

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

- 1. Framing with dimension lumber.
- 2. Wood blocking and nailers.
- 3. Wood furring and grounds.
- 4. Plywood backing panels.\
- 5. Tongue and groove plywood decking
 - a. Courtroom floors: Provide 1^{1/8}" CAT PS 1-09 Tongue and groove Douglas Fir plywood.

B. Related Requirements:

- 1. Section 061063 "Exterior Rough Carpentry."
- 2. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.3 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal (38 mm actual) size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal (38 mm actual) size or greater but less than 5 inches nominal (114 mm actual) size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. OSB: Oriented strand board.
- E. Timber: Lumber of 5 inches nominal (114 mm actual) size or greater in least dimension.

1.4 ACTION SUBMITTALS

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

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.
2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency according to ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

B. Fastener Patterns: Full-size templates for fasteners in exposed framing.

1.5 INFORMATIONAL SUBMITTALS

A. Material Certificates: For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.

B. Evaluation Reports: For the following, from ICC-ES:

1. Wood-preservative-treated wood.
2. Fire-retardant-treated wood.
3. Engineered wood products.
4. Shear panels.
5. Power-driven fasteners.
6. Post-installed anchors.
7. Metal framing anchors.

1.6 QUALITY ASSURANCE

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

1.7 DELIVERY, STORAGE, AND HANDLING

A. Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS, GENERAL

- A. Lumber: DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
 - 1. Factory mark each piece of lumber with grade stamp of grading agency.
 - 2. For exposed lumber indicated to receive a stained or natural finish, mark grade stamp on end or back of each piece
 - 3. Dress lumber, S4S, unless otherwise indicated.
- B. Maximum Moisture Content of Lumber: 15 percent for 2-inch nominal (38-mm actual) thickness or less; 19 percent for more than 2-inch nominal (38-mm actual) thickness unless otherwise indicated.
- C. Engineered Wood Products: Acceptable to authorities having jurisdiction and for which current model code research or evaluation reports exist that show compliance with building code in effect for Project.
 - 1. Allowable design stresses, as published by manufacturer, shall meet or exceed those indicated. Manufacturer's published values shall be determined from empirical data or by rational engineering analysis and demonstrated by comprehensive testing performed by a qualified independent testing agency.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Preservative Treatment by Pressure Process: AWP A U1; Use Category UC2 for interior construction not in contact with ground, Use Category UC3b for exterior construction not in contact with ground, and Use Category UC4a for items in contact with ground.
 - 1. Preservative Chemicals: Acceptable to authorities having jurisdiction and containing no arsenic or chromium. Do not use inorganic boron (SBX) for sill plates.
 - 2. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not require incising, contain colorants, bleed through, or otherwise adversely affect finishes.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Mark lumber with treatment quality mark of an inspection agency approved by the ALSC Board of Review.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by inspection agency.

- D. Application: Treat all rough carpentry unless otherwise indicated.
1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 3. Wood framing and furring attached directly to the interior of below-grade exterior masonry or concrete walls.
 4. Wood framing members that are less than 18 inches (460 mm) above the ground in crawlspaces or unexcavated areas.
 5. Wood floor plates that are installed over concrete slabs-on-grade.

2.3 FIRE-RETARDANT-TREATED MATERIALS

- A. General: Where fire-retardant-treated materials are indicated, materials shall comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested according to ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 feet (3.2 m) beyond the centerline of the burners at any time during the test.
1. Treatment shall not promote corrosion of metal fasteners.
 2. Exterior Type: Treated materials shall comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering according to ASTM D2898. Use for exterior locations and where indicated.
 3. Interior Type A: Treated materials shall have a moisture content of 28 percent or less when tested according to ASTM D3201 at 92 percent relative humidity. Use where exterior type is not indicated.
 4. Design Value Adjustment Factors: Treated lumber shall be tested according to ASTM D5664 and design value adjustment factors shall be calculated according to ASTM D6841. For enclosed roof framing, framing in attic spaces, and where high temperature fire-retardant treatment is indicated, provide material with adjustment factors of not less than 0.85 modulus of elasticity and 0.75 for extreme fiber in bending for Project's climatological zone.
- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent. Kiln-dry plywood after treatment to maximum moisture content of 15 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency.
1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece or omit marking and provide certificates of treatment compliance issued by testing agency.

- E. For exposed items indicated to receive a stained or natural finish, chemical formulations shall not bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat all rough carpentry unless otherwise indicated.
 - 1. Framing for raised platforms.
 - 2. Framing for stages.
 - 3. Concealed blocking.
 - 4. Framing for non-load-bearing partitions.
 - 5. Framing for non-load-bearing exterior walls.
 - 6. Roof construction.
 - 7. Plywood backing panels.

2.4 DIMENSION LUMBER FRAMING

- A. Joists, Rafters, for courtroom judge, jury clerk raised floor: Construction or No. 2 grade.
 - 1. Species:
 - a. Hem-fir (north); NLGA.
 - b. Southern pine; SPIB.
 - c. Douglas fir-larch; WCLIB or WWPA.
 - d. Southern pine or mixed southern pine; SPIB.
 - e. Spruce-pine-fir; NLGA.
 - f. Douglas fir-south; WWPA.
 - g. Hem-fir; WCLIB or WWPA.
 - h. Douglas fir-larch (north); NLGA.
 - i. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
- B. Joists, Rafters, and Other Framing Not Listed Above: Any species of machine stress-rated dimension lumber with a grade of not less than 2400f-2.0E.
- C. Joists, Rafters, and Other Framing Not Listed Above: Any species and grade with a modulus of elasticity of at least 1,500,000 psi (10 350 MPa) stress in bending of at least 1000 psi (6.9 MPa) for 2-inch nominal (38-mm actual) thickness and 12-inch nominal (286-mm actual) width for single-member use.

2.5 MISCELLANEOUS LUMBER

- A. General: Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.
 - 5. Furring.
 - 6. Grounds.
 - 7. Utility shelving.

- B. Dimension Lumber Items: Construction or No. 2 grade lumber of any of the following species:
 - 1. Hem-fir (north); NLGA.
 - 2. Mixed southern pine or southern pine; SPIB.
 - 3. Spruce-pine-fir; NLGA.
 - 4. Hem-fir; WCLIB or WWPA.
 - 5. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 - 6. Western woods; WCLIB or WWPA.
 - 7. Northern species; NLGA.
 - 8. Eastern softwoods; NeLMA.

- C. Concealed Boards: 15 percent maximum moisture content and any of the following species and grades:
 - 1. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 - 2. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA, WCLIB, or WWPA.
 - 3. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA, NLGA, WCLIB, or WWPA.
 - 4. Eastern softwoods; No. 2 Common grade; NeLMA.
 - 5. Northern species; No. 2 Common grade; NLGA.
 - 6. Western woods; Construction or No. 2 Common grade; WCLIB or WWPA.

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

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

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

2.6 PLYWOOD BACKING PANELS

- A. Equipment Backing Panels: Plywood, DOC PS 1 fire-retardant treated, in thickness indicated or, if not indicated, not less than **3/4-inch (19-mm)** nominal thickness.

2.7 TOUNGE AND GROOVE PLYWOOD FLOOR DECKING

- A. Provide

2.8 FASTENERS

- A. General: Fasteners shall be of size and type indicated and shall comply with requirements specified in this article for material and manufacture.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.
- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01 as appropriate for the substrate.
 1. Material: Carbon-steel components, zinc plated to comply with ASTM B633, Class Fe/Zn 5.
 2. Material: Stainless steel with bolts and nuts complying with **ASTM F593 and ASTM F594, Alloy Group 1 or 2** (ASTM F738M and ASTM F836M, Grade A1 or A4).

2.9 MISCELLANEOUS MATERIALS

- A. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
- B. Water-Repellent Preservative: NWWDA-tested and -accepted formulation containing 3-iodo-2-propynyl butyl carbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Framing with Engineered Wood Products: Install engineered wood products to comply with manufacturer's written instructions.
- C. Set rough carpentry to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- D. Install plywood backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

1. Provide metal clips for fastening gypsum board or lath at corners and intersections where framing or blocking does not provide a surface for fastening edges of panels. Space clips not more than **16 inches (406 mm)** o.c.
- G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
1. Fire block furred spaces of walls, at each floor level, at ceiling, and at not more than **96 inches (2438 mm)** o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
 2. Fire block concealed spaces of wood-framed walls and partitions at each floor level, at ceiling line of top story, and at not more than **96 inches (2438 mm)** o.c. Where fire blocking is not inherent in framing system used, provide closely fitted solid wood blocks of same width as framing members and **2-inch nominal (38-mm actual)** thickness.
 3. Fire block concealed spaces between floor sleepers with same material as sleepers to limit concealed spaces to not more than **100 sq. ft. (9.3 sq. m)** and to solidly fill space below partitions.
 4. Fire block concealed spaces behind combustible cornices and exterior trim at not more than **20 feet (6 m)** o.c.
- H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- I. Comply with AWP A M4 for applying field treatment to cut surfaces of preservative-treated lumber.
1. Use inorganic boron for items that are continuously protected from liquid water.
 2. Use copper naphthenate for items not continuously protected from liquid water.
- J. Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- K. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
1. Table 2304.9.1, "Fastening Schedule," in ICC's International Building Code (IBC).
 2. Table R602.3(1), "Fastener Schedule for Structural Members," and Table R602.3(2), "Alternate Attachments," in ICC's International Residential Code for One- and Two-Family Dwellings.
 3. ICC-ES evaluation report for fastener.
- L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.
- M. For exposed work, arrange fasteners in straight rows parallel with edges of members, with fasteners evenly spaced, and with adjacent rows staggered.

1. Comply with approved fastener patterns where applicable.
2. Use finishing nails unless otherwise indicated. Countersink nail heads and fill holes with wood filler.
3. Use common nails unless otherwise indicated. Drive nails snug but do not countersink nail heads.

