install work so that no raceway or cable is within six inches below roof deck(s).

H. Coordinate all work with all other trades prior to commencement of the work.

I. Layout and install all electrical work in strict compliance with Chapter 1, Part B, Section 110.26 of the latest adopted edition of NFPA 70. Locations and routing that may be shown on plans are schematic and diagrammatic in nature.

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 ELECTRICAL EQUIPMENT ANCHORAGE

A. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

B. Install anchor bolts to elevations required for proper attachment to supported equipment.

C. Install anchor bolts according to anchor-bolt manufacturer's written instructions.

D. Provide female expansion anchors, and install studs and nuts after equipment is positioned.

E. Bushings for Floor-Mounted Equipment Anchors: Provide to allow for resilient media between anchor bolts/studs and mounting hole in concrete.

F. Anchor Bolt Bushing Assemblies for Wall-Mounted Equipment: Provide to allow for resilient media where equipment and equipment-mounting channels are attached to wall.

G. Torque bolts and nuts on studs to values recommended by equipment manufacturer.

H. Size and provide concrete bases so expansion anchors will be a minimum of 10 bolt diameters from the edge of the concrete base.

3.5 PAINTING

A. Touchup Painting: 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. Apply paint by brush or spray to provide minimum dry film thickness of 2.0 mils.

B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 260529

Submittal Form – 260529.00 – Hangers and Supports for Electrical Systems

PROVIDE AND COMPLETE THIS SHEET AND SUBMIT AS A COVER SHEET FOR SUBMITTALS REQUESTED WITHIN THIS SECTION.

ELECTRICAL CONTRACTOR: _____ ELECTRICAL SUPPLIER: _____

ELECTRICAL CONTRACTOR REP: _____ ELECTRICAL SUPPLIER REP: _____

ELECTRIC CONTRACTOR PH. NUMBER: _____ ELECTRIC SUPPLIER PH. NUMBER: _____

ELECTRIC CONTRACTOR REP EMAIL: _____ ELECTRIC SUPPLIER REP EMAIL: _____

SUBMITTED MANUFACTURERS: METAL SUPPORT SYSTEMS AND ASSEMBLIES: _____ CONDUIT/RACEWAY/CABLE SUPPORT COMPONENTS: _____ EQUIPMET SUPPORTS: _____ PLYWOOD EQUIPMENT BOARDS: _____		
	YES	NO
MANUFACTURERS LISTED AS BASIS OF DESIGN OR LISTED EQUIVALENT MANUFACTURERS?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' QUALIFICATIONS MEET OR EXCEED THOSE REQUIRED UNDER QUALITY ASSURANCE SECTION WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' WARRANTY MEETS OR EXCEEDS THE WARRANTY PERIOD SPECIFIED WITHIN THIS SPECIFICATION?	☐	☐

IF NO, EXPLAIN _____		
SUBMITTED COMPONENTS MEET ALL REQUIREMENTS LISTED WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		

SECTION 260533 - 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. Section 26 05 53.00 “Identification for Electrical Systems” for raceway related identification requirements.

1.3 DEFINITIONS

A. EMT: Electric metallic tubing.

B. FMC: Flexible metallic conduit.

C. GRC: Galvanized rigid steel conduit.

D. IMC: Intermediate metal conduit.

E. LFMC: Liquid-tight flexible metallic conduit.

F. RNC: Rigid nonmetallic conduit.

G. Types of electrical boxes and fittings specified in this section include the following:

1. Outlet boxes.
2. Junction boxes.
3. Pull boxes.
4. Bushings.
5. Locknuts.
6. Knockout closures.

1.4 ACTION SUBMITTALS

A. Refer to Section 260503, Submittals for Electrical Systems.

B. Product Data: For surface raceways, wireways and fittings, boxes, hinged-cover enclosures, and cabinets.

C. Shop Drawings: For custom enclosures and cabinets. Include plans, elevations, sections, and attachment details.

D. Samples: For wireways, nonmetallic wireways, and surface raceways and for each color and texture specified, 12 inches long. Furnish samples if requested by Owner's representative.

1.5 INFORMATIONAL SUBMITTALS

A. Refer to Section 260503, Submittals for Electrical Systems.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

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. AFC Cable Systems, Inc.
2. Allied Tube & Conduit; a Tyco International Ltd. Co.
3. Anamet Electrical, Inc.
4. Electri-Flex Company.
5. O-Z/Gedney; a brand of EGS Electrical Group.
6. Picoma Industries, a subsidiary of Mueller Water Products, Inc.
7. Republic Conduit.
8. Robroy Industries.
9. Southwire Company.
10. Thomas & Betts Corporation.
11. Western Tube and Conduit Corporation.
12. Wheatland Tube Company; a division of John Maneely Company.
13. Steel city.
14. Regal.
15. Efcor.
16. LTV.
17. Carlon.
18. Cantex.
19. Walker/Wiremold.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering interior outlet box products that may be incorporated into the Work include, but are not limited to, the following:

1. Adalet.
2. Appleton Electric.
3. Bell Electric.

4. Bowers.
5. Eagle Electric Mfg Co., Inc.
6. Midland-Ross Corp.
7. OZ/Gedney.
8. Pass and Seymour, Inc.
9. RACO.
10. Hubbell.
11. Thomas & Betts Co.
12. Thepitt.

C. 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.

D. GRC: Comply with ANSI C80.1 and UL 6.

1. Provide zinc coating fused to inside and outside walls of conduit.

E. IMC: Comply with ANSI C80.6 and UL 1242.

F. EMT: Comply with FS WW-C-563, ANSI C80.3 and UL 797.

G. FMC: Comply with FS WW-C-566 and UL 1; zinc-coated steel .

1. Provide flexible metal conduit formed from continuous length of spirally wound, interlocked zinc-coated or galvanized (inside & outside) strip steel. Provide conduit fittings for use with flexible steel conduit of threadless hinged clamp type, with insulated throats. Provide Straight Terminal Connectors consisting of one piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end with locknut. Do not use 45 degree or 90 degree Terminal Angle Connectors for flexible or water-tight flexible metal conduit in locations that will not be fully accessible after completion of construction. Provide full size green insulated ground wire for all applications, regardless of length.

H. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

1. Provide liquid-tight flexible metal conduit formed from continuous length of spirally wound, interlocked, double-wrapped galvanized (inside & outside) strip steel. Provide liquid-tight jacket of flexible polyvinyl chloride (PVC). Provide smooth-wall type jackets (not a corrugated look) for finished area furniture whip (and similar) applications. Provide Liquid-Tight Flexible Metal Conduit Fittings compliant with FS W-F-406, Type 1, Class 3, Style G. Provide cadmium plated, malleable iron fittings with compression type steel ferrule and neoprene gasket sealing rings, with insulated throat. Provide Straight Terminal Connectors that are one piece body, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end with locknut. Provide Terminal Angle Connectors that are 45 degree or 90 degree two-piece body construction with removable upper section, female end with clamp and deep slotted machine screw for securing conduit, and male threaded end provided with locknut. Do not use 45 degree or 90 degree Terminal Angle Connectors for flexible or water-tight flexible metal conduit in locations that will not be fully accessible after completion of construction. Provide full size green insulated ground wire for all applications, regardless of length.

I. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Fittings for EMT:

a. Material: Steel.
b. Type: Compression or set screw.
c. Note: Provide galvanized or zinc-coated concrete-tight fittings. Do not use die-cast fittings.

2. Fittings for GRC:

a. Material: Steel.
b. Type: Threaded (galvanized or zinc coated after threading.)

3. Expansion Fittings: Material to match conduit type, complying with UL 651, rated for environmental conditions where installed, and including flexible external bonding jumper.
4. Provide terminal conduit fittings with insulated throats, or plastic bushings for conduits 2" and larger where insulated throats may not be not readily available.
5. Provide locknuts for securing conduit to metal enclosure with sharp edge for digging into metal, and ridged outside circumference for proper fastening. Provide screw type grounding terminal for metal bushings of standard or insulated type.
6. Provide miscellaneous fittings such as reducers, chase nipples, 3-piece unions, split couplings, and plugs that are specifically designed for their particular application.
7. Provide galvanized cast-metal (steel) conduit bodies of types, shapes and sizes as required to fulfill job requirements and NFPA 70 requirements. Construct conduit bodies with threaded-conduit-entrance ends, with removable covers, either cast or of galvanized steel, and with corrosion-resistant screws.

J. Joint Compound for Threaded Conduit: 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 METAL WIREWAYS AND AUXILIARY GUTTERS

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. Hoffman; a Pentair company.
3. Mono-Systems, Inc.
4. Square D; a brand of Schneider Electric.
5. Steel city.
6. T&B.
7. Regal.
8. Efcor
9. Wheatland.
10. Allied.
11. LTV.
12. Carlon.
13. Cantex.
14. Walker/Wiremold.

B. Description: Sheet metal, complying with UL 870 and NEMA 250, Type 1 for indoor applications and Type 3R for outdoor applications 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.
2. Provide electrical wireways of types, grades, sizes, and number of channels for each type of applicable service.
3. Provide lay-in wireways with hinged covers in accordance with UL 870, and with components UL-listed, including lengths, connectors, and fittings. Provide units that allow fastening of hinged cover closed without use of parts other than standard lengths, fittings and connectors. Provide units capable of sealing cover in closed position with sealing wire. Provide wireways with knockouts.
4. Provide wireway connectors suitable for "lay-in" conductors, with connector covers permanently attached so that removal is not necessary to utilize the lay-in feature. Provide NEMA 3R units where used outdoors or in areas subject to moisture.

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: Screw-cover type for indoor applications and Flanged-and-gasketed type for outdoor applications unless otherwise indicated.

E. Finish: Manufacturer's standard enamel finish. Protect sheet metal parts with rust inhibiting coating and baked enamel finish. Provide plate-finished hardware to prevent corrosion. Protect screws installed toward inside of wireway, with spring nuts to prevent wire insulation damage.

2.3 SURFACE RACEWAYS

A. Listing and Labeling: Surface raceways and service poles (“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 finish in color selected by Architect or Prime coated, ready for field painting, architects choice.

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

    a. Mono-Systems, Inc.
    b. Panduit Corp.
    c. Wiremold / Legrand
    d. Steel city
    e. T&B
    f. Regal
    g. Efcor
    h. Wheatland
    i. Allied
    j. LTV
    k. Carlon
    l. Cantex
    m. Wiremold / Legrand

2. One-Piece Surface Raceway Systems:

a. Provide surface metal raceways equal to Wiremold #V500 series (nominal 3/4 inch wide by 17/32 inch deep), or Wiremold #V700 series (nominal 3/4 inch wide by 21/32 inch deep), as necessary to accommodate NFPA 70 required raceway wire fill allowances. Provide Ivory “ScuffCoat” finish. Provide factory fittings, dividers, clips, and other accessories as required for a neatly installed complete and operable installation.

2.4 BOXES, ENCLOSURES, AND CABINETS

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. Adalet
2. Cooper Technologies Company; Cooper Crouse-Hinds
3. EGS/Appleton Electric
4. Erickson Electrical Equipment Company
5. FSR Inc.
6. General Electric Company
7. Hoffman; a Pentair company
8. Hubbell Incorporated; Killark Division
9. Kraloy
10. Milbank Manufacturing Co.
11. Mono-Systems, Inc.
12. O-Z/Gedney; a brand of EGS Electrical Group
13. RACO; a Hubbell Company
14. Robroy Industries
15. Siemens/ITE
16. Spring City Electrical Manufacturing Company
17. Square D Company
18. Stahlin Non-Metallic Enclosures; a division of Robroy Industries
19. Tay-Mac
20. Thomas & Betts Corporation
21. Westinghouse/Cutler-Hammer
22. 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.

1. Provide galvanized-coated flat rolled code-gage non-gangable sheet-steel outlet/junction/pull boxes, of shapes, cubic inch capacities, and sizes, including box depths as indicated, suitable for installation at respective locations.
2. Construct outlet boxes with mounting holes and with cable and conduit-size knockout openings in bottom and sides where applicable. Provide boxes with threaded screw holes, with corrosion-resistant cover and grounding screws for fastening surface and device type box covers, and for equipment type grounding.
3. Provide outlet box accessories as required for each installation, including box supports, mounting ears and brackets, wallboard hangers, box extension rings, fixture studs, cable clamps, and metal straps for supporting outlet boxes, which are compatible with outlet boxes being used to fulfill installation requirements for individual wiring situations. Provide with stainless steel nuts, bolts, screws and washers.

D. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, ferrous alloy, Type FD, with gasketed cover.

E. Nonmetallic Outlet and Device Boxes: Comply with NEMA OS 2 and UL 514C.

F. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb. Outlet boxes designed for attachment of luminaires weighing more than 50 lb shall be listed and marked for the maximum allowable weight.

G. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

H. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, galvanized, cast iron with gasketed cover.

I. Box extensions used to accommodate new building finishes shall be of same material as recessed box and shall extend to the finished wall surface.

J. Bushings, knockout closures and locknuts:

1. Provide corrosion-resistant box knockout closures, conduit locknuts and malleable iron conduit bushings, offset connectors, of types and sizes, to suit respective installation requirements and applications.

K. Device Box Dimensions: 4 inches square by 1-1/2 inches deep or 4 inches square by 2-1/8 inches deep, depending on device depths and wiring fill, with single-gang plaster/”mud” rings where only one device is being installed. Provide wider boxes for applications where more than two devices will be installed. Provide internal metal dividers where required under NFPA 70 for varying voltages, multiple circuits, etc..

L. Gangable boxes (using multiple single-gang boxes to assemble multi-gang boxes) are prohibited.

M. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 1 for indoor applications and Type 3R for outdoor applications with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

N. Cabinets:

1. NEMA 250, 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.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed, Not Subject to Physical Damage: EMT.
2. Exposed and Subject to Minor Physical Damage: EMT .
3. Exposed and Subject to Moderate Physical Damage: GRC or IMC. Raceway locations include the following:

    a. Loading dock
    b. Mechanical rooms

4. Exposed and Subject to Moderate or Severe Physical Damage: GRC. Raceway locations include the following:

    a. Loading dock
    b. Corridors and pathways used for traffic of mechanized carts, forklifts, and pallet-handling units

5. Concealed in Cavities of Ceilings and Interior Walls and Partitions: EMT.
6. Above-Grade Damp or Wet Locations: GRC or IMC.
7. Final 72 inches from accessible outlet/junction boxes to recessed luminaires that are located in accessible ceiling systems: FMC. Type AC/MC cable may be used for such "whips"; refer to Section 260519.
8. Final 24-72 Inches at Connections to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp, wet or otherwise corrosive locations (Leave sufficient slack in flexible conduit to permit movement from vibration without adversely affecting conduits and connections.)
9. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in institutional and commercial kitchens and damp or wet locations.

B. 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. EMT: Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.2 INSTALLATION

A. General Installation.

1. Minimum Raceway Size: 3/4-inch trade size.
2. Locate junction and pull boxes so they remain accessible after all construction work is complete. Coordinate all work with all other trades prior to commencement of the work.
3. Layout and install all electrical work in strict compliance with Chapter 1, Part B, Section 110.26 of the latest adopted edition of NFPA 70. Locations and routing that may be shown on plans are schematic and diagrammatic in nature.

4. Layout all proposed raceway routing, elevations, installation methods, etc. on coordination drawings and coordinate all proposed raceway routing with all affected trades prior to commencing with work. In addition review the information with Owner and design professionals for all areas where the raceways will be visible after completion of construction, to ensure a neatly organized installation occurs. Where raceways must be exposed in finished areas install them in a manner that minimizes detrimental effects on room aesthetics. Install so raceways are as out of site as reasonably possible. For instance, where applicable and if so directed by the design professionals or the Owner, make drops near corners, window casings, door casings, etc. Likewise if a receptacle needs to be installed at the center of a wall, install the raceway down the wall in a corner of the room then transition and run horizontally to the outlet location if so directed by the Architect or the Owner. Use compression fittings for EMT applications in these areas. Do not use strut or fasteners that stand off from wall for wall applications in these areas. Install exposed wall-mounted conduits tight to wall using one-hole straps for conduits 1-1/4 inches and smaller, and use two-hole straps for conduits 1-1/2 inches and larger.
5. Rigid and Intermediate Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
6. Do not install aluminum conduits, boxes, or fittings in contact with concrete or earth.
7. Do not install nonmetallic conduit where ambient temperature exceeds 120 deg F.
8. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter.
9. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.
10. Do not use access doors unless special prior written permission is granted from the owner' representative. Install pull boxes, junction boxes, etc. in areas that are accessible after construction. Do not install pull boxes or junction boxes above gypsum board, plaster or similar ceiling systems, nor above ductwork or equipment that renders them inaccessible.
11. Provide knockout closures to cap unused knockout holes where blanks have been removed.
12. Install electrical boxes in those locations that ensure accessibility to enclosed electrical wiring.
13. Do not install boxes back-to-back in walls. Provide not less than 6" (150 mm) separation in general, not less than 16” separation for acoustically rated walls and not less than 24" separation for the following applications: fire walls, fire barriers, smoke barrier walls, and fire partitions. Where outlet boxes are shown back-to-back on common walls, offset accordingly when installed.
14. Neatly cut openings for boxes so that standard size (not "midway" or "jumbo") cover plates will cover all parts of the opening.
15. Position recessed outlet boxes accurately to allow for surface finish thickness. Do not use round boxes.
16. Fasten electrical boxes firmly and rigidly to substrates and structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry as applicable. Provide box supports that are independent of conduit. Refer to Sections 260529 for further supporting requirements. Protect boxes from construction debris and damage subsequent to installation of boxes.
17. Consider the outlet, junction, and pull box locations indicated on drawings approximate. Study the general construction with relation to spaces and equipment surrounding each outlet, and neatly install outlets accordingly.
18. Record junction and pull boxes on record drawings. Permanently mark and label (using methods approved by owner's representative) junction/pullboxes as to which types of electrical services are within. Refer to Section 260502 for further related requirements.
19. Install wiring for different power voltages in raceway systems separate from each other.
20. Install wiring for the various electrical systems in raceway systems that are separate from each other.

21. Install wire in raceway/conduit (sized per NFPA 70) unless specifically permitted otherwise elsewhere in Division 26 sections, or on drawings.
22. Do not install or embed conduits within slabs .
23. Provide steel conduit and steel fittings for indoor above-slab applications, as specified in this section.
24. Provide conduit fittings with insulated throats. Plastic bushings may be used for conduits 2" and larger where insulated throats may not be readily available.
25. Provide pullboxes for conduit runs exceeding 100 feet in length, or having in excess of 270 degrees of offset.
26. Provide maximum of 40 percent fill for raceways, or a threshold of less if required by NFPA 70.
27. Keep raceways at least 6 inches away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above liquid and steam piping. Level and square raceway runs, and install at proper elevations and heights.
28. Do not begin installation of conductors and cables until electrical raceways are complete and until installation locations (end to end) are in a weatherproof environment.
29. Clean inside of conduit before wiring is pulled. Cap and plug conduit ends with standard accessories as soon as conduit has been permanently installed.
30. Comply with requirements in Section 260529 for hangers and supports.
31. Arrange stub-ups so curved portions of bends are not visible above finished grade or slab.
32. Install no more than the equivalent of three 90-degree bends in any conduit run. Support within 12 inches of changes in direction.
33. Conceal conduit and tubing within finished walls, ceilings, and floor cavities unless otherwise indicated. Install conduits parallel or perpendicular to building lines.
34. Support conduit within 12 inches of enclosures to which attached. Properly support and anchor raceways for their entire length using structural materials. Do not span any space unsupported.
35. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.
36. 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 trade size and insulated throat metal bushings on 1-1/2-inch trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits. Fasten conduit terminations in sheet metal enclosures with two locknuts. Install locknuts inside and outside enclosure.
37. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.
38. 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.
39. Cut conduit perpendicular to the length. For conduits 2-inch trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length. Cut conduits straight, properly ream, and cut threads for heavy wall conduit deep and clean. Field-bend conduits with benders designed for purpose so as not to distort, nor vary, internal diameters. Bring joints to a shoulder. Provide suitable supports and fasteners for conduit.
40. Install exposed conduit parallel to walls, and plumb on walls. Secure to walls and ceiling with pipe straps at intervals not exceeding six feet. Support conduit by approved straps, fasteners and hangers. Provide hangers suspended from rods. Do not use perforated strap.
41. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb tensile strength. Leave at least 12 inches of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use, using properly selected and attached manufactured cap (tape of any sort is not permissible).

42. 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.
43. 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. In cases where using center of box for measurement would result in a switch-height device having an operable component higher than 48 inches above finished floor, install boxes lower as needed so that uppermost part of operable component is no higher than 48 inches.
44. 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.
45. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel. Coordinate all such separations with Architect in advance to ensure boxes are located properly for each application.
46. Locate boxes so that cover or plate will not span different building finishes.
47. Support boxes from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.
48. Fasten junction and pull boxes to, or support from, building structure. Do not support boxes by conduits.
49. Provide properly wired electrical connections within enclosures. Anchor enclosures ensuring that they are level, and permanently and mechanically secure.
50. Provide conduit, tubing and fittings of types, grades, sizes and weights (wall thicknesses) for applications as needed to render electrical work fully operational.
51. Mechanically fasten together metal conduits, enclosures, and raceways to form continuous electrically conducting equipment grounding path. Connect to electrical boxes, fittings and cabinets to provide electrical continuity and firm mechanical assembly. Conduit shall be continuous between outlets to make a complete installation and to provide a continuous ground.
52. Do not use dissimilar metals throughout the systems to eliminate possibility of electrolysis. Where dissimilar metals will be unavoidably in contact, coat surfaces with corrosion inhibiting compound before assembling.
53. Use rough-in dimensions of electrically operated equipment furnished by equipment installer. Install conduit and boxes for connection to equipment only after reviewing respective equipment and clearance dimensions, and after coordinating with other trades.
54. Do not use electrical "handee" boxes with surface raceway installations.
55. Do not cross shafts, or ventilating duct openings, with raceways. Keep raceways a minimum distance of 12" from parallel runs of flues, hot water pipes or other sources of heat. Support risers at each floor level with suitable hangers.
56. Do not use running threads at conduit joints and terminations - use 3-piece union, or split coupling.
57. Provide joints made tight with water-tight couplings matching conduit. Install corners with long radius sweep bends, except conduit sizes 1 inch and over where standard elbows may be used.
58. Provide fasteners that are lead expansion shields in block and concrete, toggle bolts in hollow walls, machine screws on metal surfaces, and wood screws on wood construction.
59. Provide sleeves in member for conduits passing through structural members.
60. Where moisture conditions within conduits are encountered above grade, drill a hole at the lowest point in the conduit run so that drainage will not interfere with conditions below.
61. Where conduit is capped at wall for future additions, do not extend more than threads-length past wall (maximum of 3/4 inch past wall for EMT).

62. Install exposed conduits and extensions from concealed conduit systems neatly, parallel with, or at right angles to, walls of building.
63. Install exposed conduit work so there is no interference with ceiling inserts, lights, or ventilation ducts or outlets.
64. Where conduits for outlets on waterproof walls must be installed exposed, set anchors for supporting conduit on waterproof wall in waterproof cement.
65. Requirements for exposed conduits also apply to conduits installed in space above hung ceilings, and in crawl spaces.
66. Provide a 4 inch reinforced casing of concrete (3000-PSI minimum) around conduits that are installed in cinders or cinder concrete, to protect them.
67. Install raceways concealed, except in unfinished electrical and mechanical type rooms where raceways may be exposed.

B. 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.

C. Exposed Conduits and Raceways:

1. Review proposed installation materials, methods, routing, etc. case-by-case and area-by-area for each application with the Architect and Owner prior to installation. Accordingly, prepare installation drawings and submit to design professionals for review and comment. Revise and resubmit as required based on comments from design professionals. Coordinate with all trades while preparing the installation drawings. Show elevations and routes relative to adjacent work of all trades.
2. Group conduits together in tight banks when routed in the same direction in a given space. Coordinate with mechanical trades and route the conduit banks along common paths wherever possible, and at common elevations unless the concuit banks can be installed directly above or below the mechanical work. Review proposed routes and elevations with design professionals prior to installation.
3. Install conduits that peel off from banks in a manner that results in the conduits being progressively taken off from the sides of the banks, one at a time without crossing over or under other conduits in the bank. Rise and drop conduits at the same elevation in areas with common visibility.
4. Provide clean, tight and uniform bends and offsets for all conduits and conduit banks.
5. Route overhead work perpendicular and parallel to architectural and structural building lines. Do not install work below skylight assemblies or in front of clerestory window assemblies.
6. Provide surface conduit and raceway for wall-mounted applications only where it is impossible to fish or cut/patch, or only where specifically indicated on drawings, or only where specifically directed by Architect. Improper sequencing of work at walls shall not be used as a reason to surface-mount conduit, boxes or raceways; install all such work concealed as the walls are constructed. Provide conduit in areas that are exclusively utilitarian, such as dedicated mechanical or electrical rooms. Provide finished surface raceway systems for applications in all other areas. Consult with design professionals in advance of any installation for final direction on where to use conduit versus surface raceway systems.
7. Install conduits and raceways in a manner that minimizes detrimental effects on room aesthetics. For instance, as applicable, rise from below for wall switches, general receptacle outlets and communications wall outlets; drop from above for wall mounted lights, and other system outlets that are installed high on wall; make drops near corners, window casings, door casings, etc.).
8. Install conduits and raceways as out-of-site as reasonably possible. For instance if an receptacle outlet needs to be installed at the center of a wall and there is no possibility of

feeding from below the floor, route the drop in a corner of the room then transition and run horizontally to the outlet location.

9. Install conduit and raceway with a minimum 2-inch radius control at bend points.
10. Secure conduit and raceway with screws or other anchor-type devices at intervals not exceeding 48 inches and with no less than two supports per straight section. Support according to manufacturer's written instructions.
11. Utilize supports for wall-mounted applications that cleanly conform to the shape of the conduit or raceway and do not in any way protrude out past the outer contours of the conduit or raceway. As an example, install wall-mounted conduit using two-hole straps instead of conduit hangers. Tape, glue, tie-wraps, clips, wedges, etc. are not acceptable support methods.
12. Review all proposed mounting means and methods with design professionals for luminaires, devices, outlets, equipment, etc. that will be suspended overhead.
13. Do not use “trapeze” mounting methods for suspensions unless case-by-case permission is granted by design professionals.

D. Seals for Common Conduit and Raceways in Dissimilar Environments: 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.

E. Insulation for Common Conduit and Raceways in Dissimilar Environments: Provide insulation on the exterior of conduit on the warm side of penetrations between dissimilar environments to prevent condensation from forming. Insulate with 1.5-inch polyisocyanurate closed cell pipe insulation with an overall PVC jacket for a minimum distance of 48” from the penetration. Applications include, but are not limited to, the following:

1. Where conduits pass from warm to cold locations, such as boundaries of refrigerated spaces.
2. Where otherwise required by NFPA 70.

F. Expansion-Joint Fittings:

1. Provide expansion fittings at all locations where conduits cross building or structure expansion joints, wherever deflection is expected and as otherwise required to accommodate similar movement.
2. Provide expansion fittings with ground bonding jumpers that are long enough to accommodate respective expansions and movement.
3. Install in each run of aboveground EMT, GRC and IMC conduit that is located where environmental temperature change may exceed 100 deg F and that has straight-run length that exceeds 100 feet.
4. Install fitting(s) that provide expansion and contraction for at least 0.00041 inch per foot of length of straight run per deg F of temperature change for PVC conduits.
5. Install fitting(s) that provide expansion and contraction for at least 0.000078 inch per foot of length of straight run per deg F of temperature change for metal conduits.
6. 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.

G. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches of flexible conduit for recessed and semi-recessed luminaires, for equipment subject to vibration, noise transmission, or movement, and for transformers and motors. Use LFMC in damp or wet locations.