3.2 INSTALLATION OF WOOD BLOCKING AND NAILERS

- A. Install where indicated and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Attach items to substrates to support applied loading. Recess bolts and nuts flush with surfaces unless otherwise indicated.
- C. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than **1-1/2 inches (38 mm)** wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.3 INSTALLATION OF WOOD FURRING

- A. Install level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.
- B. Furring to Receive Plywood or Hardboard Paneling: Install **1-by-3-inch nominal- (19-by-63-mm actual-)** size furring horizontally and vertically at **24 inches (610 mm)** o.c.

3.4 INSTALLATION OF FLOOR JOIST FRAMING

- A. General: Install floor joists with crown edge up and support ends of each member with not less than **1-1/2 inches (38 mm)** of bearing on wood or metal, or **3 inches (76 mm)** on masonry. Attach floor joists as follows:
 1. Where supported on wood members, by toe nailing or by using metal framing anchors.
 2. Where framed into wood supporting members, by using wood ledgers as indicated or, if not indicated, by using metal joist hangers.
- B. Fire Cuts: At joists built into masonry, bevel cut ends **3 inches (76 mm)** and do not embed more than **4 inches (102 mm)**.
- C. Frame openings with headers and trimmers supported by metal joist hangers; double headers and trimmers where span of header exceeds **48 inches (1200 mm)**.
- D. Do not notch in middle third of joists; limit notches to one-sixth depth of joist, one-third at ends. Do not bore holes larger than one-third depth of joist; do not locate closer than **2 inches (50 mm)** from top or bottom.
- E. Provide solid blocking of **2-inch nominal (38-mm actual)** thickness by depth of joist at ends of joists unless nailed to header or band.

- F. Lap members framing from opposite sides of beams, girders, or partitions not less than **4 inches (102 mm)** or securely tie opposing members together. Provide solid blocking of **2-inch nominal (38-mm actual)** thickness by depth of joist over supports.
- G. Anchor members paralleling masonry with **1/4-by-1-1/4-inch (6.4-by-32-mm)** metal strap anchors spaced not more than **96 inches (2438 mm)** o.c., extending over and fastening to three joists. Embed anchors at least **4 inches (102 mm)** into grouted masonry with ends bent at right angles and extending **4 inches (102 mm)** beyond bend.
- H. Provide solid blocking between joists under jamb studs for openings.
- I. Under non-load-bearing partitions, provide double joists separated by solid blocking equal to depth of studs above.
 - 1. Provide triple joists separated as above, under partitions receiving ceramic tile and similar heavy finishes or fixtures.
- J. Provide bridging of type indicated below, at intervals of **96 inches (2438 mm)** o.c., between joists.
 - 1. Diagonal wood bridging formed from bevel-cut, **1-by-3-inch nominal- (19-by-64-mm actual-)** size lumber, double-crossed and nailed at both ends to joists.
 - 2. Steel bridging installed to comply with bridging manufacturer's written instructions.

3.5 PROTECTION

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

END OF SECTION 061000

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Silicone joint sealants.
2. Urethane joint sealants.
3. Latex joint sealants.
4. Preformed joint sealants.
5. Acoustical joint sealants.

1.2 PRECONSTRUCTION TESTING

- A. Preconstruction Compatibility and Adhesion Testing: Submit to joint-sealant manufacturers samples of materials that will contact or affect joint sealants. Use ASTM C 1087 to determine whether priming and other specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.
- B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates. Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

1.3 ACTION SUBMITTALS

- A. Product Data: For each joint-sealant product indicated.
- B. Samples: For each kind and color of joint sealant required.
- C. Joint-Sealant Schedule: Include the following information:
 1. Joint-sealant application, joint location, and designation.
 2. Joint-sealant manufacturer and product name.
 3. Joint-sealant formulation.
 4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Product test reports.
- B. Preconstruction compatibility and adhesion test reports.
- C. Preconstruction field-adhesion test reports.
- D. Field-adhesion test reports.

- E. Warranties.

1.5 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to ASTM C 1021 to conduct the testing indicated.
- B. Pre-installation Conference: Conduct conference at Project site.

1.6 WARRANTY

- A. Special Installer's Warranty: Manufacturer's standard form in which Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 - 1. Warranty Period: 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: Two 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.
- B. Low-Emitting Interior Sealants: Sealants and sealant primers used inside the weatherproofing system 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. Liquid-Applied Joint Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied joint sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
 - 1. Suitability for Immersion in Liquids. Where sealants are indicated for Use I for joints that will be continuously immersed in liquids, provide products that have undergone testing according to ASTM C 1247. Liquid used for testing sealants is deionized water, unless otherwise indicated.

- D. Stain-Test-Response Characteristics: Where sealants are specified to be nonstaining to porous substrates, provide products that have undergone testing according to ASTM C 1248 and have not stained porous joint substrates indicated for Project.
- E. Suitability for Contact with Food: Where sealants are indicated for joints that will come in repeated contact with food, provide products that comply with 21 CFR 177.2600.

2.2 SILICONE JOINT SEALANTS

A. Neutral-Curing Silicone Joint Sealant: ASTM C 920.

- 1. Basis-of-Design Product (Masonry Conditions): Subject to compliance with requirements, provide Dow Corning 790 or comparable product by one of the following:
 - a. BASF Building Systems.
 - b. Dow Corning Corporation.
 - c. GE Advanced Materials - Silicones.
 - d. May National Associates, Inc.
 - e. Pecora Corporation.
 - f. Polymeric Systems, Inc.
 - g. Schnee-Morehead, Inc.
 - h. Sika Corporation; Construction Products Division.
 - i. Tremco Incorporated.
- 2. Type: Single component (S).
- 3. Grade: Nonsag (NS).
- 4. Class: 100/50.
- 5. Uses Related to Exposure: Non-traffic (NT).

B. Neutral-Curing Silicone Joint Sealant: ASTM C 920.

- 1. Basis-of-Design Product (Joints at Window Frames to Walls): Subject to compliance with requirements, provide Dow Corning 795 or comparable product by one of the following:
 - a. BASF Building Systems.
 - b. Dow Corning Corporation.
 - c. GE Advanced Materials - Silicones.
 - d. May National Associates, Inc.
 - e. Pecora Corporation.
 - f. Polymeric Systems, Inc.
 - g. Schnee-Morehead, Inc.
 - h. Sika Corporation; Construction Products Division.
 - i. Tremco Incorporated.
- 2. Type: Single component (S).
- 3. Grade: Nonsag (NS).
- 4. Class: 50.
- 5. Uses Related to Exposure: Non-traffic (NT).

C. Neutral-Curing Silicone Joint Sealant: ASTM C 920.

1. Basis-of-Design Product: Subject to compliance with requirements, provide Dow Corning 799 or comparable product by one of the following:
 - a. BASF Building Systems.
 - b. Dow Corning Corporation.
 - c. GE Advanced Materials - Silicones.
 - d. May National Associates, Inc.
 - e. Pecora Corporation.
 - f. Polymeric Systems, Inc.
 - g. Schnee-Morehead, Inc.
 - h. Sika Corporation; Construction Products Division.
 - i. Tremco Incorporated.
 2. Type: Single component (S).
 3. Grade: Nonsag (NS).
 4. Class: 25.
 5. Uses Related to Exposure: Non-traffic (NT).
- D. Mildew-Resistant Silicone Joint Sealant: ASTM C 920.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Dow Corning 786 or comparable product by one of the following:
 - a. BASF Building Systems.
 - b. Dow Corning Corporation.
 - c. GE Advanced Materials - Silicones.
 - d. May National Associates, Inc.
 - e. Pecora Corporation.
 - f. Polymeric Systems, Inc.
 - g. Schnee-Morehead, Inc.
 - h. Sika Corporation; Construction Products Division.
 - i. Tremco Incorporated.
 2. Type: Single component (S).
 3. Grade: Nonsag (NS).
 4. Class: 25.
 5. Uses Related to Exposure: Non-traffic (NT).
- E. Acid-Curing Silicone Joint Sealant : ASTM C 920.
1. Basis-of-Design Product: Subject to compliance with requirements, provide Dow Corning 999-A or comparable product by one of the following:
 - a. BASF Building Systems.
 - b. Dow Corning Corporation.
 - c. GE Advanced Materials - Silicones.
 - d. May National Associates, Inc.
 - e. Pecora Corporation.
 - f. Polymeric Systems, Inc.
 - g. Schnee-Morehead, Inc.
 - h. Sika Corporation; Construction Products Division.
 - i. Tremco Incorporated.
 2. Type: Single component (S).
 3. Grade: Nonsag (NS).

4. Class: 25.
5. Uses Related to Exposure: Non-traffic (NT).

2.3 LATEX JOINT SEALANTS

- A. Latex Joint Sealant: Acrylic latex or siliconized acrylic latex, ASTM C 834, Type OP, Grade NF.
 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. BASF Building Systems.
 - b. Bostik, Inc.
 - c. May National Associates, Inc.
 - d. Pecora Corporation.
 - e. Schnee-Morehead, Inc.
 - f. Tremco Incorporated.

2.4 PREFORMED JOINT SEALANTS

- A. Preformed Foam Joint Sealant: Manufacturer's standard preformed, pre-compressed, open-cell foam sealant manufactured from urethane foam with minimum density of 10 lb/cu. ft. (160 kg/cu. m) and impregnated with a nondrying, water-repellent agent. Factory produce in pre-compressed sizes in roll or stick form to fit joint widths indicated; coated on one side with a pressure-sensitive adhesive and covered with protective wrapping.
 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. Dayton Superior Specialty Chemicals.
 - b. EMSEAL Joint Systems, Ltd.
 - c. Sandell Manufacturing Co.
 - d. Schul International, Inc.
 - e. Willseal USA, LLC.

2.5 ACOUSTICAL JOINT SEALANTS

- A. Acoustical Joint Sealant: Manufacturer's standard non-sag, paintable, non-staining latex sealant complying with ASTM C 834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E 90.
 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. Pecora Corporation .
 - b. USG Corporation.