3.3 SLEEVE AND SLEEVE-SEAL INSTALLATION FOR ELECTRICAL PENETRATIONS

A. Install sleeves and sleeve seals at penetrations of exterior floor and wall assemblies, at penetrations of abutted perimeter walls for building expansions/additions, and where expansion joints are used at walls. Comply with requirements in Section 260544 "Sleeves and Sleeve Seals for Electrical Raceways and Cabling."

3.4 FIRESTOPPING

A. Fire walls, fire barriers, smoke barrier walls and fire partitions:

1. Steel outlet boxes that do not exceed 16 square inches in area may be used in fire walls, fire barriers, smoke barrier walls, and fire partitions only if the total area of such openings does not exceed 100 square inches for any 100 square feet of wall area. Verify with local authorities having jurisdiction prior to commencing with related rough-in work.
2. Provide a minimum of 24 inches of separation between outlet boxes on opposite sides of a common wall.
3. Provide outlet boxes, equipment back-boxes, etc. in fire walls, fire barriers, smoke barrier walls, and fire partitions that are of the type tested for use in fire-resistance-rated assemblies. Install in accordance with the tested assembly, and with the instructions included in the listing.

B. Install firestopping at penetrations of fire-rated floor and wall assemblies. Refer to Section 260502 “Common Electric Materials and Methods”. Comply with requirements in Section 078413 "Penetration Firestopping."

3.5 PROTECTION

A. Protect coatings, finishes, and cabinets from damage and deterioration.

1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.

END OF SECTION 260533

Submittal Form – 260533.00 – Raceways and Boxes for Electrical Systems
PROVIDE AND COMPLETE THIS SHEET AND SUBMIT AS A COVER SHEET FOR SUBMITTALS REQUESTED WITHIN THIS SECTION.

ELECTRICAL CONTRACTOR: _____ ELECTRICAL SUPPLIER: _____

ELECTRICAL CONTRACTOR REP: _____ ELECTRICAL SUPPLIER REP: _____

ELECTRIC CONTRACTOR PH. NUMBER: _____ ELECTRIC SUPPLIER PH. NUMBER: _____

ELECTRIC CONTRACTOR REP EMAIL: _____ ELECTRIC SUPPLIER REP EMAIL: _____

SUBMITTED RACEWAY MANUFACTURERS (LIST CONDUIT/RACEWAY TYPE AND MANUFACTURER): _____		
_____ _____		
SUBMITTED BOX MANUFACTURERS (LIST BOX TYPE AND MANUFACTURER): _____		
_____ _____		
	YES	NO
MANUFACTURERS LISTED AS BASIS OF DESIGN OR LISTED EQUIVALENT MANUFACTURERS?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' QUALIFICATIONS MEET OR EXCEED THOSE REQUIRED UNDER QUALITY ASSURANCE SECTION WITHIN THIS SPECIFICATION?	☐	☐

IF NO, EXPLAIN _____		
MANUFACTURERS' WARRANTY MEETS OR EXCEEDS THE WARRANTY PERIOD SPECIFIED WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
SUBMITTED COMPONENTS MEET ALL REQUIREMENTS LISTED WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
WILL RNC CONDUITS RISING FROM BELOW GRADE/SLAB-ON-GRADE BE TRANSITIONED TO GRC CONDUITS AS SPECIFIED?	☐	☐
IF NO, EXPLAIN _____		
CONFIRM YES THAT NO CONDUITS WILL BE EMBEDDED IN OR "SCRATCHED-IN" JUST BELOW SLABS.	☐	☐
IF NO, EXPLAIN _____		

SECTION 260553 - 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. Refer to Section 260503, Submittals for Electrical Systems.

B. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

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 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:

1. Black letters on an orange field.
2. Legend: Indicate voltage.

C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less

1. 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. Vinyl Labels for Empty “Spare” conduits

1. Provide labels with description of purpose, and location of opposite end, on each end of conduits provided for future.

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.

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.

1. Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

2.3 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. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil 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 tape not less than 3 mils thick by 1 to 2 inches wide (where permitted by NEC for large feeder and sub-feeder conductors).

B. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil 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 conductor diameter such that the clear shield overlaps the entire printed legend.

C. Marker Tapes: Vinyl or vinyl-cloth, self-adhesive wraparound type, with circuit identification legend machine printed by thermal transfer or equivalent process.

2.5 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. 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 for 0-150 volts to ground equipment: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES."

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch thick for signs up to 20 sq. inches and 1/8 inch 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.

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. Black letters on a white background for normal applications. Minimum letter height shall be 3/8 inch.

B. Provide white letters on a black background for normal power distribution system equipment.

C. Provide 1/16" thickness for units up to 20 sq. in. or 8" length; provide 1/8" thickness for larger units.

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. All equipment & system identification nomenclature shown on drawings and listed herein is shown for general design and installation reference only. Field-verify the actual nameplate, etc. nomenclature prior to fabrication. Prepare record documents accordingly. Unless determined otherwise in field, provide text matching terminology and numbering of the contract documents and submittals.

C. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

D. No labeling is required for raceways with readily identifiable terminations within the same room.

E. In accessible ceiling spaces and exposed in unfinished areas, label conduit with panel and circuit numbers of conductors routed through the conduit. Label conduit at all wall penetrations and connections to all panels, junction boxes, and equipment served.

F. Apply identification devices to surfaces that require finish after finish work is complete.

G. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

H. Attach signs and plastic labels that are not self-adhesive type with mechanical fasteners appropriate to the location and substrate.

I. Attach plastic raceway and cable labels that are not self-adhesive type with clear vinyl tape with adhesive appropriate to the location and substrate.

J. 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 maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas.

K. Cable Ties: For attaching tags. Cut off excess lengths after installing ties. Use general-purpose type, except as listed below:

1. Outdoors: UV-stabilized nylon.
2. Indoors: Plenum rated.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less: Identify with self-adhesive vinyl label. Locate at changes in direction, at penetrations of walls and floors, at 50-foot maximum intervals in straight runs, and at 25-foot maximum intervals in congested areas. Do not install in finished occupied areas.

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. Power

C. Power-Circuit Conductor Identification, 600 V or Less: For conductors in pull and junction boxes, and handholes, use color-coding to identify the phase. Color shall be factory applied to conductor insulation or field applied for sizes No. 4 AWG and larger, if authorities having jurisdiction permit. These colors apply for factory-assembled cables as well as for individual insulated conductors.

1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for conductors.

a. Colors for 208/120-V Circuits:

1) Phase A: Black
2) Phase B: Red
3) Phase C: Blue
4) Neutral: White

b. Color for Equipment Grounding:

1) Green

c. Field-Applied, Color-Coding Conductor Tape: Apply in half-lapped turns for a minimum distance of 6 inches 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. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, manholes, and handholes, use self-adhesive, self-laminating polyester labels or self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

F. Control-Circuit Conductor Termination Identification: For identification at terminations provide heat-shrink preprinted tubes, or self-adhesive, self-laminating polyester labels or self-adhesive vinyl labels with the conductor designation.

G. Conductors to Be Extended in the Future: Attach write-on tags or marker tape to conductors and list source.

H. 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.

I. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring and optical fiber cable.

1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

J. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.
    c. Other equipment and components with multiple power or control sources.

K. Operating and Warning Instruction Signs: Provide pre-manufactured operating and warning signage if indicated on drawings and where required by NEC or local authority having jurisdiction. 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.

L. 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: Self-adhesive, engraved, laminated acrylic or melamine label for normal conditioned areas, and mechanically-fastened engraved, laminated acrylic or melamine label for areas with adverse environments (unconditioned, high humidity, detrimental vapors, etc.). Unless otherwise indicated, provide a single line of text with 1/2-inch high letters on 1-1/2-inch high label; where two lines of text are required, use labels 2 inches high.
    b. Outdoor Equipment: Engraved, laminated acrylic or melamine label, mechanically fastened.
    c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
    d. 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. Secure to substrate with stainless steel fasteners on main switchboards

and switchgear and in locations where adhesives cannot be expected to work long-term due to environmental conditions

2. Equipment to Be Labeled: (Project may not include all pieces of equipment.)

   a. Panelboards (also including typewritten directory of circuits in the location provided by panelboard manufacturer).
   b. Enclosures and electrical cabinets.
   c. Access doors and panels for concealed electrical items.
   d. Switchgear (also include descriptive labels for each section, switch, overcurrent protection device, etc.).
   e. Switchboards (also include descriptive labels for each section, switch, overcurrent protection device, etc.; additionally include name of engineering firm, name of installing contractor and year of installation for service-entrance switchboards).
   f. Transformers: Label that includes tag designation shown on Drawings for the transformer, feeder, and panelboards or equipment supplied by the secondary.
   g. Substations (also include descriptive labels for each section, switch, overcurrent protection device, etc.).
   h. Emergency system boxes and enclosures.
   i. Motor-control centers (also include descriptive labels for each section, switch, overcurrent protection device, etc.).
   j. Enclosed switches.
   k. Enclosed circuit breakers.
   l. Enclosed controllers/starters.
   m. Variable-speed controllers.
   n. Push-button stations.
   o. Power transfer equipment.
   p. Contactors.
   q. Remote-controlled switches, dimmer modules, and control devices, via engraved wall plates.
   r. Miscellaneous Control Stations.
   s. Battery-inverter units.
   t. Battery racks.
   u. Power-generating units (also include descriptive labels for each output overcurrent protection device, etc.).
   v. Frequency changers.
   w. Monitoring and control equipment.
   x. UPS equipment (also include descriptive labels for each major component section, switch, overcurrent protective device, etc. if not provided by factory).
   y. Other similar equipment designated by owner's representative, architect or engineer in field.

M. Fire Alarm Systems: Provide permanent identification for boxes, enclosures, etc. that are associated with fire alarm system work. Paint and identify fire alarm system pull boxes, junction boxes, and other access/pull points (boxes and covers) in accordance with NEC/NFPA. Provide fire alarm system control panel equipment cabinets, enclosures, etc. with engraved nameplates (white letters on red background) with the first line of text to read "FIRE ALARM" and the remaining lines to include the necessary descriptive text.

END OF SECTION 260553

SUBMITTAL FORM - 260553.00 – IDENTIFICATION FOR ELECTRICAL SYSTEMS

PROVIDE AND COMPLETE THIS SHEET AND SUBMIT AS A COVER SHEET FOR SUBMITTALS REQUESTED WITHIN THIS SECTION.

ELECTRICAL CONTRACTOR: _____ ELECTRICAL SUPPLIER: _____

ELECTRICAL CONTRACTOR REP.: _____ ELECTRICAL SUPPLIER REP.: _____

ELECTRIC CONTRACTOR PH. NUMBER: _____ ELECTRIC SUPPLIER PH. NUMBER: _____

ELECTRIC CONTRACTOR REP. EMAIL: _____ ELECTRIC SUPPLIER REP. EMAIL: _____

	YES	NO
ARE IDENTIFICATION PRODUCTS AND INSTALLATION METHODS INCLUDED FOR RACEWAYS?	☐	☐
IF NO, EXPLAIN _____		
ARE IDENTIFICATION PRODUCTS AND INSTALLATION METHODS INCLUDED FOR CONDUCTORS & CABLES?	☐	☐
IF NO, EXPLAIN _____		
ARE IDENTIFICATION PRODUCTS AND INSTALLATION METHODS INCLUDED FOR EQUIPMENT IDENTIFICATION LABELS?	☐	☐
IF NO, EXPLAIN _____		
ARE IDENTIFICATION PRODUCTS AND INSTALLATION METHODS INCLUDED FOR OTHER APPLICABLE IDENTIFICATION PRODUCTS AND METHODS?	☐	☐
IF NO, EXPLAIN _____		
IS IDENTIFICATION SCHEDULE INCLUDED?	☐	☐

IF NO, EXPLAIN _____		
SUBMITTED INFORMATION MEETS ALL REQUIREMENTS LISTED WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		

SECTION 260584 - MECHANICAL EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including the following apply to this section:

1. General and Supplementary Conditions
2. Division 01 Specification Sections
3. Division 22 Specification Sections
4. Division 23 Specification Sections

1.2 SUMMARY

A. Section Includes:

1. Supplemental information related to electrical work associated with mechanical equipment and other equipment furnished and/or installed under all other divisions or by others.

1.3 ACTION SUBMITTALS

A. No submittal actions are required under this specification section. Refer to applicable specification sections for related submittal requirements.

PART 2 - PRODUCTS

2.1 REFER TO APPLICABLE SPECIFICATION SECTIONS

PART 3 - EXECUTION

3.1 GENERAL

A. Common Requirements

1. Provide all necessary electrically related work as required to render all mechanical equipment (including plumbing, heating, ventilating and air conditioning equipment) fully operational and fully compliant with NEC. This includes, prior to ordering materials or commencing with rough-in, reviewing equipment submittal data and coordinating with installing contractors to ensure the correct size, rating and quantity of conductors are provided.
2. Drawn locations of equipment and devices are shown only for schematic indication of wiring requirements. Coordinate with locations and rough-in requirements as required to determine actual locations and termination requirements. Refer to all contract documents

for additional electrical requirements and concerns, and for further representation of this work.

3. Provide raceway, wiring, connections, and terminations for power and interlocks for electrically operated equipment. Provide starters and disconnect switches for mechanical equipment unless specifically indicated otherwise herein or on the drawings.
4. Provide disconnect switch ahead of all equipment, including controls, unless the mechanical equipment comes with integral NEC-compliant disconnect(s). Provide NEMA 3R enclosures where installed outdoors and where installed indoors in areas subject to moisture. Ground metal frames of equipment by connecting frames to the grounded metal raceway or to a full size green ground conductor or both. Provide the necessary electrical connections between the specified equipment and the junction box near equipment with flexible metallic conduit (liquid-tight outdoors) and matched connectors (see Section 26 05 33). Where mechanical equipment lugs cannot accommodate conductor sizes shown on drawings, provide ILSCO ClearTap Insulated Multi-Tap Connectors.
5. Sizes, electrical ratings, etc. of equipment and wiring shown on drawings are based on the respective equipment design base manufacturers. If different manufacturer(s) or model(s) are actually supplied, provide necessary coordination in field (prior to ordering materials and prior to rough-in) and provide the necessary size of related electrical equipment, wiring, conduit, etc.
6. Prior to furnishing submittals and prior to rough-in, determine exact electrically related characteristics, loads, voltages, disconnect and starter requirements, locations, mounting heights, connection points, etc. of mechanical equipment.
7. Provide lugs, lug kits and related accessory work as required to accommodate the conductor sizes and quantities needed for each application. Coordinate with single-line diagram, field conditions, etc.

B. HACR Breakers

1. Coordinate in field with the respective trades and determine case by case, which equipment is factory listed for use with Heating and Air Conditioning Rated (HACR) breakers. In an effort to minimize requirements for stocking of fuses by the owner, utilize HACR breakers at the source panelboards as the NEC required overcurrent protection wherever possible (in lieu of fusing local disconnect switches).

C. Disconnect Switch and/or Starter Locations

1. Locations shown on drawings are indicated for schematic purposes only. Determine exact locations in field so that they are compliant with NEC Article 110.26.

D. Maintenance Receptacles for Equipment.

1. Provide duplex receptacle within 25 feet of all electrically operated equipment of any nature that requires periodic testing or maintenance. Provide Type WR duplex GFCI weatherproof receptacle for outdoor applications and for applications subject to high humidity or moisture. Provide Type WR duplex GFCI weatherproof receptacle at rooftop within 25 feet of all electrically operated rooftop equipment of any nature that requires periodic testing or maintenance.

E. Heating, Ventilating and Air Conditioning (HVAC) Equipment

1. Refer to HVAC / Electrical Coordination Schedule (HECS) on drawings. Provide disconnects, starters, accessories, wiring, connections, services, etc. where defined as “EC” in the schedule. Information in this section supplements the information in the HECS.

2. Provide power wiring and connections for all equipment (including motor dampers and accessories where applicable) as required to render equipment fully operational.

3. Provide engraved plates at all local disconnects and starters with equipment identification and mark indicated.

4. Install local disconnects and starters at 48 inches to top of outlet box or enclosure as applicable above finished floor/slab/grade; provide flush mounted units in finished areas. Provide key operated manual starters where accessible to general staff and general public.

F. Heating, Ventilating and Air Conditioning (HVAC) Control Wiring

1. General

a. Unless specifically indicated as empty conduit on drawings or herein, provide electrical control and interlock work as shown on drawings. Provide additional control work as specifically indicated herein.
b. Coordinate HVAC thermostat and sensor locations in field (case by case) with Architect, Owner's Representative and equipment installer to ensure that they are placed in locations that will not interfere with furniture, equipment, artwork, wall-hung specialties, room finishes, etc. Field-verify these wall locations case by case, prior to rough-in, since locations shown on drawings are schematic only.

2. Schematic Thermostat and Sensor Locations

a. Refer to HVAC drawings and documents.

3. Low Voltage Thermostats and Sensors

a. Provide 4 inch square by 2-1/8 inch deep wall outlet boxes at 46 inches above finished floor to center of outlet box (with single-gang rings) for each unit. Provide one 3/4 inch empty conduit from each location, turned out above accessible ceilings (in joist space or against overhead slab/deck). Identify conduit in ceiling cavity; provide sweep bends, bushings and drag line.

END OF SECTION 260584

SECTION 260923 - 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.

B. RELATED SECTIONS

1. See Section 26 05 53.00 for special identification-related requirements.
2. See Section 26 05 33.00 for damp and wet location box and cover plate requirements.
3. See Section 26 27 26.00 for cover plates and related specialties.

1.2 SUMMARY

A. Section includes:

1. Manual lighting control devices
2. Automated Lighting Control
3. Occupancy sensors
4. Emergency shunt relays

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for all manual lighting control devices, occupancy sensors and time/light-based lighting controls.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

B. Shop Drawings:

1. Include plans, elevations, sections, and details.
2. Include diagrams for power, signal, and control wiring for occupancy sensors and time/light-based lighting controls.

C. Special Additional Submittal Requirements for Occupancy Sensors

1. Sensor quantities, types and locations shown on drawings are shown only for schematic representation that a room or area is to have occupancy sensor control. Provide actual sensor quantities, types and locations as needed to provide fully operationally coverage for each affected area, and based on submittal review comments by engineer, architect and/or owner.
2. Submit lighting plans clearly marked by manufacturer showing proper product, location, orientation and coverage (ultrasound or infrared or both as applicable) of each sensor

along with quantity of sensors required to provide proper coverage for the respective room or space.

3. Select and locate sensors so that controlled lights automatically turn on immediately upon entering the room or space.
4. Select and locate sensors so that controlled lights will not be turned on by motion that occurs outside of the respective room or space (including applicable when doors are open).
5. Select and locate sensors so that full coverage for the respective room/area is provided.
6. Submit interconnection diagrams per major subsystem showing proper wiring.
7. Submit standard catalog literature that includes performance specifications indicating compliance to the specification.
8. Submit catalog sheets that clearly state load restrictions when used with electronic ballasts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Source Limitations: Obtain lighting controls (including sensors, etc.) and lighting-control power distribution components from single manufacturer.

2.2 MANUAL LIGHTING CONTROL DEVICES

A. See Section 262726 “Wiring Devices”.

2.3 OCCUPANCY SENSORS

A. General

1. Related Work

a. Provide labor, materials, tools, appliances, control hardware, sensor, wire, junction boxes and equipment necessary for and incidental to the delivery, installation and furnishing of completely operational occupancy sensor lighting controls, as described herein.
b. Provide products supplied from a single manufacturer that has been continuously involved in manufacturing of occupancy sensors for a minimum of five (5) years.
c. Provide occupancy sensors for entire project that are all made by the same manufacturer, regardless of where the materials are specified in Division 26 documents. Provide components that are all made by the same manufacturer in cases where occupancy sensor components are also connected to a building lighting control system, regardless of where the materials are specified in Division 26 documents.
d. Provide components that are U.L. listed, offer a five (5) year warranty and meet state and local applicable code requirements.
e. Provide products manufactured by an ISO 9002 certified manufacturing facility with a defect rate of less than one-third of one percent.

B. General Standards

1. Provide sensors capable of operating normally with electronic ballasts, PL lamp systems and rated motor loads.
2. Provide sensors with coverage that remains constant after sensitivity control has been set. Automatic reduction in coverage due to the cycling of air conditioner or heating fans is not permitted.
3. Provide sensors with readily accessible, user adjustable settings for time delay and sensitivity. Locate settings on the sensor (not the control unit) and recess to limit tampering.
4. Provide bypass manual override on each sensor to accommodate failures. Configure so that when bypass is utilized, lighting remains on constantly or control diverts to a wall switch until sensor is replaced. Recess this control to prevent tampering.
5. Provide sensors with an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.
6. Where specified, provide sensor with internal additional isolated relay with Normally Open, Normally Closed and Common outputs for use with HVAC control, Data Logging and other control options. Do not use sensors that utilize separate components or specially modified units to achieve this function.
7. Provide sensors with UL rated, 94V-0 plastic enclosures.

C. Basis-of-Design Product: WattStopper (model numbers as specified further below).

D. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below. If not listed, submit as substitution prior to final addendum for inclusion.

1. Cooper Greengate CA
2. Hubbell
3. LC&D
4. Leviton
5. Lutron
6. Sensor Switch
7. Phillips

E. Passive infrared sensors

1. Provide sensors that utilize Pulse Count Processing and Digital Signature Analysis to respond only to those signals caused by human motion and that provide high immunity to false triggering from RFI (hand-held radios) and EMI (electrical noise on the line). Provide sensors that also have multiple segmented Fresnel lens, in a multiple-tier configuration, with grooves-in to eliminate dust and residue build-up.

F. Dual technology sensors

1. Provide sensors that are either wall mounted, corner mounted or ceiling mounted in such a way as to minimize coverage in unwanted areas. Provide passive infrared and ultrasonic or microphonic technologies for occupancy detection.

G. Ultrasonic sensors

1. Provide sensors that utilize Advanced Signal Processing to adjust the detection threshold dynamically to compensate for constantly changing levels of activity and air flow throughout controlled space. Crystal control operating frequency at 25 kHz within ± 0.005% tolerance, 32 kHz within ± 0.002% tolerance, or 40 kHz ± 0.002% tolerance to

assure reliable performance and eliminate sensor cross-talk. Do not use sensors with multiple frequencies.

H. Ceiling Sensors

1. Provide Standard of Quality equal to WattStopper: WT-605, WT-600, WT-1105, WT-1100, WT-2205, WT-2200, WT-2250, WT-2255, WP-605, WP-1105, WP-2255, WP-2205, W-500A, W-1000A, W-2000A, W-2000H, UT-300, UT-305, UT-355, WPIR, HB-100, HB-150, DT-200, DT-205, DT-300, DT-305, DT-355, CX-100, CX-105, CI-200, CI-205, CI-300, CI-305, CI-355, CI-12 or CI-24 series.

I. Wall Switch Sensors

1. Provide Standard of Quality equal to WattStopper: PW-100, PW-100-24, PW-200, WI-200, WI-300, WS-200, WD-170, WD-180, WD-270, WD-280, WN-100-120, WN-100-277, UW-100, UW-100-24, UW-200, DW-100, DW-100-24 or DW-200 series.
2. Provide wall switch sensors capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet.
3. Provide units that accommodate loads from 0 to 800 watts at 120 volts; 0 to 1200 watts at 277 volts and that have 180˚ coverage capability.
4. Provide wall switch products that utilize Zero Crossing Circuitry to increase relay life, protect from the effects of inrush current, and increase sensor's longevity.
5. Provide wall switch sensors that have no leakage current to load, in manual or in Auto/Off mode for safety purposes, and that have voltage drop protection.
6. Where specified, provide wall switch sensors with field selectable option to convert sensor operation from automatic-ON to manual-ON.
7. Where specified, provide vandal resistant wall switch sensors that utilize hard lens with minimum 1.0mm thickness. Do not provide products that utilize a soft lens.

J. Power and Auxiliary Packs

1. Provide Standard of Quality equal to WattStopper: B120E-P, B277E-P, BZ-100, LC-100, C120E-P, C277E-P, S120/277-P, AT-120 or AT-277 series.

K. Circuit Control Hardware

1. Control Units - For ease of mounting, installation and future service, provide control units that are able to be externally mounted through a 1/2" knock-out on a standard electrical enclosure and be integrated, self-contained units consisting internally of isolated load switching control relay and transformer to provide low-voltage power. Provide control units that provide power to a minimum of two (2) sensors.
2. Provide Relay Contacts with ratings of:

    a. 20A - 120 VAC Ballast

3. Provide control wiring between sensors and controls units that is Class II , 18-24 AWG, stranded U.L. Classified, PVC insulated or TEFLON jacketed cable suitable for use in plenums.
4. Provide minimum #12 AWG wire gauge to and from the circuit control hardware relays.

PART 3 - EXECUTION

3.1 GENERAL

A. Installation

1. Provide grounded (“neutral”) conductor in all lighting control device (switch, dimmer, occupancy sensor, etc.) wall outlet boxes, even if not immediately used.
2. Install equipment and devices only in electrical boxes that are clean, free from building materials, dirt, and debris, and after wiring work is completed. Install wall plates only after respective wall surfaces have received their final finish.
3. Prior to energizing circuits, test wiring for electrical continuity and for short-circuits. Subsequent to energizing, test wiring devices and demonstrate compliance with requirements, operating each operable device at least six times.

3.2 OCCUPANCY SENSORS

A. Installation

1. Locate and aim sensors in the correct location required for complete and proper volumetric coverage within the range of coverage(s) of controlled areas per the manufacturer's recommendations. Provide ninety (90) to one hundred (100) percent coverage in rooms to completely cover the controlled area to accommodate all occupancy habits of single or multiple occupants at any location within the rooms. The locations and quantities of sensors shown on the drawings are diagrammatic and indicate only the rooms which are to be provided with sensors. Provide additional sensors if required to properly and completely cover the respective room.
2. Arrange a pre-installation meeting with manufacturer's factory authorized representative, at owner's facility, to verify placement of sensors and installation criteria.
3. Exercise proper judgment in executing the installation to ensure the best possible installation in the available space and to overcome local difficulties due to space limitations or interference of structural components.
4. Provide, at the owner's facility, the training necessary to familiarize the owner's personnel with the operation, use, adjustment, and problem solving diagnosis of the occupancy sensing controls.

B. Factory Commissioning

1. Upon completion of the installation, provide complete commissioning for controls by the manufacturer's factory authorized technician who will verify adjustments and sensor placement to ensure trouble-free occupancy-based lighting controls.
2. Provide the owner, the manufacturer and the electrical engineer with ten working days written notice of the scheduled commissioning date. Upon completion of related work, including fine tuning, provide factory authorized technician training to the owner's personnel in the adjustment and maintenance of the sensors.

END OF SECTION 260923

SUBMITTAL FORM – 260923.00 – LIGHTING CONTROL DEVICES

PROVIDE AND COMPLETE THIS SHEET AND SUBMIT AS A COVER SHEET FOR SUBMITTALS REQUESTED WITHIN THIS SECTION.

ELECTRICAL CONTRACTOR: _____ ELECTRICAL SUPPLIER: _____

ELECTRICAL CONTRACTOR REP: _____ ELECTRICAL SUPPLIER REP: _____

ELECTRIC CONTRACTOR PH. NUMBER: _____ ELECTRIC SUPPLIER PH. NUMBER: _____

ELECTRIC CONTRACTOR REP EMAIL: _____ ELECTRIC SUPPLIER REP EMAIL: _____

SUBMITTED LIGHTING CONTROL MANUFACTURERS (LIST TYPE AND MANUFACTURER): _____		
_____ _____		
	YES	NO
MANUFACTURERS LISTED AS BASIS OF DESIGN OR LISTED EQUIVALENT MANUFACTURERS?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' QUALIFICATIONS MEET OR EXCEED THOSE REQUIRED UNDER QUALITY ASSURANCE SECTION WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' WARRANTY MEETS OR EXCEEDS THE WARRANTY PERIOD SPECIFIED WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
SUBMITTED COMPONENTS MEET ALL REQUIREMENTS LISTED WITHIN THIS	☐	☐

SPECIFICATION?		
IF NO, EXPLAIN _____		
PRODUCT DATA IS INCLUDED FOR EACH LIGHTING CONTROL DEVICE?	☐	☐
IF NO, EXPLAIN _____		
SHOP DRAWINGS ARE INCLUDED FOR EACH LIGHTING CONTROL DEVICE THAT IS PART OF A SYSTEM?	☐	☐
IF NO, EXPLAIN _____		
SPECIAL ADDITIONAL SUBMITTAL REQUIREMENTS FOR OCCUPANCY SENSORS ARE ALL INCLUDED?	☐	☐
IF NO, EXPLAIN _____		

SECTION 262726 - 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.