2.6 JOINT SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C 1330, Type C (closed-cell material with a surface skin), 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.

2.7 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: Non-staining, 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. Acoustical Sealant Installation: Comply with ASTM C 919 and with manufacturer's written recommendations.
- G. 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 FIELD QUALITY CONTROL

- A. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - 1. Extent of Testing: Test completed and cured sealant joints as follows:
 - a. Perform 10 tests for the first 1000 feet (300 m) of joint length for each kind of sealant and joint substrate.
 - b. Perform 1 test for each 1000 feet (300 m) of joint length thereafter or 1 test per each floor per elevation.
 - 2. Test Method: Test joint sealants according to Method A, Field-Applied Sealant Joint Hand Pull Tab, in Appendix X1 in ASTM C 1193 or Method A, Tail Procedure, in ASTM C 1521.

- B. Evaluation of Field-Adhesion Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.

3.4 JOINT-SEALANT SCHEDULE

- A. Joint-Sealant Application: Exterior joints in horizontal traffic surfaces[<JS-#>].
1. Joint Locations:
 - a. Control and expansion joints in brick pavers.
 - b. Isolation and contraction joints in cast-in-place concrete slabs.
 - c. Joints between plant-precast architectural concrete paving units.
 - d. Joints in stone paving units, including steps.
 - e. Tile control and expansion joints.
 - f. Joints between different materials listed above.
 - g. Other joints as indicated.
 2. Joint Sealant: Silicone.
 3. Joint Sealant: Urethane.
 4. Joint Sealant: Preformed foam.
 5. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- B. Joint-Sealant Application: Exterior joints in vertical surfaces and horizontal non-traffic surfaces.
1. Joint Locations:
 - a. Construction joints in cast-in-place concrete.
 - b. Joints between plant-precast architectural concrete units.
 - c. Control and expansion joints in unit masonry.
 - d. Joints in dimension stone cladding.
 - e. Joints in glass unit masonry assemblies.
 - f. Joints in exterior insulation and finish systems.
 - g. Joints between metal panels.
 - h. Joints between different materials listed above.
 - i. Perimeter joints between materials listed above and frames of doors, windows, and louvers.
 - j. Control and expansion joints in ceilings and other overhead surfaces.
 - k. Other joints as indicated.
 2. Joint Sealant: Silicone.
 3. Joint Sealant: Urethane.
 4. Joint Sealant: Preformed foam.
 5. Joint Sealant: Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- C. Joint-Sealant Application: Interior joints in horizontal traffic surfaces.
1. Joint Locations:

- a. Isolation joints in cast-in-place concrete slabs.
 - b. Control and expansion joints in stone flooring.
 - c. Control and expansion joints in brick flooring.
 - d. Control and expansion joints in tile flooring.
 - e. Other joints as indicated.
2. Joint Sealant: Silicone.
 3. Joint Sealant: Urethane.
 4. Joint Sealant: Preformed foam.
 5. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- D. Joint-Sealant Application: Interior joints in vertical surfaces and horizontal non-traffic surfaces.
1. Joint Locations:
 - 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 joints on exposed surfaces of interior unit masonry, walls, and partitions.
 - e. Perimeter joints between interior wall surfaces and frames of interior doors, windows, and elevator entrances.
 - f. Other joints as indicated.
 2. Joint Sealant: Latex.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- E. Joint-Sealant Application: Mildew-resistant interior joints in vertical surfaces and horizontal non-traffic surfaces.
1. Joint Sealant Location:
 - a. Joints between plumbing fixtures and adjoining walls, floors, and counters.
 - b. Tile control and expansion joints where indicated.
 - c. Other joints as indicated.
 2. Joint Sealant: Silicone.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range of colors.
- F. Joint-Sealant Application: Interior acoustical joints in vertical surfaces and horizontal non-traffic surfaces.
1. Joint Location:
 - a. Acoustical joints where indicated.
 - b. Other joints as indicated.
 2. Joint Sealant: Acoustical.
 3. Joint-Sealant Color: As selected by Architect from manufacturer's full range.

END OF SECTION 079200

SECTION 083113 - ACCESS DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Access doors and frames for walls and ceilings.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

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

C. Samples: For each door face material.

D. Schedule: Types, locations, sizes, latching or locking provisions, and other data pertinent to installation.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Fire-Rated Access Doors and Frames: Units complying with NFPA 80 tested according to the following test method:

1. NFPA 252 or UL 10B for fire-rated access door assemblies installed vertically.
2. NFPA 288 for fire-rated access door assemblies installed horizontally.

2.2 ACCESS DOORS AND FRAMES FOR WALLS AND CEILINGS

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. Access Panel Solutions.
2. Acudor Products, Inc.
3. Alfab, Inc.
4. Babcock-Davis.
5. Cendrex Inc.
6. Elmdor/Stoneman Manufacturing Co.; Div. of Acorn Engineering Co.
7. Jensen Industries; Div. of Broan-Nutone, LLC.
8. J. L. Industries, Inc.; Div. of Activar Construction Products Group.
9. Karp Associates, Inc.

10. Larsen's Manufacturing Company.
 11. Maxam Metal Products Limited.
 12. Metropolitan Door Industries Corp.
 13. MIFAB, Inc.
 14. Milcor Inc.
 15. Nystrom, Inc.
 16. Williams Bros. Corporation of America (The).
- B. Source Limitations: Obtain each type of access door and frame from single source from single manufacturer.
- C. Flush Access Doors with Exposed Flanges :
1. Assembly Description: Fabricate door to fit flush to frame. Provide manufacturer's standard-width exposed flange, proportional to door size.
 2. Locations: Wall and ceiling.
 3. Door Size: Size is dependent on location in the field. Coordinate with Architect.
 4. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.
 - a. Finish: Factory prime.
 5. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage.
 - a. Finish: Factory prime.
 6. Frame Material: Same material, thickness, and finish as door.
 7. Hinges: Manufacturer's standard.
 8. Hardware: Lock.
- D. Flush Access Doors with Concealed Flanges :
1. Assembly Description: Fabricate door to fit flush to frame. Provide frame with gypsum board beads for concealed flange installation.
 2. Locations: Wall and ceiling.
 3. Door Size: Size is dependent on location in the field. Coordinate with Architect.
 4. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.
 - a. Finish: Factory prime.
 5. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage.
 - a. Finish: Factory prime.
 6. Frame Material: Same material and thickness as door.
 7. Hinges: Manufacturer's standard.
 8. Hardware: Lock.
- E. Recessed Access Doors :
1. Assembly Description: Fabricate door in the form of a pan recessed 5/8 inch (16 mm) for gypsum board infill. Provide frame with gypsum board bead for concealed flange installation.

2. Locations: Wall and ceiling.
 3. Door Size: Size is dependent on location in the field. Coordinate with Architect.
 4. Uncoated Steel Sheet for Door: Nominal 0.060 inch (1.52 mm), 16 gage.
 - a. Finish: Factory prime.
 5. Metallic-Coated Steel Sheet for Door: Nominal 0.064 inch (1.63 mm), 16 gage.
 - a. Finish: Factory prime.
 6. Frame Material: Same material and thickness as door.
 7. Hinges: Manufacturer's standard.
 8. Hardware: Lock.
- F. Fire-Rated, Flush Access Doors with Exposed Flanges :
1. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release. Provide manufacturer's standard-width exposed flange, proportional to door size.
 2. Locations: Wall and ceiling.
 3. Fire-Resistance Rating: Not less than that indicated.
 4. Temperature-Rise Rating: 450 deg F (250 deg C) at the end of 30 minutes.
 5. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20 gage.
 - a. Finish: Factory prime.
 6. Metallic-Coated Steel Sheet for Door: Nominal 0.040 inch (1.02 mm), 20 gage.
 - a. Finish: Factory prime.
 7. Frame Material: Same material, thickness, and finish as door.
 8. Hinges: Manufacturer's standard.
 9. Hardware: Lock.
- G. Fire-Rated, Flush Access Doors with Concealed Flanges :
1. Basis-of-Design Product: Indicated on Drawings.
 2. Assembly Description: Fabricate door to fit flush to frame, with a core of mineral-fiber insulation enclosed in sheet metal. Provide self-latching door with automatic closer and interior latch release. Provide frame with gypsum board beads for concealed flange installation.
 3. Locations: Wall and ceiling.
 4. Fire-Resistance Rating: Not less than that indicated.
 5. Temperature-Rise Rating: 450 deg F (250 deg C) at the end of 30 minutes.
 6. Uncoated Steel Sheet for Door: Nominal 0.036 inch (0.91 mm), 20 gage.
 - a. Finish: Factory prime.
 7. Metallic-Coated Steel Sheet for Door: Nominal 0.040 inch (1.02 mm), 20 gage.
 - a. Finish: Factory prime.

8. Frame Material: Same material, thickness, and finish as door.
9. Hinges: Manufacturer's standard.
10. Hardware: Lock.

H. Hardware:

1. Latch: Cam latch operated by spanner-head wrench.
2. Lock: Cylinder.
 - a. Lock Preparation: Prepare door panel to accept cylinder specified in Section 087100 "Door Hardware.

2.3 MATERIALS

- A. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
- B. Rolled-Steel Floor Plate: ASTM A 786/A 786M, rolled from plate complying with ASTM A 36/A 36M or ASTM A 283/A 283M, Grade C or D.
- C. Steel Sheet: Uncoated or electrolytic zinc coated, ASTM A 879/A 879M, with cold-rolled steel sheet substrate complying with ASTM A 1008/A 1008M, Commercial Steel (CS), exposed.
- D. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum G60 (Z180) or A60 (ZF180) metallic coating.
- E. Frame Anchors: Same type as door face.
- F. Inserts, Bolts, and Anchor Fasteners: Hot-dip galvanized steel according to ASTM A 153/A 153M or ASTM F 2329.