B. See Section 26 09 23.00 for Occupancy Sensors.

C. See E-series drawings for Occupancy Sensors.

1.2 SUMMARY

A. Provide wiring devices, in types, characteristics, grades, colors, and electrical ratings for applications indicated which are UL listed and which comply with NEMA WD 1 and other applicable UL and NEMA standards. Verify color selections with Owner's representative.

B. Section Includes:

1. Receptacles
2. Switches

1.3 DEFINITIONS

A. EMI: Electromagnetic interference.

B. GFCI: Ground-fault circuit interrupter.

C. Pigtail: Short lead used to connect a device to a branch-circuit conductor.

D. RFI: Radio-frequency interference.

E. SPD: Surge protection device.

F. Tamper-resistant: This term and “safety type” shall be taken to mean the same thing for receptacles.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.5 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.

1.6 INFORMATIONAL SUBMITTALS

A. Field quality-control reports.

1.7 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 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper)
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell)
3. Hubbell Incorporated; Wiring Device-Bryant (Hubbell)
4. Leviton Mfg. Company Inc. (Leviton)
5. Pass & Seymour/Legrand (Pass & Seymour)
6. Lutron Electronics, Inc. (Lutron)
7. Hubbell Incorporated (Hubbell)
8. Wiremold/Legrand (Wiremold)
9. FSR Inc. (FSR)

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 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. For receptacle circuits protected with 15A breakers, provide NEMA 5-15R equivalents for the devices shown below.

D. Provide Weather-Resistant Receptacles with UL “WR” marking, compliant with NEC 406.8, for all applications in wet or damp locations.

E. Where GFI protected receptacles are shown on drawings, provide a separate GFI receptacle for each one shown. Do not feed downstream receptacles from load-side (GFI-protected) terminals of upstream receptacles.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R (20A) or 5-15R (15A), UL 498, and FS W-C-596.

1. Provide duplex and single specification grade receptacles, 2-pole, 3-wire grounding, self-grounding, green grounding screw, ground terminals and poles internally connected to mounting yoke, color coded base, 20-amperes, 125-volts, with metal plaster ears, back & side wiring, NEMA configuration 5-20R.
2. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; 5351 (single), CR5362 (duplex)
    b. Hubbell; HBL5351 (single), HBL5352 (duplex)
    c. Bryant; 5351 (single), 5352A (duplex)
    d. Leviton; 5351 (single), 5362 (duplex)
    e. Pass & Seymour; 5351 (single), 5362 (duplex)

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, feed-through or non-feed-through type depending on application.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Cooper; VGF20.
    b. Hubbell; GFR5352L.
    c. Bryant; GF20LA.
    d. Pass & Seymour; 2095.
    e. Leviton; 6490

2.5 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

1. Products: Subject to compliance with requirements, provide one of the following:

    a. Single Pole:

        1) Cooper; AH1221.

2) Hubbell; HBL1221.
3) Bryant; 1121
4) Leviton; 1221-2.
5) Pass & Seymour; CSB20AC1.

b. Two Pole:

1) Cooper; AH1222.
2) Hubbell; HBL1222.
3) Bryant; 4902
4) Leviton; 1222-2.
5) Pass & Seymour; CSB20AC2.

c. Three Way:

1) Cooper; AH1223.
2) Hubbell; HBL1223.
3) Bryant; 4903
4) Leviton; 1223-2.
5) Pass & Seymour; CSB20AC3.

d. Four Way:

1) Cooper; AH1224.
2) Hubbell; HBL1224.
3) Bryant; 4804
4) Leviton; 1224-2.
5) Pass & Seymour; CSB20AC4.

2.6 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: satin finish stainless steel, equal to Leviton Type 430 series
3. Material for Unfinished Spaces with surface-mounted outlet boxes: Galvanized steel
4. Material for Indoor Damp Locations: satin finish stainless steel, equal to Leviton Type 430 series
5. 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. Refer to Section 26 05 33.00.

2.7 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: Ivory unless otherwise indicated or required by NFPA 70 or device listing.

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. Provide grounded (“neutral”) conductor in all lighting control device (switch, dimmer, occupancy sensor, etc.) wall outlet boxes, even if not immediately used.
2. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
3. 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.
4. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.
5. 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 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.

10. Install wiring devices only in electrical boxes that are clean; free from building materials, dirt, and debris. Install wiring devices after wiring work is completed. Install wall plates only after respective wall surfaces have received their final finish.
11. Consider locations indicated on the drawings to be approximate (unless specifically dimensioned on drawings). Determine exact locations of each floor outlet, case by case, after consulting with Owner and Architect, and after reviewing architectural documents so outlets are properly located to accommodate the final furniture and equipment layouts. Study the general construction with relation to spaces and equipment surrounding each outlet.
12. Do not use aluminum products in concrete.
13. Fasten electrical boxes firmly and rigidly to substrates, or structural surfaces to which attached, or solidly embed electrical boxes in concrete or masonry. Support boxes independent of conduit.

E. Receptacle Orientation: Install receptacles so that the ground pin is oriented in a consistent manner throughout the facility, so that the orientation is compliant with all prevailing codes and regulations, and so that the orientation is acceptable to the electrical inspector. Where no existing building standard or owner project requirement, install receptacles with ground pin down. Where receptacles are installed horizontally, install such that neutral connection faces up.

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, multigang 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 feed-through-type GFCI receptacles where downstream receptacles are fed from the line side of the GFCI receptacle.

3.3 IDENTIFICATION

A. Comply with Section 26 05 53.00 "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. Perform the following tests and inspections:

B. In healthcare facilities, prepare reports that comply with recommendations in NFPA 99.

1. Test Instruments: Use instruments that comply with UL 1436.
2. 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

SUBMITTAL FORM – 262726.00 – WIRING DEVICES

PROVIDE AND COMPLETE THIS SHEET AND SUBMIT AS A COVER SHEET FOR SUBMITTALS REQUESTED WITHIN THIS SECTION.

ELECTRICAL CONTRACTOR: _____ ELECTRICAL SUPPLIER: _____

ELECTRICAL CONTRACTOR REP: _____ ELECTRICAL SUPPLIER REP: _____

ELECTRIC CONTRACTOR PH. NUMBER: _____ ELECTRIC SUPPLIER PH. NUMBER: _____

ELECTRIC CONTRACTOR REP EMAIL: _____ ELECTRIC SUPPLIER REP EMAIL: _____

SUBMITTED MANUFACTURERS (LIST DEVICE TYPE AND MANUFACTURER): _____		
_____ _____		
_____ _____		
	YES	NO
MANUFACTURERS LISTED AS BASIS OF DESIGN OR LISTED EQUIVALENT MANUFACTURERS?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' QUALIFICATIONS MEET OR EXCEED THOSE REQUIRED UNDER QUALITY ASSURANCE SECTION WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' WARRANTY MEETS OR EXCEEDS THE WARRANTY PERIOD SPECIFIED WITHIN THIS SPECIFICATION?	☐	☐

IF NO, EXPLAIN _____		
SUBMITTED COMPONENTS MEET ALL REQUIREMENTS LISTED WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
WIRING DEVICE COLORS HAVE BEEN COORDINATED WITH ARCHITECT?	☐	☐
IF NO, EXPLAIN _____		
PRODUCT DATA SUBMITTALS ARE CLEAR, CRISP AND DISTINCTLY LEGIBLE – INCLUDING GRAPHICS?	☐	☐
IF NO, EXPLAIN _____		
PRODUCT DATA SUBMITTALS ARE CLEARLY MARKED AS TO EXACTLY WHICH DEVICES ARE SUBMITTED FOR REVIEW WITH THE UNDERSTANDING THAT ALL UNMARKED DEVICES WILL BE IGNORED DURING REVIEW?	☐	☐
IF NO, EXPLAIN _____		

SECTION 262816 - 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. Switches.
2. Enclosures.

1.3 DEFINITIONS

A. NC: Normally closed.

B. NO: Normally open.

1.4 ACTION 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.
2. Current and voltage ratings.
3. Short-circuit current ratings (interrupting and withstand, as appropriate).

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. Manufacturer's field service report.

1.6 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. Include the following:

1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.

1.7 QUALITY ASSURANCE

A. Testing Agency Qualifications: Member company of NETA or an NRTL.

1. Testing Agency's Field Supervisor: Currently certified by NETA to supervise on-site testing.

B. Source Limitations: Obtain enclosed switches and circuit breakers, overcurrent protective devices, components, and accessories, within same product category, from single source from single manufacturer.

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.

1.8 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).

1.9 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 GENERAL REQUIREMENTS

A. Provide lugs, lug kits and related accessory work as required to accommodate the conductor sizes and quantities needed for each application. Coordinate with single-line diagram, field conditions, etc.

B. Fault Current Ratings

1. Provide electrical distribution related equipment with appropriately braced terminals and properly rated breakers, fuses, etc. for the available fault currents.
2. In existing buildings where fault current values are not indicated on drawings, coordinate with existing “upstream” distribution equipment, and provide equipment AIC ratings that meet or exceed same.

2.2 SWITCHES

A. Acceptable Manufacturers: Subject to being equivalent and subject to compliance with requirements, provide product by one of the manufacturers listed below. If not listed, submit as substitution.

1. Eaton Electrical Inc.; Cutler-Hammer Business Unit.
2. General Electric Company; GE Consumer & Industrial - Electrical Distribution.
3. Siemens Industry, Inc.
4. Square D; a brand of Schneider Electric.

B. Characteristics:

1. 50 through 60 Hz., with 200,000 RMS symmetrical interrupting current rating.
2. 250VAC rated, for projects with service-entrance line to line voltage not exceeding 240V.
3. 600VAC rated, for projects with service-entrance line to line voltage not exceeding 600V.

C. Type HD, Heavy Duty, Single Throw: UL 98 and NEMA KS 1, horsepower rated, with clips or bolt pads to accommodate required fuses where applicable, 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. Class R Fuse Kit: Provides rejection of other fuse types when Class R fuses are specified.
4. Lugs: Mechanical type, suitable for number, size, and conductor material.
5. Service-Rated Switches: Labeled for use as service equipment.

2.3 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. Refer to drawings for NEMA type. Provide the following enclosure types if not noted on drawings, or if not noted otherwise on drawings.

1. Indoor, Dry and Clean Locations: NEMA 250, Type 1.
2. Outdoor Locations: NEMA 250, Type 3R.
3. Other Wet or Damp, Indoor Locations: Type 3R.
4. Indoor Locations Subject to Dust, Falling Dirt, and Dripping Noncorrosive Liquids: NEMA 250, Type 12.

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 units with tops at uniform height unless otherwise indicated, or unless units must be stacked vertically, or unless field conditions otherwise dictate.

B. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

C. Install fuses in fusible devices.

D. Comply with NECA 1.

E. Install disconnect switches within sight of controller position unless otherwise indicated.

F. Size units according to load being served or as noted on drawings, whichever requirement is larger. Provide units with horsepower ratings suitable to the loads where applicable. Install overloads and fuses as necessary to fulfill requirements of each application as applicable.

G. Subsequent to completion of installation of equipment, energize circuits and demonstrate capability and compliance with requirements. Begin by demonstrating switch operation through six opening/closing cycles with circuit unloaded. Open each switch enclosure and inspect interiors, inspect mechanical and electrical connections, inspect fuse/overload installations, and verify accuracy of type and rating of fuses/overloads installed. Correct deficiencies then retest to demonstrate compliance. Remove and replace defective units with new units and retest.

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. Acceptance Testing Preparation:

1. Test insulation resistance for each unit, component, connecting supply, feeder, and control circuit.
2. Test continuity of each circuit.

B. 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. Test and adjust controls, remote monitoring, and safeties. Replace damaged and malfunctioning controls and equipment.

C. Enclosed switches and circuit breakers will be considered defective if they do not pass tests and inspections.

3.5 ADJUSTING

A. Adjust moving parts and operable components to function smoothly, and lubricate as recommended by manufacturer.

B. Set field-adjustable circuit-breaker trip ranges

END OF SECTION 262816

SUBMITTAL FORM – 262816.00 – ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PROVIDE AND COMPLETE THIS SHEET AND SUBMIT AS A COVER SHEET FOR SUBMITTALS REQUESTED WITHIN THIS SECTION.