2.4 FABRICATION

- A. General: Provide access door and frame assemblies manufactured as integral units ready for installation.
- B. Metal Surfaces: For metal surfaces exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, rolled trade names, or roughness.
- C. Doors and Frames: Grind exposed welds smooth and flush with adjacent surfaces. Furnish attachment devices and fasteners of type required to secure access doors to types of supports indicated.
- D. Recessed Access Doors: Form face of panel to provide recess for application of applied finish. Reinforce panel as required to prevent buckling.
 1. For recessed doors with plaster infill, provide self-furring expanded metal lath attached to door panel.

- E. Latching Mechanisms: Furnish number required to hold doors in flush, smooth plane when closed.
 - 1. For cylinder locks, furnish two keys per lock and key all locks alike.
 - 2. For recessed panel doors, provide access sleeves for each locking device. Furnish plastic grommets and install in holes cut through finish.

2.5 FINISHES

- A. Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- D. Steel and Metallic-Coated-Steel Finishes:
 - 1. Factory Prime: Apply manufacturer's standard, fast-curing, lead- and chromate-free, universal primer immediately after surface preparation and pretreatment.
 - 2. Factory Finish: Immediately after cleaning and pretreating, apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, with a minimum dry-film thickness of 1 mil (0.025 mm) for topcoat.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's written instructions for installing access doors and frames.
- B. Install doors flush with adjacent finish surfaces or recessed to receive finish material.

3.2 ADJUSTING

- A. Adjust doors and hardware, after installation, for proper operation.
- B. Remove and replace doors and frames that are warped, bowed, or otherwise damaged.

END OF SECTION 083113

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Non-load-bearing steel framing systems for interior partitions.
2. Suspension systems for interior ceilings and soffits.
3. Grid suspension systems for gypsum board ceilings.

B. Related Requirements:

1. Section 054000 "Cold-Formed Metal Framing" for exterior and interior load-bearing and exterior non-load-bearing wall studs; floor joists; and roof rafters and ceiling joists.
2. Section 078443 "Fire-Resistive Joint Systems" for head-of-wall joint systems installed with non-load-bearing steel framing.
3. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for non-load-bearing metal shaft-wall framing, gypsum panels, and other components of shaft-wall assemblies

1.3 ACTION SUBMITTALS

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

1.4 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation Reports: For embossed, high-strength steel studs and tracks, firestop tracks, post-installed anchors and power-actuated fasteners, from ICC-ES or other qualified testing agency acceptable to authorities having jurisdiction.

1.5 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Certified Steel Stud

Association, the Steel Framing Industry Association or the Steel Stud Manufacturers Association.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: For fire-resistance-rated assemblies that incorporate non-load-bearing steel framing, provide materials and construction identical to those tested in assembly indicated, according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated on Drawings, according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.
- C. Horizontal Deflection: For composite and non-composite wall assemblies, limited to 1/240 of the wall height based on horizontal loading of 5 lbf/sq. ft. (239 Pa).

2.2 FRAMING SYSTEMS

- A. Framing Members, General: Comply with ASTM C754 for conditions indicated.
 - 1. Steel Sheet Components: Comply with ASTM C645 requirements for steel unless otherwise indicated.
 - 2. Protective Coating: ASTM A653/A653M, G40 (Z120), hot-dip galvanized unless otherwise indicated.
- B. Studs and Tracks: ASTM C645. Use either conventional steel studs and tracks or embossed, high-strength steel studs and tracks.
 - 1. Steel Studs and Tracks:
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1) ClarkDietrich.
 - 2) MRI Steel Framing, LLC.
 - 3) SCAFCO Steel Stud Company.
 - 4) Steel Construction Systems.
 - b. Minimum Base-Steel Thickness: As indicated on Drawings.
 - c. Depth: As indicated on Drawings (3-5/8 inches (92 mm), 6 inches (152 mm), 4 inches (102 mm), 2-1/2 inches (64 mm), 1-5/8 inches (41 mm)).
 - 2. Embossed, High Strength Steel Studs and Tracks: Roll-formed and embossed with surface deformations to stiffen the framing members so that they are structurally comparable to conventional ASTM C645 steel studs and tracks.
 - a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

- 1) [ClarkDietrich.](#)
 - 2) [SCAFCO Steel Stud Company.](#)
 - 3) [Steel Construction Systems.](#)
- b. Minimum Base-Steel Thickness: As indicated on Drawings.
 - c. Depth: As indicated on Drawings .
- C. Slip-Type Head Joints: Where indicated, provide one of the following:
1. Clip System: Clips designed for use in head-of-wall deflection conditions that provide a positive attachment of studs to tracks while allowing **1-1/2-inch (38-mm)** minimum vertical movement.
 - a. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
 - 1) [ClarkDietrich.](#)
 - 2) [SCAFCO Steel Stud Company.](#)
 - 3) [The Steel Network, Inc.](#)
 2. Single Long-Leg Track System: ASTM C645 top track with **2-inch- (51-mm-)** deep flanges in thickness not less than indicated for studs, installed with studs friction fit into top track and with continuous bridging located within **12 inches (305 mm)** of the top of studs to provide lateral bracing.
 3. Double-Track System: ASTM C645 top outer tracks, inside track with **2-inch- (51-mm-)** deep flanges in thickness not less than indicated for studs and fastened to studs, and outer track sized to friction-fit over inner track.
 4. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - a. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
 - 1) [ClarkDietrich.](#)
 - 2) [SCAFCO Steel Stud Company.](#)
 - 3) [The Steel Network, Inc.](#)
- D. Firestop Tracks: Top track manufactured to allow partition heads to expand and contract with movement of structure while maintaining continuity of fire-resistance-rated assembly indicated; in thickness not less than indicated for studs and in width to accommodate depth of studs.
1. [Manufacturers:](#) Subject to compliance with requirements, provide products by one of the following:
 - a. [ClarkDietrich.](#)
 - b. [Fire Trak Corp.](#)
 - c. [The Steel Network, Inc.](#)
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. SCAFCO Steel Stud Company.
 2. Minimum Base-Steel Thickness: As indicated on Drawings.
- F. Cold-Rolled Channel Bridging: Steel, **0.0538-inch (1.367-mm)** minimum base-steel thickness, with minimum **1/2-inch- (13-mm-)** wide flanges.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. SCAFCO Steel Stud Company.
 - c. Steel Construction Systems.
 2. Depth: **1-1/2 inches (38 mm)**.
 3. Clip Angle: Not less than **1-1/2 by 1-1/2 inches (38 by 38 mm)**, **0.068-inch- (1.72-mm-)** thick, galvanized steel.
- G. Hat-Shaped, Rigid Furring Channels: ASTM C645.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. SCAFCO Steel Stud Company.
 - c. Steel Construction Systems.
 2. Minimum Base-Steel Thickness: As indicated on Drawings.
 3. Depth: **7/8 inch (22.2 mm)**.
- H. Resilient Furring Channels: **1/2-inch- (13-mm-)** deep, steel sheet members designed to reduce sound transmission.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. SCAFCO Steel Stud Company.
 - c. Steel Construction Systems.
 2. Configuration: Hat shaped.
- I. Cold-Rolled Furring Channels: **0.053-inch (1.34-mm)** uncoated-steel thickness, with minimum **1/2-inch- (13-mm-)** wide flanges.
1. Depth: **3/4 inch (19 mm)**.

2. Furring Brackets: Adjustable, corrugated-edge-type steel sheet with minimum uncoated-steel thickness of **0.0329 inch (0.8 mm)**.
 3. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, **0.062-inch- (1.59-mm-)** diameter wire, or double strand of **0.048-inch- (1.21-mm-)** diameter wire.
- J. Z-Shaped Furring: With slotted or nonslotted web, face flange of **1-1/4 inches (32 mm)**, wall attachment flange of **7/8 inch (22 mm)**, minimum uncoated-steel thickness of **0.0179 inch (0.455 mm)**, and depth required to fit insulation thickness indicated.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. ClarkDietrich.
 - b. SCAFCO Steel Stud Company.
 - c. Steel Construction Systems.

2.3 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, **0.062-inch- (1.59-mm-)** diameter wire, or double strand of **0.048-inch- (1.21-mm-)** diameter wire.
- B. Hanger Attachments to Concrete:
1. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, AC193, AC58, or AC308 as appropriate for the substrate.
 - a. Uses: Securing hangers to structure.
 - b. Type: Torque-controlled, expansion anchor.
 - c. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or **ASTM F1941 (ASTM F1941M)**, Class Fe/Zn 5, unless otherwise indicated.
 - d. Material for Exterior or Interior Locations and Where Stainless Steel Is Indicated: Alloy Group **1 (A1)** stainless-steel bolts, **ASTM F593 (ASTM F738M)**, and nuts, **ASTM F594 (ASTM F836M)**.
 2. Power-Actuated Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- C. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, **0.16 inch (4.12 mm)** in diameter.
- D. Flat Hangers: Steel sheet, **1 by 3/16 inch (25 by 5 mm)** by length indicated.
- E. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of **0.0538 inch (1.367 mm)** and minimum **1/2-inch- (13-mm-)** wide flanges.
1. Depth: **1-1/2 inches (38 mm)**.
- F. Furring Channels (Furring Members):

1. Cold-Rolled Channels: **0.0538-inch (1.367-mm)** uncoated-steel thickness, with minimum **1/2-inch- (13-mm-)** wide flanges, **3/4 inch (19 mm)** deep.
 2. Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Steel Thickness:**0.0329 inch (0.836 mm)**.
 - b. Depth: As indicated on Drawings.
 3. Embossed, High-Strength Steel Studs and Tracks: ASTM C645.
 - a. Minimum Base-Steel Thickness: As indicated on Drawings.
 - b. Depth: As indicated on Drawings.
 4. Hat-Shaped, Rigid Furring Channels: ASTM C645, **7/8 inch (22 mm)** deep.
 - a. Minimum Base-Steel Thickness: **0.0329 inch (0.836 mm)**.
 5. Resilient Furring Channels: **1/2-inch- (13-mm-)** deep members designed to reduce sound transmission.
 - a. Configuration: Hat shaped.
- G. Grid Suspension System for Gypsum Board Ceilings: ASTM C645, direct-hung system composed of main beams and cross-furring members that interlock.
1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Armstrong World Industries, Inc.
 - b. Rockfon (Rockwool International).
 - c. USG Corporation.