ELECTRICAL CONTRACTOR: _____ ELECTRICAL SUPPLIER: _____

ELECTRICAL CONTRACTOR REP: _____ ELECTRICAL SUPPLIER REP: _____

ELECTRIC CONTRACTOR PH. NUMBER: _____ ELECTRIC SUPPLIER PH. NUMBER: _____

ELECTRIC CONTRACTOR REP. EMAIL: _____ ELECTRIC SUPPLIER REP EMAIL: _____

SUBMITTED MANUFACTURER: _____		
	YES	NO
MANUFACTURERS LISTED AS BASIS OF DESIGN OR LISTED EQUIVALENT MANUFACTURERS?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' QUALIFICATIONS MEET OR EXCEED THOSE REQUIRED UNDER QUALITY ASSURANCE SECTION WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' WARRANTY MEETS OR EXCEEDS THE WARRANTY PERIOD SPECIFIED IN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
SUBMITTED COMPONENTS MEET ALL REQUIREMENTS LISTED IN THIS SPECIFICATION AND ON DRAWINGS?	☐	☐
IF NO, EXPLAIN _____		
PRODUCT DATA SUBMITTAL INFORMATION SPECIFIED IN THIS SECTION IS ALL INCLUDED?	☐	☐

IF NO, EXPLAIN _____		
SHOP DRAWING SUBMITTAL INFORMATION SPECIFIED IN THIS SECTION IS ALL INCLUDED?	☐	☐
IF NO, EXPLAIN _____		
FAULT CURRENT BRACING FOR ALL COMPONENTS MEETS OR EXCEEDS THE AVAILABLE FAULT CURRENT AT THE RESPECTIVE COMPONENT?	☐	☐
IF NO, EXPLAIN _____		
FAULT CURRENT RATINGS FOR ALL OVERCURRENT PROTECTIVE DEVICES MEET OR EXCEED THE AVAILABLE FAULT CURRENT AT THE RESPECTIVE OVERCURRENT PROTECTIVE DEVICE?	☐	☐
IF NO, EXPLAIN _____		
SUBMITTALS WERE PREPARED AFTER COORDINATING INFORMATION SHOWN ON DRAWINGS IN EQUIPMENT SCHEDULES, IN PANELBOARD SCHEDULES, IN FEEDER SCHEDULE AND ON SINGLE-LINE OR RISER DIAGRAM?	☐	☐
IF NO, EXPLAIN _____		

SECTION 265100 - LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior luminaires, lamps, and ballasts
2. Exit signs
3. Emergency lighting units
4. Emergency fluorescent power unit
5. Luminaire supports

B. Related Sections:

1. Section 26 09 23.00 "Lighting Control Devices" for automatic control of lighting, including time switches, photoelectric relays, occupancy sensors, and multi-pole lighting relays and contactors.

1.3 DEFINITIONS

A. BF: Ballast factor.

B. CCT: Correlated color temperature.

C. CRI: Color-rendering index.

D. HID: High-intensity discharge.

E. LER: Luminaire efficacy rating.

F. Lumen: Measured output of lamp, luminaire, or both.

G. Luminaire: Complete lighting unit consisting of lamps or sources, and some or all of the following components: optical control devices, sockets, mechanical components to support or attach the luminaire, and electrical and electronic components to start, operate, dim or control and maintain the operation of the lamps or LEDs.

1.4 ACTION SUBMITTALS

A. Product Data: Arrange luminaire submittals in booklet form with separate sheets for each luminaire, assembled by luminaire "type" in alphabetical order. Submit details indicating compatibility with ceiling grid system. Provide lamp or source and ballast/low voltage transformer/LED

driver schedules (by luminaire type). Provide technical submittal data in separately tabbed sections for lamp or source submittals and for ballast, low voltage transformer or LED driver submittals.

B. Only fully complete submittals will be reviewed. Failure to provide lamp/source and ballast/ low voltage transformer/LED driver submittals at time of luminaire submittal will result in immediate return of submittal package without review.

C. Include data sheets for the following:

1. Luminaire

   a. Original manufacturer datasheets or first generation printed copies of manufacturer's electronic datasheet (i.e. printed copy of a PDF file).
   b. Datasheets shall include dimensions, finishes and technical support data including energy efficiency data. Provide data sheets for applicable luminaire support and accessories.
   c. Each datasheet to be labeled with the project name, luminaire "type" and exact catalog number. Affix to same location on each sheet.
   d. Where datasheets depict multiple products, versions or options, the Contractor shall highlight (indicate with an arrow) all applicable model(s), version(s) and option(s) applying to the specific product the Contactor will be providing. The submitted items must be from "approved materials".

2. Lamps

   a. Original manufacturer datasheets or first generation printed copies of manufacturer's electronic datasheet (i.e. printed copy of a PDF file).
   b. Datasheets shall include all technical data described in this section and data including, but not limited to, life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
   c. Each datasheet to be labeled with the project name, luminaire "type" and exact catalog number. Affix to same location on each sheet.

3. Ballasts

   a. Original manufacturer datasheets or first generation printed copies of manufacturer's electronic datasheet (i.e. printed copy of a PDF file).
   b. Datasheets shall include all technical data described in this section and energy-efficiency data.
   c. Each datasheet to be labeled with the project name, luminaire "type" and exact catalog number. Affix to same location on each sheet

4. LED Source and Driver System

   a. Original manufacturer datasheets or first generation printed copies of manufacturer's electronic datasheet (i.e. printed copy of a PDF file).
   b. Datasheets shall include:
   c. Voltage
   d. Input watts
   e. Energy efficiency data
   f. Initial Lumen output
   g. Source correlated color temperature (CCT)
   h. Source color rendering index (CRI) value

i. Provide verification the system has been tested to IES LM-79-2008 standards
j. The system is RoHS compliant, lead free and mercury free
k. Name the LED manufacturer
l. Provide verification the LED's have been tested to IES LM-80-2008 standards and the rated life of the system in hours
m. Warranty for LED's and driver
n. Each datasheet to be labeled with the project name, luminaire "type" and exact catalog number. Affix to same location on each sheet

5. Exit signs, including battery.
6. Emergency lighting units, including battery and charger.
7. Emergency fluorescent lamp power unit, including battery and charger.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and luminaires to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes. List by luminaire "type".
2. Provide a list of all ballast types used on Project; use ANSI and manufacturers' codes. List by "type".
3. Provide a list of all LED sources and driver types used on Project; use ANSI and manufacturers' codes. List by luminaire "type".

1.6 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. Lamps: 15 for every 100 of each type and rating installed. Furnish at least four of each type.
2. Ballasts: One for every 100 of each type and rating installed. Furnish at least one of each type.
3. Fluorescent-luminaire-mounted, emergency battery pack: One for every 20 emergency lighting unit.
4. Plastic Diffusers and Lenses: One for every 100 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

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 NFPA 70.

1.8 COORDINATION

A. Coordinate layout and installation of luminaires and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

1.9 WARRANTY

A. Special Warranty for Emergency Lighting Batteries: Manufacturer's standard form in which manufacturer of battery-powered emergency lighting unit agrees to repair or replace components of rechargeable batteries that fail in materials or workmanship within specified warranty period.

1. Warranty Period for Emergency Lighting Unit Batteries: five years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining years.
2. Warranty Period for Emergency Fluorescent Ballast Batteries: five years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining years.
3. Warranty Period for Self-Powered Exit Sign Batteries: five years from date of Substantial Completion. Full warranty shall apply for first year, and prorated warranty for the remaining years.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, provide products indicated on Drawings . Provide products of one of the manufacturers listed in this section for products that are not defined on the Luminaire Schedule. Provide specification grade luminaires that comply with minimum requirements as stated therein. If a particular “type” does not include basis of design manufacturer or model number, provide "pre-approved equivalent” manufacturer’s and model numbers compliant with, and equivalent to: quality, performance, dimensions, and aesthetics as the respective basis of design for Designers review no less than five business days prior to bid due date.

2.2 GENERAL REQUIREMENTS FOR LUMINAIRES AND COMPONENTS

A. Luminaires designated by letters are defined as indicated on the Luminaire Schedule.

B. Provide luminaires, of sizes, types and ratings indicated; complete with, but not limited to, housings, energy-efficient lamps, lampholders, reflectors, energy efficient ballasts, starters and wiring. Ship luminaires factory-assembled, with components required for a complete operating installation.

C. Recessed Luminaires:

1. Comply with NEMA LE 4 for ceiling compatibility for recessed luminaires.
2. Provide recessed luminaires with necessary gypsum board, plaster frames, and surface trim.

3. Provide recessed luminaires that are constructed without rolled edges and that are post-painted.
4. Provide door frames on troffer style luminaires with spring latches on door frames.
5. Provide static air function for luminaires unless otherwise noted.
6. Provide luminaires that are non-IC constructed unless otherwise noted.
7. Provide junction boxes and serviceable components (ballasts, thermal protection devices, fuses, etc.) for recessed luminaires that are accessible for service and replacement from below the ceiling, without removing ceiling components.
8. Where plaster frames are inferred for luminaires (either by narrative, or by catalog number, or by application) interpret the actual function to mean for mounting within gypsum board, wet plaster or similar type inaccessible ceiling system. Field verify related requirements and provide required accessories, such as frames, accordingly.
9. Provide UL approved (listed and labeled) thermal protection per latest edition of NFPA/NEC for recess mounted luminaires.
10. Provide recessed fluorescent luminaires that are suitably constructed to operate with "P" rated ballasts as specified hereafter.

D. Surface Luminaires: Install surface mounted ballasted luminaires with air spaces between luminaire and surface per latest edition of NFPA/NEC. Provide factory luminaire wiring that is per NEC, #16 AWG minimum. Wire luminaires having medium base and mogul base sockets with not smaller than No. 16 or No. 14 wire respectively in accordance with the latest requirements of the National Electric Code.

E. Review drawings and specifications of other trades to verify ceiling types, modules, and suspension systems appropriate to installation.

F. Incandescent Luminaires: Comply with UL 1598.

G. Fluorescent Luminaires: Comply with UL 1598.

H. HID Luminaires: Comply with UL 1598.

I. Metal Parts: Free of burrs and sharp corners and edges.

J. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

K. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position. Fabricate luminaires with concealed hinges and catches, with metal parts grounded as common unit, and so constructed as to dampen ballast generated noise

L. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

    a. Lens Thickness: At least 0.125 inch minimum unless otherwise indicated.
    b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

M. Factory-Applied Labels: Comply with UL 1598. Include recommended lamps and ballasts. Labels shall be located where they will be readily visible to service personnel, but not seen from normal viewing angles when lamps are in place.

1. Label shall include the following lamp and ballast characteristics:

a. "USE ONLY" and include specific lamp type.
b. Lamp diameter code (T-4, T-5, T-8, T-12, etc.), tube configuration (twin, quad, triple, etc.), base type, and nominal wattage for fluorescent and compact fluorescent luminaires.
c. Lamp type, wattage, bulb type (ED17, BD56, etc.) and coating (clear or coated) for HID luminaires.
d. Start type (preheat, rapid start, instant start, etc.) for fluorescent and compact fluorescent luminaires.
e. ANSI ballast type (M98, M57, etc.) for HID luminaires.
f. CCT and CRI for all luminaires.

N. Provide fusing for high intensity discharge (HID/H.I.D.) luminaires.

O. Provide open Metal-Halide luminaires with open-rated sockets and open-rated lamps. Provide Metal-Halide luminaires with clear tempered glass lenses to protect persons from possible violent end of lamp life. This applies throughout the project though this may not be written into the Luminaire Schedule.

2.3 BALLASTS FOR LINEAR FLUORESCENT LAMPS

A. General Requirements for Electronic Ballasts:

1. Provide same manufacturer and catalog number for ballasts of the same type. Refer to the drawings for input voltage requirements. If fusing requirements are indicated herein or on the Luminaire Schedule, fuse each ballast separately with a replaceable fuse external to the ballast.
2. Provide ballasts that are compatible with power line carrier systems, and that do not adversely impact such systems.
3. Provide luminaires shown on drawings with multi-level switching or similar special circuiting with multiple ballasts. Provide single ballasts wherever possible for other applications.
4. Provide outdoor ballasts (or ballasts indoors, but in unconditioned areas) that are cold weather low starting temperature type (-20 degrees Fahrenheit).
5. Comply with UL 935 and with ANSI C82.11.
6. Designed for type and quantity of lamps served.
7. Ballasts shall be designed for full light output unless another BF, dimmer, or bi-level control is indicated.
8. Sound Rating: Class A.
9. Total Harmonic Distortion Rating: Less than 20 percent.
10. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
11. Operating Frequency: 42 kHz or higher.
12. Lamp Current Crest Factor: 1.7 or less.
13. BF: 0.88 or higher.
14. Power Factor: 0.95 or higher.

B. Luminaires controlled by occupancy sensors shall have programmed-start ballasts.

C. Electronic Programmed-Start Ballasts for T8, T5 and T5HO Lamps: Comply with ANSI C82.11 and the following:

1. Lamp end-of-life detection and shutdown circuit for T5 diameter lamps.
2. Automatic lamp starting after lamp replacement.

D. Electromagnetic Ballasts: Comply with ANSI C82.1; energy saving, high-power factor, Class P, and having automatic-reset thermal protection.

1. Ballast Manufacturer Certification: Indicated by label.

E. Ballasts for Low-Temperature Environments:

1. Temperatures 0 Deg F and Higher: Electronic type rated for 0 deg F starting and operating temperature with indicated lamp types.

F. Ballasts for Dimmer-Controlled Luminaires: Electronic type.

1. Dimming Range: 100 to 5 percent of rated lamp lumens.
2. Ballast Input Watts: Can be reduced to 20 percent of normal.
3. Compatibility: Certified by manufacturer for use with specific dimming control system and lamp type indicated.
4. Control: Coordinate wiring from ballast to control device to ensure that the ballast, controller, and connecting wiring are compatible.

2.4 BALLASTS FOR COMPACT FLUORESCENT LAMPS

A. Description: Electronic-programmed rapid-start type, complying with UL 935 and with ANSI C 82.11, designed for type and quantity of lamps indicated. Ballast shall be designed for full light output unless dimmer or bi-level control is indicated: Solid State Rapid Start Electronic Fluorescent Lamp Ballasts - Compact Fluorescent Lamps

1. Lamp end-of-life detection and shutdown circuit.
2. Automatic lamp starting after lamp replacement.
3. Sound Rating: Class A.
4. Total Harmonic Distortion Rating: Less than 20 percent.
5. Transient Voltage Protection: IEEE C62.41.1 and IEEE C62.41.2, Category A or better.
6. Operating Frequency: 20 kHz or higher.
7. Lamp Current Crest Factor: 1.7 or less.
8. BF: 0.95 or higher unless otherwise indicated.
9. Power Factor: 0.95 or higher.
10. Interference: Comply with 47 CFR 18, Ch. 1, Subpart C, for limitations on electromagnetic and radio-frequency interference for nonconsumer equipment.

2.5 PROGRAMMED START DIMMING BALLASTS FOR FLUORESCENT LAMPS

1. Physical Characteristics

a. Ballast shall be physically interchangeable with standard electromagnetic or standard electronic ballasts, where applicable.
b. Ballast shall be available in a plastic/metal can or fully metal can construction to meet plenum requirements.

c. Ballast shall be provided with poke-in wire trap connectors or integral leads color coded per ANSI C82.11.