2.4 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, **1/8 inch (3.2 mm)** thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including welded hollow-metal frames, cast-in anchors, and structural framing, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Assemblies: Coordinate installation of suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive hangers at spacing required to support the Work and that hangers will develop their full strength.
 - 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.
- B. Coordination with Sprayed Fire-Resistive Materials:
 - 1. Before sprayed fire-resistive materials are applied, attach offset anchor plates or ceiling tracks to surfaces indicated to receive sprayed fire-resistive materials. Where offset anchor plates are required, provide continuous plates fastened to building structure not more than **24 inches (610 mm)** o.c.
 - 2. After sprayed fire-resistive materials are applied, remove them only to extent necessary for installation of non-load-bearing steel framing. Do not reduce thickness of fire-resistive materials below that are required for fire-resistance ratings indicated. Protect adjacent fire-resistive materials from damage.

3.3 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
 - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
 - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
 - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.

- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.
- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.4 INSTALLING FRAMED ASSEMBLIES

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 - 1. Single-Layer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
 - 2. Multilayer Application: 16 inches (406 mm) o.c. unless otherwise indicated.
 - 3. Tile Backing Panels: 16 inches (406 mm) o.c. unless otherwise indicated.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch (13-mm) clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.

6. Curved Partitions:
 - a. Bend track to uniform curve and locate straight lengths so they are tangent to arcs.
 - b. Begin and end each arc with a stud, and space intermediate studs equally along arcs. On straight lengths of no fewer than two studs at ends of arcs, place studs **6 inches (150 mm)** o.c.
- E. Direct Furring:
 1. Screw to wood framing.
 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches (610 mm)** o.c.
- F. Z-Shaped Furring Members:
 1. Erect insulation, specified in Section 072100 "Thermal Insulation," vertically and hold in place with Z-shaped furring members spaced **24 inches (610 mm)** o.c.
 2. Except at exterior corners, securely attach narrow flanges of furring members to wall with concrete stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced **24 inches (610 mm)** o.c.
 3. At exterior corners, attach wide flange of furring members to wall with short flange extending beyond corner; on adjacent wall surface, screw-attach short flange of furring channel to web of attached channel. At interior corners, space second member no more than **12 inches (305 mm)** from corner and cut insulation to fit.
- G. Installation Tolerance: Install each framing member so fastening surfaces vary not more than **1/8 inch (3 mm)** from the plane formed by faces of adjacent framing.

3.5 INSTALLING CEILING SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
 1. Hangers: **48 inches (1219 mm)** o.c.
 2. Carrying Channels (Main Runners): **48 inches (1219 mm)** o.c.
 3. Furring Channels (Furring Members): **24 inches (610 mm)** o.c.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension

system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.

- a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 5. Do not attach hangers to steel roof deck.
 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.
- D. Fire-Resistance-Rated Assemblies: Wire tie furring channels to supports.
- E. Seismic Bracing: Sway-brace suspension systems with hangers used for support.
- F. Grid Suspension Systems: Attach perimeter wall track or angle where grid suspension systems meet vertical surfaces. Mechanically join main beam and cross-furring members to each other and butt-cut to fit into wall track.
- G. Installation Tolerances: Install suspension systems that are level to within **1/8 inch in 12 feet (3 mm in 3.6 m)** measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior gypsum board.
2. Exterior gypsum board for ceilings and soffits.
3. Tile backing panels.
4. Texture finishes.

B. Related Requirements:

1. Section 055400 "Cold-Formed Framing" for load-bearing steel that supports gypsum board.
2. Section 061600 "Sheathing" for gypsum sheathing for exterior walls.
3. Section 092116.23 "Gypsum Board Shaft Wall Assemblies" for metal shaft-wall framing, gypsum shaft liners, and other components of shaft-wall assemblies.
4. Section 092216 "Non-Structural Metal Framing" for non-structural steel framing and suspension systems that support gypsum board panels.
5. Section 092613 "Gypsum Veneer Plastering" for gypsum base for veneer plaster and for other components of gypsum-veneer-plaster finishes.
6. Section 093013 "Ceramic Tiling" for cementitious backer units installed as substrates for ceramic tile.
7. Section 099123 "Painting" for primers applied to gypsum board surfaces.
8. Section 078443 "Fire-Resistive Joint Systems" for head-of-wall assemblies that incorporate gypsum board.
9. Section 072100 "Thermal Insulation" for insulation installed in assemblies that incorporate gypsum board.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

B. Samples: For the following products:

1. Trim Accessories: Full-size Sample in 12-inch- (300-mm-) long length for each trim accessory indicated.

1.4 QUALITY ASSURANCE

- A. Mockups: Build mockups of at least 100 sq. ft. (9 sq. m) in surface area to demonstrate aesthetic effects and to set quality standards for materials and execution.
 - 1. Build mockups for the following:
 - a. Each level of gypsum board finish indicated for use in exposed locations.
 - b. Each texture finish indicated.
 - 2. Apply or install final decoration indicated, including painting and wallcoverings, on exposed surfaces for review of mockups.
 - 3. Simulate finished lighting conditions for review of mockups.
 - 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Store materials inside under cover and keep them dry and protected against weather, condensation, direct sunlight, construction traffic, and other potential causes of damage. Stack panels flat and supported on risers on a flat platform to prevent sagging.

1.6 FIELD CONDITIONS

- A. Environmental Limitations: Comply with ASTM C840 requirements or gypsum board manufacturer's written instructions, whichever are more stringent.
- B. Do not install paper-faced gypsum panels until installation areas are enclosed and conditioned.
- C. Do not install panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Resistance-Rated Assemblies: For fire-resistance-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E119 by an independent testing agency.
- B. STC-Rated Assemblies: For STC-rated assemblies, provide materials and construction identical to those tested in assembly indicated according to ASTM E90 and classified according to ASTM E413 by an independent testing agency.

2.2 GYPSUM BOARD, GENERAL

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

2.3 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C1396/C1396M.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. CertainTeed Gypsum.
 - c. Georgia-Pacific Gypsum LLC.
 - d. National Gypsum Company.
 - e. PABCO Gypsum.
 - f. USG Corporation.
2. Thickness: **1/2 inch (12.7 mm)**.
3. Long Edges: Tapered.

- B. Gypsum Board, Type X: ASTM C1396/C1396M.

1. Thickness: **5/8 inch (15.9 mm)**.
2. Long Edges: Tapered.

- C. Flexible Gypsum Board: ASTM C1396/C1396M. Manufactured to bend to fit radii and to be more flexible than standard regular-type gypsum board of same thickness.

1. Thickness: **1/4 inch (6.4 mm)**.
2. Long Edges: Tapered.

- D. Gypsum Ceiling Board: ASTM C1396/C1396M.

1. Thickness: **1/2 inch (12.7 mm)**.
2. Long Edges: Tapered.

- E. Foil-Backed Gypsum Board: ASTM C1396/C1396M.

1. Core: **5/8 inch (15.9 mm)**, Type X.
2. Long Edges: Tapered.

- F. Abuse-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.

1. Core: **5/8 inch (15.9 mm)**, Type X.
2. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
3. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
5. Long Edges: Tapered.
6. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

- G. Impact-Resistant Gypsum Board: ASTM C1396/C1396M gypsum board, tested according to ASTM C1629/C1629M.

1. Core: **5/8 inch (15.9 mm)**, Type X.

2. Surface Abrasion: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
3. Indentation: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
4. Soft-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 1 requirements.
5. Hard-Body Impact: ASTM C1629/C1629M, meets or exceeds Level 2 requirements according to test in Annex A1.
6. Long Edges: Tapered.
7. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

H. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.

1. Core: **5/8 inch (15.9 mm)**, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

2.4 SPECIALTY GYPSUM BOARD

A. Gypsum Board, Type C: ASTM C1396/C1396M. Manufactured to have increased fire-resistive capability.

1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. CertainTeed Gypsum.
 - c. Georgia-Pacific Gypsum LLC.
 - d. National Gypsum Company.
 - e. PABCO Gypsum.
 - f. USG Corporation.
2. Thickness: As required by fire-resistance-rated assembly indicated on Drawings.
3. Long Edges: Tapered.

B. Glass-Mat Interior Gypsum Board: ASTM C1658/C1658M. With fiberglass mat laminated to both sides. Specifically designed for interior use.

1. Core: **5/8 inch (15.9 mm)**, Type X.
2. Long Edges: Tapered.
3. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.

C. Acoustically Enhanced Gypsum Board: ASTM C1396/C1396M. Multilayer products constructed of two layers of gypsum boards sandwiching a viscoelastic sound-absorbing polymer core.

1. Core: **5/8 inch (15.9 mm)**, Type X.
2. Long Edges: Tapered.

D. Skim-Coated Gypsum Board: ASTM C1396/C1396M. Manufactured with a factory-applied skim coat.

1. Core: **5/8 inch (15.9 mm)**, Type X.
2. Long Edges: Tapered.

2.5 EXTERIOR GYPSUM BOARD FOR CEILINGS AND SOFFITS

- A. Exterior Gypsum Soffit Board: ASTM C1396/C1396M, with manufacturer's standard edges.
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. American Gypsum.
 - b. CertainTeed Gypsum.
 - c. Georgia-Pacific Gypsum LLC.
 - d. National Gypsum Company.
 - e. PABCO Gypsum.
 - f. USG Corporation.
 - 2. Core: **5/8 inch (15.9 mm)**, Type X.
- B. Glass-Mat Gypsum Sheathing Board: ASTM C1177/C1177M, with fiberglass mat laminated to both sides and with manufacturer's standard edges.
 - 1. Core: **5/8 inch (15.9 mm)**, Type X.