2. Performance Requirements

a. Ballast shall be Programmed Start.
b. Ballast shall be provided with integral protection circuitry to withstand connection of low voltage control leads to mains power supply. In this event, ballast shall default to maximum light output.
c. Ballast shall contain auto restart circuitry in order to restart lamps without resetting power.
d. Ballast shall operate from 50/60 Hz input source of 120V or 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast. IntelliVolt models shall operate from 50/60 Hz input source of 120V through 277V with sustained variations of +/- 10% (voltage and frequency) with no damage to the ballast.
e. Ballast shall be high frequency electronic type and operate lamps at a frequency above 42 kHz to avoid interference with infrared devices and eliminate visible flicker.
f. Ballast shall have a Power Factor greater than 0.98 at full light output and greater than 0.90 throughout the dimming range for primary lamp.
g. Ballast shall have a minimum ballast factor of 1.00 at maximum light output and 0.03 at minimum light output for primary lamp application.
h. Ballast shall provide for a Lamp Current Crest Factor of 1.7 or less throughout the dimming range in accordance with lamp manufacturer recommendations.
i. Ballast input current shall have Total Harmonic Distortion (THD) of less than 12% when operated at nominal line voltage with primary lamp.
j. Ballast shall have a Class A sound rating.
k. Ballast shall have a minimum starting temperature of 10C (50F) for primary lamp.
l. Ballast shall provide Lamp EOL Protection Circuit for T5, T5/HO, CFL lamps, and T8 lamps operating on 4-lamp ballast.
m. Ballast shall control lamp output from 100% - 3 % relative light output for T8 and CFL lamps and 100% - 1% relative light output for T5/HO lamps.
n. Ballast shall ignite the lamps at any light output setting without first going to another output setting.
o. Ballast shall tolerate sustained open circuit and short circuit output conditions without damage.

3. Regulatory Requirements

a. Ballast shall not contain Polychlorinated Biphenyl (PCB).
b. Ballast shall be Underwriters Laboratories (UL) listed, Class P and Type 1 Outdoor; and Canadian Standards Association (CSA) certified where applicable.
c. Ballast shall comply with ANSI C62.41 Category A for Transient protection.
d. Ballast shall comply with ANSI C82.11 where applicable.
e. Ballast shall comply with the requirements of the Federal Communications Commissioning (FCC) rules and regulations, Title 47 CFR part 18, Non-Consumer (Class A) for EM/RFI (conducted and radiated).

4. Other

a. Ballast shall carry a five-year warranty from date of manufacture against defects in material and workmanship, including replacement, for operation at a maximum case temperature of 70C.

b. Ballast shall be controlled by a Class 1 or Class 2 low voltage controller.

2.6 EMERGENCY FLUORESCENT POWER UNIT

A. Internal Type: Self-contained, modular, battery-inverter unit, factory mounted within luminaire body and compatible with ballast. Comply with UL 924.

1. Emergency Connection: Unless noted otherwise, operate two fluorescent lamp(s) continuously at an output of 1100 lumens each. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
2. "Nightlight" Connection: Operate one fluorescent lamp continuously.
3. Test Push Button and Indicator Light: Visible and accessible without opening luminaire or entering ceiling space.

    a. Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    b. Indicator Light: LED indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

4. Battery: Sealed, maintenance-free, nickel-cadmium type.
5. Charger: Fully automatic, solid-state, constant-current type with sealed power transfer relay.
6. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.
7. "EMCP" designation: Provide Bodine B50Cold-Pak or approved equivalent. Provide emergency ballast with temperature-control circuitry to fulfill both low-temperature and high-temperature operation. Provide emergency ballast with high-temperature, maintenance-free nickel cadmium battery, charger, and electronic circuitry contained in one nominal 13-3/8" x 2-3/8" x 1-1/2" red metal case. Provide solid-state charging indicator light to monitor the charger and battery, a single-pole test switch, and installation hardware. Provide emergency ballast capable of operating two 32 watt linear fluorescent lamps at 1200 lumens initial light output in the emergency mode for a minimum of 90 minutes. Provide unit that is suitable for use in damp locations and suitable for use in sealed & gasketed luminaires. Provide unit with storage and operating temperature range for the B50Cold-Pak of -20 degrees C to +55 degrees C. Provide emergency ballast UL listed for installation inside, on top of, or remote from the luminaire. Provide unit with full five year warranty from the date of purchase.
8. "EM11" designation: Provide Bodine B84CG or approved equivalent. Provide emergency ballast capable of operating one (26W-DTT), (26W-TRT), (32W-DTT), (32W-TRT), (42W-DTT), (42W-TRT), (or select lamps from Bodine cut sheet if different from those listed) normal or reduced mercury compact fluorescent lamp at (700), (1100), (850), (select lumen output based on table 2 in Bodine Catalog) lumens initial light output in the emergency mode for a minimum of 90 minutes. Provide emergency ballast circuit that delays AC ballast operation for five seconds upon restoration of normal power to prevent false-tripping of AC ballast end-of-life shutdown circuit. Provide unit with high-temperature, maintenance-free nickel cadmium battery, charger, and electronic circuitry contained in one nominal 21.5" x 1.18" x 1.18" galvanized steel case. Provide solid-state charging indicator light to monitor the charger and battery. Provide single-pole test switch. Provide installation hardware. Provide emergency ballast that is UL listed for installation inside, or on top of the luminaire. Provide full five year warranty from date of purchase.
9. "EM13" designation: Provide Bodine LP600 or approved equivalent. Provide emergency ballast capable of operating one 28 watt, T5 fluorescent lamp at 1245 lumens initial light

output in the emergency mode for a minimum of 90 minutes. Provide emergency ballast circuit that delays AC ballast operation for five seconds upon restoration of normal power to prevent false-tripping of AC ballast end-of-life shutdown circuit. Provide unit with high-temperature, maintenance-free nickel cadmium battery, charger and electronic circuitry contained in one nominal 21.5" x 1.18" x 1.18" galvanized steel case. Provide solid-state charging indicator light to monitor the charger and battery. Provide single-pole test switch. Provide installation hardware. Provide emergency ballast that is UL listed for installation inside, or on top of the luminaire. Provide full five year warranty from date of purchase.

10. "EM14" designation: Provide Bodine B50U or approved equivalent. Provide emergency ballast with high-temperature, maintenance-free nickel cadmium battery, charger and electronic circuitry contained in one nominal 13-3/8" x 2-3/8" x 1-1/2" metal case. Provide solid-state charging indicator light to monitor the charger and battery. Provide double-pole test switch. Provide installation hardware. Provide emergency ballast capable of operating two 32 watt, T-8 fluorescent lamps at 1350 lumens initial light output in the emergency mode for a minimum of 90 minutes. Provide unit with universal input that operates at any line voltage from 120 through 277 VAC at frequencies of 50 or 60 Hz. Provide emergency ballast UL listed for installation inside, on top of, or remote from the luminaire. Provide full five year warranty from date of purchase.

B. External Type: Self-contained, modular, battery-inverter unit, suitable for powering one or more fluorescent lamps, remote mounted from luminaire. Comply with UL 924.

1. Emergency Connection: Operate one fluorescent lamp continuously. Connect unswitched circuit to battery-inverter unit and switched circuit to luminaire ballast.
2. "Nightlight" Connection: Operate one fluorescent lamp in a remote luminaire continuously.
3. Battery: Sealed, maintenance-free, nickel-cadmium type.
4. Charger: Fully automatic, solid-state, constant-current type.
5. Housing: NEMA 250, Type 1 enclosure.
6. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
7. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.
8. Integral Self-Test: Factory-installed electronic device automatically initiates code-required test of unit emergency operation at required intervals. Test failure is annunciated by an integral audible alarm and a flashing red LED.

2.7 FLUORESCENT LAMPS

A. Lamps shall be manufactured by G.E., Osram Sylvania or Philips.

B. T8 rapid-start lamps, CRI 82 (minimum), and average rated life 20,000 hours unless otherwise indicated. Refer to Luminaire Schedule for wattage and color temperature.

C. T5 rapid-start lamps, CRI 85 (minimum), and average rated life 20,000 hours unless otherwise indicated. Refer to Luminaire Schedule for wattage and color temperature.

D. T5HO rapid-start, high-output lamps, CRI 85 (minimum), and average rated life 20,000 hours unless otherwise indicated. Refer to Luminaire Schedule for wattage and color temperature.

E. Compact Fluorescent Lamps, Twin-Tube/Dual Twin-Tube and Triple-Tube, CRI 80 (minimum), color temperature as indicated in Luminaire Schedule, average rated life of 10,000 hours at

three hours operation per start, and suitable for use with dimming ballasts unless otherwise indicated.

2.8 LIGHT EMITTING DIODE (LED) SYSTEMS

A. Light Emitting Diode (LED) Systems

1. LED Source

a. Provide factory installed LED modules that are specifically designed for, and matched and mated to, the respective luminaire in which they are used.
b. Provide LED modules that can easily be replaced in the field and are readily accessible for replacement.
c. Provide color temperature as indicated in Luminaire Schedule.

2. LED Driver

a. Provide factory installed driver(s) for the LED source utilized that are specifically coordinated to the LED source and luminaire in which they are used.
b. Provide driver(s) having specific operating characteristics defined in the Luminaire Schedule.
c. Provide driver(s) that can easily be replaced in the field and are readily accessible for replacement.
d. Provide specification sheet for the specific driver as part of the Luminaire Submittal.

2.9 LUMINAIRE SUPPORT COMPONENTS

A. Support fixtures in compliance with NEC.

B. Comply with Section 260529 "Hangers and Supports for Electrical Systems" for channel- and angle-iron supports and nonmetallic channel and angle supports.

C. Single-Stem Hangers: 1/2-inch steel tubing with swivel ball fittings and ceiling canopy. Finish same as luminaire.

D. Twin-Stem Hangers: Two, 1/2-inch steel tubes with single canopy designed to mount a single luminaire. Finish same as luminaire.

E. Wires: ASTM A 641/A 641M, Class 3, soft temper, zinc-coated steel, 12 gage.

F. Wires for Humid Spaces: ASTM A 580/A 580M, Composition 302 or 304, annealed stainless steel, 12 gage.

G. Rod Hangers: 3/16-inch minimum diameter, cadmium-plated, threaded steel rod.

H. Hook Hangers: Integrated assembly matched to luminaire and line voltage and equipped with threaded attachment, cord, and locking-type plug.

I. Provide additional supports as required in seismic areas.

2.10 EMERGENCY REMOTE BATTERY INVERTERS (RBI)

A. Provide remote battery inverters were indicated on the drawings. The self-diagnostic Emergency Remote Battery Inverter works in conjunction with a fluorescent, incandescent or LED luminaire to create an emergency lighting system. The (RBI) a maximum load of 250 watts. The RBI allows the connected luminaires to be on, off, switched or dimmed without affecting emergency operation. The RBI unit consists of a sealed lead calcium battery, charger and electronic circuitry in one steel case. The RBI provides power to the input side of the luminaire, including the ballast.

1. Upon failure of normal power, the RBI instantly begins providing emergency power to the connected lighting load for a minimum of 90 minutes and will support lumen output at 91% of the lamp's rating throughout the 90-minute duration. A solid-state low voltage disconnect circuit protects the inverter battery from severe damage by deep discharge during prolonged power failures. When normal power is restored, the automatic, temperature-compensated, variable-rate float charger begins recharging the battery. The battery capacity is fully restored in 24 hours. A brownout sensing circuit ensures proper operation during low line conditions.
2. The RBI features self-diagnostic circuitry. This circuitry checks different operating parameters during initial start-up, normal standby and diagnostic stages. If a fault is detected, the fault indicator flashes to alert maintenance personnel.
3. The RBI self-diagnostic unit automatically initiates a 15-minute diagnostic cycle every 25 to 30 days to test emergency operation. The self-diagnostic circuitry does not utilize the lighting load (i.e., the emergency lamps) to cycle and test the unit battery. Instead, a built-in resistive load is used, thereby eliminating emergency lamp illumination during diagnostic testing and saving lamp life.
4. The RBI does not affect normal fixture operation and may be used with a switched or unswitched luminaire and is designed for surface mounting and may be installed up to 1000 feet from the emergency fixture.
5. The RBI shall be as manufactured by Bodine ELI-250-SD. The ELI-250-SD has been tested by Underwriters Laboratory in accordance with the standards set forth in UL 924, "Emergency Lighting and Power Equipment," and is UL Listed for field installation. Emergency illumination exceeds the National Electrical Code (NEC) and Life Safety Code (NFPA-LSC) requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Luminaires:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Remote Mounting of Ballasts: Distance between the ballast and luminaire shall not exceed that recommended by ballast manufacturer. Verify, with ballast manufacturers, maximum distance between ballast and luminaire.

D. Lay-in Ceiling Luminaires Supports: Use grid as a support element.

1. Install ceiling support system rods or wires, independent of the ceiling suspension devices, for each luminaire. Locate not more than 6 inches from luminaire corners.
2. Support Clips: Fasten to luminaires and to ceiling grid members at or near each luminaire corner with clips that are UL listed for the application.
3. Luminaires of Sizes Less Than Ceiling Grid: Install as indicated on reflected ceiling plans or center in acoustical panel, and support luminaires independently with at least two 3/4-inch metal channels spanning and secured to ceiling tees.

E. Suspended Luminaire Support:

1. Pendants and Rods: Where longer than 48 inches brace to limit swinging.
2. Stem-Mounted, Single-Unit Luminaires: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of luminaire chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

F. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

G. Install surface and recessed ceiling luminaires on grid and tile ceilings to agree with module of ceiling either displacing a tile, or unit on center of tile, or centered on grid lines.

H. Install flush mounted luminaires properly to eliminate light leakage between luminaire frame and finished surface.

I. Do not locate splice or tap within an arm, stem, or chain. Provide wiring continuous from splice in outlet box of the building wiring system to lamp socket, or to ballasts terminals in fluorescent luminaires.

J. Provide Type AC/MC Cable or wiring in minimum 1/2” diameter flexible metal conduit (with full parity sized green insulated equipment ground wire) for "drops" from building wiring system junction boxes to suspended ceiling mounted luminaires. Limit the length of these “drops” to 72”. Install "drops" to luminaires in gypsum board, and similar inaccessible ceiling systems, from identified accessible junction boxes.

K. Connect luminaires utilized for emergency egress lighting ahead of switching and other controls. The only exceptions to this are photocell-only controls for outdoor emergency egress luminaires.

L. Provide luminaires and luminaire outlet boxes with hangers to properly support luminaire weight. Submit design of hangers, method of fastening, other than indicated or specified herein, for review by Owner's representative and review by ceiling installer. Anchor luminaires installed in, or on, suspended ceiling systems in strict compliance with NEC, including advance coordination with the ceiling installer. Support surface mounted luminaires greater than 2 feet in length at a point in addition to the outlet box luminaire stud.

M. Fasten electrical luminaires and brackets securely to structural supports. Install luminaires level and plumb.

N. Where special mounting conditions are encountered, such as mounting to rounded columns or similar special circumstances, provide special factory fabricated mounting means (i.e., brackets

designed to conform with curvature of rounded columns, or to conform with similar special surfaces).

O. Provide stems and chains for luminaires as designated by the Owner's representative where deemed necessary by the owner's representative to achieve a functional and neat installation. Contact owner's representative to determine pendant, stem, and chain lengths if mounting height is not indicated.

P. Provide plaster frames, or gypsum board frames, or similar kits for recessed luminaires installed in other than suspended grid type acoustical ceiling systems. Brace frames temporarily to prevent distortion during handling.

Q. Wear clean white cotton gloves when handling the luminaires reflective and diffusing surfaces. Clean surfaces including dust, finger prints, paint, etc with a clean dry cheesecloth after interior work has been completed. Remove plastic shipping bags from luminaires only after work in the respective area is complete.

R. Where applicable, verify that measured illuminance values comply with respective isolux (or equivalent) plot diagram values.

S. Provide full assembly for luminaires that are shipped with any loose components, regardless of who furnishes the luminaires.

3.2 LIGHTING STANDARDS AND POST LIGHTS

A. Utilize belt slings or rope (not chain or cable) to protect finishes of poles and standards when raising and setting finished poles and standards.

B. Provide sufficient space encompassing hand access and cable entrance holes for installation of underground cabling where applicable.

C. Fasten electrical poles, luminaires and brackets securely to structural supports.

D. Provide concrete base for each luminaire standard pole. Provide base that is reinforced, and, unless indicated deeper on drawings, of the depth recommended by the manufacturer. Provide galvanized steel washers, nuts and anchor bolts, in diameters, lengths and classes as directed by pole manufacturer.

E. After ensuring that the poles are plumb, neatly fill the entire space between top of concrete bases and bottom of pole bases with grout. Provide poles with matching factory base covers ("skirts"). This applies even if not specifically indicated on Luminaire Schedule.

F. Separately fuse luminaires within the pole-base handholes.

3.3 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

B. Prepare a written report of tests, inspections, observations, and verifications indicating and interpreting results. If adjustments are made to lighting system, retest to demonstrate compliance with standards.

3.5 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.6 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION 265100

SUBMITTAL FORM - 265100.00 – LUMINAIRES - PART 1

PROVIDE AND COMPLETE THIS SHEET AND SUBMIT AS A COVER SHEET FOR SUBMITTALS REQUESTED WITHIN THIS SECTION. PROVIDE AND COMPLETE SUBMITTAL FORM – 265100.00 – LUMINAIRES - PART 2, LUMINAIRE SUBMITTAL TABLE, AS AN ATTACHMENT TO THIS SHEET.

ELECTRICAL CONTRACTOR: _____ ELECTRICAL SUPPLIER: _____

ELECTRICAL CONTRACTOR REP: _____ ELECTRICAL SUPPLIER REP: _____

ELECTRIC CONTRACTOR PH. NUMBER: _____ ELECTRIC SUPPLIER PH. NUMBER: _____

ELECTRIC CONTRACTOR REP EMAIL: _____ ELECTRIC SUPPLIER REP EMAIL: _____

LUMINAIRE SUBMITTAL TABLE MUST BE DOWNLOADED FROM KLH ENGINEERS, PSC WEBSITE, WWW.KLHENGRS.COM.

EXPLANATION RESPONSES TO QUESTIONS BELOW MUST INDICATE SPECIFIC LUMINAIRE TYPE COMMENT REFERS TO.

	YES	NO
LUMINAIRE SUBMITTAL TABLE HAS BEEN FILLED OUT COMPLETELY AND IS ATTACHED WITH THIS FORM?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS LISTED AS BASIS OF DESIGN OR LISTED EQUIVALENT MANUFACTURER?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURER'S QUALIFICATIONS MEET OR EXCEED THOSE REQUIRED UNDER QUALITY ASSURANCE SECTION WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
SUBMITTED LUMINAIRES, LAMPS (SOURCES), BALLASTS (DRIVERS), AND ASSOCIATED COMPONENTS MEET ALL REQUIREMENTS LISTED WITHIN THIS SPECIFICATION?	☐	☐

IF NO, EXPLAIN _____		
Manufacturer's warranty meets or exceeds the warranty period specified within this specification?	☐	☐
If No, Explain _____		
Are all system components referenced in other sections by the same manufacturer, coordinated with this system and included in this submittal (such as occupancy sensors)?	☐	☐
If No, Explain _____		

SECTION 283113 - FIRE ALARM SYSTEM EXTENSION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

Refer to Division 26 Section 26 05 01.00 “Common Requirements for Electric”. Comply with applicable requirements therein.

Refer to Division 26 Section 26 05 02.00 “Common Electric Materials and Methods”. Comply with applicable requirements therein.

Refer to Division 26 Section 26 05 05.00 “Existing Conditions”. Comply with applicable requirements therein.

Refer to Division 26 Section 26 05 19.00 “Low-Voltage Electrical Power Conductors and Cables”. Comply with applicable requirements therein.

Refer to Division 26 Section 26 05 26.00 “Grounding and Bonding for Electrical Systems”. Comply with applicable requirements therein.

Refer to Division 26 Section 26 05 29.00 “Hangers and Supports”. Comply with applicable requirements therein.

Refer to Division 26 Section 26 05 33.00 “Raceways and Boxes for Electrical Systems”. Comply with applicable requirements therein.

Refer to Division 26 Section 26 05 53.00 “Identification for Electrical Systems”. Comply with applicable requirements therein.

1.2 SUMMARY

A. Section Includes: All materials, labor and services to provide fully operational modifications to and extensions of existing facility fire alarm system(s).

B. Provide minimum 25% spare capacity for each data loop, each alarm circuit and for each set of power supplies and batteries.

1.3 ACTION SUBMITTALS

A. Provide submittals for equipment, materials and systems specified in this section. Include cuts, descriptive information, technical data, wiring diagrams, system battery calculations, plan-view layouts, legend, point-to-point wiring, etc. Identify all information that is specific to this project.

B. The fire alarm system supplier shall provide to the electrical contractor a complete set of floor plan drawings showing conduit sizes and number of conductors required to all components plus detailed wiring connections required at each type of device.

C. It shall be the responsibility of the Fire Alarm System Manufacturer to furnish submittals to the authority having jurisdiction for approval. This action shall be taken during the shop drawing procedure. The system must be approved by this authority and a copy submitted to the Engineer with the shop drawing submittal. All fire alarm system working drawings shall be provided by manufacturer.

1.4 PROJECT CONDITIONS

A. Interruption of Existing Fire-Alarm Service: Do not interrupt fire-alarm service to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary guard service according to requirements indicated:

1. Notify Owner's Representative no fewer than two days in advance of proposed interruption of fire-alarm service.
2. Do not proceed with interruption of fire-alarm service without Owner's Representative's written permission.

1.5 SEQUENCING AND SCHEDULING

A. Existing Fire-Alarm Equipment: Maintain existing equipment fully operational until new equipment has been tested and accepted. As new equipment is installed, label it "NOT IN SERVICE" until it is accepted. Remove labels from new equipment when put into service and label existing fire-alarm equipment "NOT IN SERVICE" until removed from the building.

B. Equipment Removal: After acceptance of new fire-alarm system, remove existing disconnected fire-alarm equipment and wiring.

PART 2 - PRODUCTS

2.1 FIRE ALARM EXTENSION

A. Connecting to Existing Equipment and System

1. Verify that existing fire-alarm system is operational before making changes or connections.
2. Connect new equipment to existing control panel in existing part of the building.
3. Connect new equipment to existing monitoring equipment at the supervising station.
4. Expand, modify, and supplement existing control/monitoring equipment as necessary to extend existing control/monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
5. Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
6. Provide Initiating Device, Notification Appliance, and Signaling Line Circuits that are NFPA 72, Class B, to match existing system.

B. General Requirements

1. Provide materials and labor as required to result in a fully operational extension and modification to the existing fire alarm system.

2. Where indicated on drawings, remove existing fire alarm devices in affected areas and protect during demolition and construction phases. Clean and reinstall these existing devices as indicated on drawings. Relocate devices as indicated on drawings and extend conduit and wiring as required. Modify and/or extend related existing wiring in conduit as required.
3. Fire alarm system devices (smoke detectors, pull stations, A/V alarm indicating devices, etc.) shall be of the same manufacturer as, compatible with, and UL Listed and labeled for use on, the existing building fire alarm system.
4. Provide auxiliary contacts if required for special applications. All strobe alarms shall be ADA compliant, minimum 75cd per ADA unless specifically indicated on drawings with lower candela rating.
5. Install wall-mounted devices at the following heights above finished floor:

    a. Fire Alarm Manual Pull Stations: 46” to top of operating handle.
    b. Fire Alarm A/V Annunciators: 80” to bottom of outlet box.
    c. Fire Alarm Door Holders: 84”.

6. All new wiring shall be installed in strict accordance with manufacturer's requirements.
7. Fire alarm system wiring shall be installed in a raceway system separate from security sub-system wiring where/if applicable.
8. The installation shall include a complete system test of the equipment by the local representative of the system installed. This test shall be performed in the presence of representatives of the Owner, Engineer, and local fire department.
9. Provide all required modifications (cards, power supplies, hardware, firmware, software, etc.) to the existing Fire Alarm system as required to render the entire extension fully operable.
10. Provide ceiling mounted smoke detector located above each Fire Alarm Control Unit (FACU), if not already existing, and above all remote/satellite control and power units.
11. Provide all required 120VAC power as required to energize all new fire alarm related components. This requirement applies whether or not such power work is shown on the drawings. Branch circuits serving fire alarm related equipment shall be dedicated to fire alarm related equipment only.
12. Smoke detector locations shall not exceed the rated coverage of the detector and, in general, shall be no more than 15 feet from a wall or 30 feet apart. Smoke detectors shall not be installed within 3 feet from a supply air diffuser. Provide contact bases for all applications where auxiliary contacts are required.
13. Provide isolation modules as required to isolate wire to wire shorts on a data loop to limit the number of other modules or detectors that are incapacitated by the short circuit fault and/or grounds. Isolation modules shall be part of the smoke detector base. The isolation modules shall permit the entire system to operate independently of the area disconnected by the isolation module due to wiring faults.
14. Provide monitor modules as required to interface "non-intelligent" devices into the system as shown on the drawings (i.e.).
15. Provide control modules for all auxiliary devices including door closures.
16. Furnish and install one magnetic door holder set for each door leaf for doors requiring hold-open devices, equipped for wall or floor mounting as applicable, complete with matching doorplate. Provide blocking in wall for wall mounted applications. Provide material and finish to match respective door hardware. Provide one smoke detector (listed for release service) on each side of the respective door or door set. Do not install door-holder power wiring in the same conduit as fire alarm system wiring. Unless indicated otherwise on drawings or herein, configure and program the fire alarm system so that all held-open doors are released upon any alarm condition that activates building notification devices. Install door holders at uniform heights as recommended by fire alarm system manufacturer’s representative. Verify that proposed mounting heights are acceptable with Architect.

a. Rating: 120-V ac, fed from local normal-utility convenience outlet circuit.

END OF SECTION 283113

SUBMITTAL FORM – 263113.00 – FIRE ALARM SYSTEM EXTENSION

PROVIDE AND COMPLETE THIS SHEET AND SUBMIT AS A COVER SHEET FOR SUBMITTALS REQUESTED WITHIN THIS SECTION.

ELECTRICAL CONTRACTOR: _____ ELECTRICAL SUPPLIER: _____

ELECTRICAL CONTRACTOR REP: _____ ELECTRICAL SUPPLIER REP: _____

ELECTRIC CONTRACTOR PH. NUMBER: _____ ELECTRIC SUPPLIER PH. NUMBER: _____

ELECTRIC CONTRACTOR REP EMAIL: _____ ELECTRIC SUPPLIER REP EMAIL: _____

SUBMITTED MANUFACTURERS (LIST TYPE AND MANUFACTURER): _____		
	YES	NO
MANUFACTURERS LISTED AS BASIS OF DESIGN OR LISTED EQUIVALENT MANUFACTURERS?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' QUALIFICATIONS MEET OR EXCEED THOSE REQUIRED UNDER QUALITY ASSURANCE SECTION WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
MANUFACTURERS' WARRANTY MEETS OR EXCEEDS THE WARRANTY PERIOD SPECIFIED WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		
SUBMITTED COMPONENTS MEET ALL REQUIREMENTS LISTED WITHIN THIS SPECIFICATION?	☐	☐
IF NO, EXPLAIN _____		

PRODUCT DATA IS INCLUDED FOR EACH COMPONENT?	☐	☐
IF NO, EXPLAIN _____		
COVERAGE AND CANDELA REQUIREMENTS FOR ALL VISIBLE NOTIFICATION APPLIANCES HAVE BEEN CHECKED AND DEVICES SHOWN ON SHOP DRAWINGS ACCORDINGLY?	☐	☐
IF NO, EXPLAIN _____		
BATTERY CALCULATIONS ARE INCLUDED?	☐	☐
IF NO, EXPLAIN _____		
PROJECT-SPECIFIC SHOP DRAWINGS ARE INCLUDED FOR ALL PLAN-VIEW AREAS?	☐	☐
IF NO, EXPLAIN _____		