2.6 TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Board: ASTM C1178/C1178M, with manufacturer's standard edges.
 - 1. Core: **1/2 inch (12.7 mm)**, regular type.
 - 2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- B. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
 - 1. Thickness: **1/2 inch (12.7 mm)**.
 - 2. Mold Resistance: ASTM D3273, score of 10 as rated according to ASTM D3274.
- C. Water-Resistant Gypsum Backing Board: ASTM C1396/C1396M, with manufacturer's standard edges.
 - 1. Core: **5/8 inch (15.9 mm)**, Type X.

2.7 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
 - 2. Shapes:
 - a. Cornerbead.
 - b. Bullnose bead.
 - c. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - d. L-Bead: L-shaped; exposed long flange receives joint compound.
 - e. U-Bead: J-shaped; exposed short flange does not receive joint compound.

- f. Expansion (control) joint.
 - g. Curved-Edge Cornerbead: With notched or flexible flanges.
- B. Exterior Trim: ASTM C1047.
- 1. Material: Hot-dip galvanized-steel sheet, plastic, or rolled zinc.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. Expansion (Control) Joint: One-piece, rolled zinc with V-shaped slot and removable strip covering slot opening.
- C. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
- 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corporation.
 - b. Gordon, Inc.
 - c. Pittcon Industries.
 - 2. Aluminum: Alloy and temper with not less than the strength and durability properties of **ASTM B221 (ASTM B221M)**, Alloy 6063-T5.
 - 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified requirements for Class II anodic finishes and factory-painted, baked-enamel finishes.

2.8 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
- 1. Interior Gypsum Board: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
 - 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 4. Tile Backing Panels: As recommended by panel manufacturer.
- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
- 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.

4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use high-build interior coating product designed for application by airless sprayer and to be used instead of skim coat to produce Level 5 finish.

D. Joint Compound for Exterior Applications:

1. Exterior Gypsum Soffit Board: Use setting-type taping compound and setting-type, sandable topping compound.
2. Glass-Mat Gypsum Sheathing Board: As recommended by sheathing board manufacturer.

E. Joint Compound for Tile Backing Panels:

1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
2. Cementitious Backer Units: As recommended by backer unit manufacturer.
3. Water-Resistant Gypsum Backing Board: Use setting-type taping compound and setting-type, sandable topping compound.

2.9 AUXILIARY MATERIALS

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

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

C. Steel Drill Screws: ASTM C1002 unless otherwise indicated.

1. Use screws complying with ASTM C954 for fastening panels to steel members from **0.033 to 0.112 inch (0.84 to 2.84 mm)** thick.
2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.

D. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.

1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

E. Acoustical Sealant: Manufacturer's standard nonsag, paintable, nonstaining latex sealant complying with ASTM C834. Product effectively reduces airborne sound transmission through perimeter joints and openings in building construction as demonstrated by testing representative assemblies according to ASTM E90.

1. **Manufacturers:** Subject to compliance with requirements, provide products by one of the following:
 - a. **Hilti, Inc.**
 - b. **Pecora Corporation.**

- c. [Specified Technologies, Inc.](#)
 - d. [USG Corporation.](#)
- F. Thermal Insulation: As specified in Section 072100 "Thermal Insulation."
- G. Vapor Retarder: As specified in Section 072600 "Vapor Retarders."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates including welded hollow-metal frames and support framing, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 APPLYING AND FINISHING PANELS, GENERAL

- A. Comply with ASTM C840.
- B. Install ceiling panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install panels with face side out. Butt panels together for a light contact at edges and ends with not more than **1/16 inch (1.5 mm)** of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Form control and expansion joints with space between edges of adjoining gypsum panels.
- F. Cover both faces of support framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.
 - 1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than **8 sq. ft. (0.7 sq. m)** in area.
 - 2. Fit gypsum panels around ducts, pipes, and conduits.
 - 3. Where partitions intersect structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by structural members; allow **1/4- to 3/8-inch- (6.4- to 9.5-mm-)** wide joints to install sealant.

- G. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide ~~1/4-~~ to ~~1/2-inch-~~ (6.4- to 12.7-mm-) wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- H. Attachment to Steel Framing: Attach panels so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- I. Wood Framing: Install gypsum panels over wood framing, with floating internal corner construction. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members or provide control joints to counteract wood shrinkage.
- J. STC-Rated Assemblies: Seal construction at perimeters, behind control joints, and at openings and penetrations with a continuous bead of acoustical sealant. Install acoustical sealant at both faces of partitions at perimeters and through penetrations. Comply with ASTM C919 and with manufacturer's written instructions for locating edge trim and closing off sound-flanking paths around or through assemblies, including sealing partitions above acoustical ceilings.
- K. Install sound attenuation blankets before installing gypsum panels unless blankets are readily installed after panels have been installed on one side.

3.3 APPLYING INTERIOR GYPSUM BOARD

- A. Install interior gypsum board in the following locations:
 - 1. Wallboard Type: As indicated on Drawings.
 - 2. Type X: Where required for fire-resistance-rated assembly and vertical surfaces unless otherwise indicated.
 - 3. Flexible Type: Apply in double layer at curved assemblies.
 - 4. Ceiling Type: As indicated on Drawings.
 - 5. Foil-Backed Type: As indicated on Drawings.
 - 6. Abuse-Resistant Type: As indicated on Drawings.
 - 7. Impact-Resistant Type: As indicated on Drawings.
 - 8. Mold-Resistant Type: As indicated on Drawings.
 - 9. Type C: Where required for specific fire-resistance-rated assembly indicated.
 - 10. Glass-Mat Interior Type: As indicated on Drawings.
 - 11. Acoustically Enhanced Type: As indicated on Drawings.
 - 12. Skim-Coated Type: As indicated on Drawings.
- B. Single-Layer Application:
 - 1. On ceilings, apply gypsum panels before wall/partition board application to greatest extent possible and at right angles to framing unless otherwise indicated.
 - 2. On partitions/walls, apply gypsum panels vertically (parallel to framing) unless otherwise indicated or required by fire-resistance-rated assembly, and minimize end joints.
 - a. Stagger abutting end joints not less than one framing member in alternate courses of panels.

- b. At stairwells and other high walls, install panels horizontally unless otherwise indicated or required by fire-resistance-rated assembly.
 3. On Z-shaped furring members, apply gypsum panels vertically (parallel to framing) with no end joints. Locate edge joints over furring members.
 4. Fastening Methods: Apply gypsum panels to supports with steel drill screws.
 - C. Multilayer Application:
 1. On ceilings, apply gypsum board indicated for base layers before applying base layers on walls/partitions; apply face layers in same sequence. Apply base layers at right angles to framing members and offset face-layer joints one framing member, **16 inches (400 mm)** minimum, from parallel base-layer joints, unless otherwise indicated or required by fire-resistance-rated assembly.
 2. On partitions/walls, apply gypsum board indicated for base layers and face layers vertically (parallel to framing) with joints of base layers located over stud or furring member and face-layer joints offset at least one stud or furring member with base-layer joints unless otherwise indicated or required by fire-resistance-rated assembly. Stagger joints on opposite sides of partitions.
 3. On Z-shaped furring members, apply base layer vertically (parallel to framing) and face layer either vertically (parallel to framing) or horizontally (perpendicular to framing) with vertical joints offset at least one furring member. Locate edge joints of base layer over furring members.
 4. Fastening Methods: Fasten base layers and face layers separately to supports with screws.
 - D. Laminating to Substrate: Where gypsum panels are indicated as directly adhered to a substrate (other than studs, joists, furring members, or base layer of gypsum board), comply with gypsum board manufacturer's written instructions and temporarily brace or fasten gypsum panels until fastening adhesive has set.
 - E. Curved Surfaces:
 1. Install panels horizontally (perpendicular to supports) and unbroken, to extent possible, across curved surface plus **12-inch- (300-mm-)** long straight sections at ends of curves and tangent to them.
 2. For double-layer construction, fasten base layer to studs with screws **16 inches (400 mm)** o.c. Center gypsum board face layer over joints in base layer, and fasten to studs with screws spaced **12 inches (300 mm)** o.c.

3.4 APPLYING EXTERIOR GYPSUM PANELS FOR CEILINGS AND SOFFITS

- A. Apply panels perpendicular to supports, with end joints staggered and located over supports.
 1. Install with **1/4-inch (6.4-mm)** open space where panels abut other construction or structural penetrations.
 2. Fasten with corrosion-resistant screws.

3.5 APPLYING TILE BACKING PANELS

- A. Glass-Mat, Water-Resistant Backing Panels: Comply with manufacturer's written installation instructions and install at showers, tubs, and where indicated and locations indicated to receive tile. Install with **1/4-inch (6.4-mm)** gap where panels abut other construction or penetrations.
- B. Cementitious Backer Units: ANSI A108.11, at showers, tubs, and where indicated and locations indicated to receive tile.
- C. Water-Resistant Backing Board: Install where indicated with **1/4-inch (6.4-mm)** gap where panels abut other construction or penetrations.
- D. Where tile backing panels abut other types of panels in same plane, shim surfaces to produce a uniform plane across panel surfaces.

3.6 INSTALLING TRIM ACCESSORIES

- A. General: For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.
- B. Control Joints: Install control joints according to ASTM C840 and in specific locations approved by Architect for visual effect.
- C. Interior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners unless otherwise indicated.
 - 2. Bullnose Bead: Use where indicated.
 - 3. LC-Bead: Use at exposed panel edges.
 - 4. L-Bead: Use where indicated.
 - 5. U-Bead: Use where indicated.
 - 6. Curved-Edge Cornerbead: Use at curved openings.
- D. Exterior Trim: Install in the following locations:
 - 1. Cornerbead: Use at outside corners.
 - 2. LC-Bead: Use at exposed panel edges.
- E. Aluminum Trim: Install in locations indicated on Drawings.

3.7 FINISHING GYPSUM BOARD

- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Prefill open joints, rounded or beveled edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.

- D. Gypsum Board Finish Levels: Finish panels to levels indicated below and according to ASTM C840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 2: Panels that are substrate for tile.
 - 3. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
 - 4. Level 5: Where indicated on Drawings.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- E. Glass-Mat Gypsum Sheathing Board: Finish according to manufacturer's written instructions for use as exposed soffit board.
- F. Glass-Mat Faced Panels: Finish according to manufacturer's written instructions.
- G. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.8 PROTECTION

- A. Protect adjacent surfaces from drywall compound and promptly remove from floors and other non-drywall surfaces. Repair surfaces stained, marred, or otherwise damaged during drywall application.
- B. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- C. Remove and replace panels that are wet, moisture damaged, and mold damaged.
 - 1. Indications that panels are wet or moisture damaged include, but are not limited to, discoloration, sagging, or irregular shape.
 - 2. Indications that panels are mold damaged include, but are not limited to, fuzzy or splotchy surface contamination and discoloration.

END OF SECTION 092900

SECTION 09 30 00

TILING

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Ceramic tile.
2. Stone thresholds.
3. Waterproof membrane.
4. Crack isolation membrane.
5. Tile backing panels.
6. Metal edge strips.

1.2 ACTION SUBMITTALS

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

B. Samples:

1. Each type and composition of tile and for each color and finish required.
2. Assembled samples, with grouted joints, for each type and composition of tile and for each color and finish required.
3. Stone thresholds in 6-inch (150-mm) lengths.

1.3 MAINTENANCE MATERIAL SUBMITTALS

A. Furnish extra materials that match and are from same production runs as products installed and that are packaged with protective covering and identified with labels describing contents.

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

1.4 QUALITY ASSURANCE

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

1. Build mockup of each type of floor tile installation.
2. Build mockup of each type of wall tile installation.
3. Approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 TILE PRODUCTS

- A. ANSI Ceramic Tile Standard: Provide Standard grade tile that complies with ANSI A137.1 for types, compositions, and other characteristics indicated.
- B. FloorScore Compliance: Tile for floors shall comply with requirements of FloorScore Standard.
- C. Refer to Finish Material Legend for Tile Product Data.
 - 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 Olean; Division of Dal-Tile International Inc.
 - b. Crossville, Inc.
 - c. Daltile; Division of Dal-Tile International Inc.
 - d. Deutsche Steinzeug America, Inc.
 - e. Interceramic.
 - f. Lone Star Ceramics Company.
 - g. Grupo Porcelanite.
 - h. Portobello America, Inc.
 - i. Seneca Tiles, Inc.

2.2 THRESHOLDS

- A. General: Fabricate to sizes and profiles indicated or required to provide transition between adjacent floor finishes.
 - 1. Bevel edges at 1:2 slope, with lower edge of bevel aligned with or up to 1/16 inch (1.5 mm) above adjacent floor surface. Finish bevel to match top surface of threshold. Limit height of threshold to 1/2 inch (12.7 mm) or less above adjacent floor surface.
- B. Marble Thresholds: ASTM C 503, with a minimum abrasion resistance of 10 per ASTM C 1353 or ASTM C 241 and with honed finish.
 - 1. Description: Uniform, fine- to medium-grained white stone with gray veining.

2.3 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 or ASTM C 1325.
 - 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. C-Cure; C-Cure Board 990.

- b. Custom Building Products; Wonderboard.
 - c. FinPan, Inc.; Util-A-Crete Concrete Backer Board.
 - d. USG Corporation; DUROCK Cement Board.
2. Thickness: 5/8 inch (15.9 mm).

2.4 SETTING MATERIALS

A. Latex-Portland Cement Mortar (Thin Set): ANSI A118.4.

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. Boiardi Products; a QEP company.
 - b. Bonsal American; an Oldcastle company.
 - c. Bostik, Inc.
 - d. C-Cure.
 - e. Custom Building Products.
 - f. Jamo Inc.
 - g. Laticrete International, Inc.
 - h. MAPEI Corporation.
 - i. Mer-Kote Products, Inc.
 - j. Southern Grouts & Mortars, Inc.
 - k. Summitville Tiles, Inc.
 - l. TEC; a subsidiary of H. B. Fuller Company.
2. Prepackaged, dry-mortar mix to which only water must be added.
3. Prepackaged, dry-mortar mix combined with liquid-latex additive.
4. For wall applications, provide nonsagging mortar.

2.5 GROUT MATERIALS

A. Water-Cleanable Epoxy Grout: ANSI A118.3.

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. Atlas Minerals & Chemicals, Inc.
 - b. Boiardi Products; a QEP company.
 - c. Bonsal American; an Oldcastle company.
 - d. Bostik, Inc.
 - e. C-Cure.
 - f. Custom Building Products.
 - g. Jamo Inc.
 - h. Laticrete International, Inc.
 - i. MAPEI Corporation.
 - j. Mer-Kote Products, Inc.

- k. Southern Grouts & Mortars, Inc.
- l. Summitville Tiles, Inc.
- m. TEC; a subsidiary of H. B. Fuller Company.

B. Grout for Pregrouted Tile Sheets: Same product used in factory to pregrout tile sheets.

2.6 ELASTOMERIC SEALANTS

A. One-Part, Mildew-Resistant Silicone Sealant: ASTM C 920; Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to nonporous joint substrates indicated, O; formulated with fungicide, intended for sealing interior ceramic tile joints and other nonporous substrates that are subject to in-service exposures of high humidity and extreme temperatures.

- 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. DAP Inc.; Titanium Enriched Kitchen and Bath Sealant.
 - b. Dow Corning Corporation; Dow Corning 786.
 - c. GE Silicones, a division of GE Specialty Materials; Sanitary 1700.
 - d. Laticrete International, Inc.; Latasil Tile & Stone Sealant.
 - e. Pecora Corporation; Pecora 898 Sanitary Silicone Sealant.
 - f. Tremco Incorporated; Tremsil 600 White.

2.7 MISCELLANEOUS MATERIALS

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

B. Metal Edge Strips: Angle or L-shape, stainless steel, ASTM A 666, 300 Series exposed-edge material.

C. Grout Sealer: Manufacturer's standard silicone product for sealing grout joints and that does not change color or appearance of grout.

- 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. Bonsal American, an Oldcastle company; Grout Sealer.
 - b. Bostik, Inc.; CeramaSeal.
 - c. C-Cure; Penetrating Sealer 978.
 - d. Custom Building Products; Surfaceguard Sealer.
 - e. Jamo Inc.; Penetrating Sealer.
 - f. MAPEI Corporation; KER 003, Silicone Spray Sealer for Cementitious Tile Grout.
 - g. Southern Grouts & Mortars, Inc.; Silicone Grout Sealer.
 - h. Summitville Tiles, Inc.; SL-15, Invisible Seal Penetrating Grout and Tile Sealer.
 - i. TEC, a subsidiary of H. B. Fuller Company; TA-256 Penetrating Silicone Grout Sealer.

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 of coatings that are incompatible with tile-setting materials including curing compounds and other substances that contain soap, wax, oil, or silicone; and comply with flatness tolerances required by ANSI A108.01 for installations indicated.

3.2 PREPARATION

- A. Fill cracks, holes, and depressions in concrete substrates for tile floors installed with thin-set mortar with trowelable leveling and patching compound specifically recommended by tile-setting material manufacturer.
- B. Where indicated, prepare substrates to receive waterproofing by applying a reinforced mortar bed that complies with ANSI A108.1A and is sloped 1/4 inch per foot (1:50) toward drains.
- C. Blending: For tile exhibiting color variations, use factory blended tile or blend tiles at Project site before installing.
- D. Field-Applied Temporary Protective Coating: If indicated under tile type or needed to prevent grout from staining or adhering to exposed tile surfaces, precoat them with continuous film of temporary protective coating, taking care not to coat unexposed tile surfaces.

3.3 INSTALLATION

- A. Comply with TCA's "Handbook for Ceramic Tile Installation" for TCA installation methods specified in tile installation schedules. Comply with parts of the ANSI A108 Series "Specifications for Installation of Ceramic Tile" that are referenced in TCA installation methods, specified in tile installation schedules, and apply to types of setting and grouting materials used.
 - 1. For the following installations, follow procedures in the ANSI A108 Series of tile installation standards for providing 95 percent mortar coverage:
 - a. Exterior tile floors.
 - b. Tile floors in wet areas.
 - c. Tile swimming pool decks.
 - d. Tile floors in laundries.
 - e. Tile floors composed of tiles 8 by 8 inches (200 by 200 mm) or larger.
 - f. Tile floors composed of rib-backed tiles.

- B. Extend tile work into recesses and under or behind equipment and fixtures to form complete covering without interruptions unless otherwise indicated. Terminate work neatly at obstructions, edges, and corners without disrupting pattern or joint alignments.
- C. Accurately form intersections and returns. Perform cutting and drilling of tile without marring visible surfaces. Carefully grind cut edges of tile abutting trim, finish, or built-in items for straight aligned joints. Fit tile closely to electrical outlets, piping, fixtures, and other penetrations so plates, collars, or covers overlap tile.
- D. Provide manufacturer's standard trim shapes where necessary to eliminate exposed tile edges.
- E. Jointing Pattern: Lay tile in grid pattern unless otherwise indicated. Lay out tile work and center tile fields in both directions in each space or on each wall area. Lay out tile work to minimize the use of pieces that are less than half of a tile. Provide uniform joint widths unless otherwise indicated.
- F. Joint Widths: Unless otherwise indicated, install tile with the following joint widths:
 - 1. Ceramic Mosaic Tile: 1/16 inch (1.6 mm).
 - 2. Glazed Wall Tile: 1/16 inch (1.6 mm).
 - 3. Decorative Thin Wall Tile: 1/16 inch (1.6 mm).
- G. Lay out tile wainscots to dimensions indicated or to next full tile beyond dimensions indicated.
- H. Expansion Joints: Provide expansion joints and other sealant-filled joints, including control, contraction, and isolation joints, where indicated. Form joints during installation of setting materials, mortar beds, and tile. Do not saw-cut joints after installing tiles.
 - 1. Where joints occur in concrete substrates, locate joints in tile surfaces directly above them.
 - 2. Prepare joints and apply sealants to comply with requirements in Section 079200 "Joint Sealants."
- I. Stone Thresholds: Install stone thresholds in same type of setting bed as adjacent floor unless otherwise indicated.
 - 1. At locations where mortar bed (thickset) would otherwise be exposed above adjacent floor finishes, set thresholds in latex-portland cement mortar (thin set).
- J. Metal Edge Strips: Install where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with top of tile where exposed edge of tile flooring meets carpet, wood, or other flooring that finishes flush with or below top of tile and no threshold is indicated.
- K. Grout Sealer: Apply grout sealer to grout joints according to grout-sealer manufacturer's written instructions. As soon as grout sealer has penetrated grout joints, remove excess sealer and sealer from tile faces by wiping with soft cloth.
- L. Install cementitious backer units and treat joints according to ANSI A108.11 and manufacturer's written instructions for type of application indicated. Use latex-portland cement mortar for bonding material unless otherwise directed in manufacturer's written instructions.

produce waterproof membrane of uniform thickness and bonded securely to substrate.

- N. Install crack isolation membrane to comply with ANSI A108.17 and manufacturer's written instructions to produce membrane of uniform thickness and bonded securely to substrate.

3.4 INTERIOR TILE INSTALLATION SCHEDULE

A. Interior Wall Installations, Metal Studs or Furring:

- 1. Tile Installation: Thin-set mortar on cementitious backer units or fiber cement underlayment over cleavage membrane; TCA W244.
 - a. Tile Type: Refer to Finish Material Legend.
 - b. Thin-Set Mortar: Dry-set portland cement mortar.
 - c. Grout: Water-cleanable epoxy grout.

END OF SECTION 093000

SECTION 095133 - ACOUSTICAL METAL PAN CEILINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:
 - 1. Acoustical metal pans and associated suspension system for interior ceilings.
- B. Products furnished, but not installed, under this Section include anchors, clips, and other ceiling attachment devices to be cast in concrete.

1.3 PREINSTALLATION MEETINGS

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

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include procedure for cutting metal pans.
- B. Samples: For each exposed product and for each color and texture specified, **6 inches (150 mm)** in size.
- C. Samples for Initial Selection: For units with factory-applied finishes.
- D. Samples for Verification: For each component indicated and for each exposed finish required, prepared on Samples of size indicated below:
 - 1. Metal Pans: Set of full-size Samples of each type, finish, color, pattern, and texture. Show pan edge profile.
 - 2. Exposed Suspension-System Members, Moldings, and Trim: Set of **6-inch- (150-mm-)** long Samples of each type, finish, and color.
 - 3. Sound Absorber: Sample of each type matching size of Sample metal pan.
- E. Delegated-Design Submittal: For design of attachment devices.

1.5 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. Suspended ceiling components.
 - 2. Structural members to which suspension systems will be attached.
 - 3. Size and location of access modules for acoustical panels.
 - 4. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Speakers.
 - d. Sprinklers.
 - e. Access panels.
 - 5. Perimeter moldings.
- B. Qualification Data: For testing agency.
- C. Product Test Reports: For each acoustical metal pan ceiling, for tests performed by manufacturer and witnessed by a qualified testing agency.
- D. Evaluation Reports: For each acoustical metal pan ceiling suspension system and anchor and fastener type.
- E. Field quality-control reports.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For finishes to include in maintenance manuals.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. Furnish extra materials that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Acoustical Metal Pans with Sound Absorber: Full-size units equal to 2 percent of quantity installed.
 - 2. Suspension-System Components: Quantity of each grid, exposed molding, and trim equal to 2 percent of quantity installed.
 - 3. Hold-Down Clips: Equal to 2 percent of quantity installed.

1.8 QUALITY ASSURANCE

- A. Testing Agency Qualifications: Qualified according to NVLAP for testing indicated.
- B. Mockups: Build mockups to verify selections made under Sample submittals, to demonstrate aesthetic effects, and to set quality standards for materials and execution.

1. Build mockup of typical ceiling area as shown on Drawings.
2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical metal pans, suspension-system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they are protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Handle acoustical metal pans, suspension-system components, and accessories carefully to avoid damaging units and finishes in any way.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design attachment devices.
- B. Surface-Burning Characteristics: Comply with ASTM E84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.
 1. Flame-Spread Index: Comply with ASTM E1264 for Class A materials.
 2. Smoke-Developed Index: 50 or less.

2.2 ACOUSTICAL METAL PANS, GENERAL

- A. Source Limitations: Obtain each type of acoustical metal ceiling pan and supporting suspension system from single source from single manufacturer.
- B. Acoustical Panel Standard: Provide manufacturer's standard pans of configuration indicated that comply with ASTM E1264 classifications as designated by types, patterns, acoustical ratings, and light reflectances unless otherwise indicated.
 1. Mounting Method for Measuring NRC: Type E-400; plenum mounting in which face of test specimen is 15-3/4 inches (400 mm) away from test surface according to ASTM E795.
- C. Sheet Metal Characteristics: For metal components exposed to view in the completed Work, provide materials with smooth, flat surfaces without blemishes. Do not use materials with exposed pitting, seam marks, roller marks, roughness, stains, or discolorations.
 1. Aluminum Sheet: Rolled aluminum sheet, complying with ASTM B209 (ASTM B209M); alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.

2. Steel Sheet: Commercial-quality, cold-rolled, carbon-steel sheet; stretcher leveled; with protective coating complying with ASTM C635/C635M.
 - a. Painted Finishes: Electrolytic zinc-coated steel complying with ASTM A879/A879M, 13Z (40G) coating, surface treatment as recommended by finish manufacturer for type of use and finish indicated.
 - b. Chemical/Mechanical Finishes: Uncoated steel sheet complying with ASTM A1008/A1008M with luster or bright finish as required by finisher for applying electroplating or other metallic-finishing processes.
 - D. Sound-Absorbent Fabric Layer: Provide fabric layer, sized to fit concealed surface of pan, and consisting of black, nonwoven, nonflammable, sound-absorbent material with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing according to ASTM E84.
 1. Bond fabric layer to panels in the factory with manufacturer's standard nonflammable adhesive.
 - E. Sound-Absorbent Pads: Provide width and length to completely fill concealed surface of pan, with surface-burning characteristics for flame-spread index of 25 or less and smoke-developed index of 50 or less, as determined by testing according to ASTM E84, and to comply with the following requirements:
 - F. Sound Attenuation Panels: Provide manufacturer's standard aluminum unperforated metal backing unit that acts as a sound attenuation pan to reduce sound travel through ceiling plenum into adjoining rooms.
 1. Sound-Absorbent Pads: Provide secondary sound-absorbent pads, same as specified for primary sound-absorbent pads, for placement over sound attenuation pan to reduce plenum sound.
- 2.3 ALUMINUM PANS FOR ACOUSTICAL METAL PAN CEILING (RE:A0.20)
- A. MC-1, MC-2, MC-3
 - B. Classification: Units complying with ASTM E1264 for Type VII, perforated aluminum facing (pan) with mineral- or glass-fiber-base backing.
- 2.4 METAL SUSPENSION SYSTEMS, GENERAL
- A. Metal Suspension System Standard: Provide manufacturer's standard metal suspension systems of types, structural classifications, and finishes indicated that comply with applicable ASTM C635/C635M requirements.
 - B. Suspension Systems: Provide systems complete with carriers, runners, splice sections, connector clips, alignment clips, leveling clips, hangers, molding, trim, retention clips, load-resisting struts, and other suspension components required to support ceiling units and other ceiling-supported construction.

- C. Attachment Devices: Size for 5 times the design load indicated in ASTM C635/C635M, Table 1, Direct Hung, unless otherwise indicated. Comply with seismic design requirements.
- D. Expansion Anchors: Fabricated from corrosion-resistant materials, with allowable load or strength design capacities calculated according to ICC-ES AC193 and ACI 318 greater than or equal to the design load, as determined by testing per ASTM E488/E488M conducted by a qualified testing agency.
- E. Power-Actuated Anchors: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hangers of type indicated and with allowable load capacities calculated according to ICC-ES AC70, greater than or equal to the design load, as determined by testing per ASTM E1190 conducted by a qualified testing agency.
- F. Wire Hangers, Braces, and Ties: Provide wires complying with the following requirements:
 - 1. Zinc-Coated, Carbon-Steel Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper.
 - 2. Stainless Steel Wire: ASTM A580/A580M, Type 304, nonmagnetic.
 - 3. Nickel-Copper-Alloy Wire: ASTM B164, nickel copper alloy for UNS No. N04400 alloy.
 - 4. Size: Select wire diameter so its stress at 3 times the hanger design load indicated in ASTM C635/C635M, Table 1, Direct Hung, is less than yield stress of wire, but provide not less than **0.106-inch- (2.69-mm-)** diameter wire.
- G. Hanger Rods: Mild steel, zinc coated or protected with rust-inhibitive paint.
- H. Angle Hangers: Angles with legs not less than **7/8 inch (22 mm)** wide; formed with **0.04-inch- (1.0-mm-)** thick, galvanized-steel sheet complying with ASTM A653/A653M, **G90 (Z275)** coating designation; with bolted connections and **5/16-inch- (8-mm-)** diameter bolts.
- I. Seismic Stabilizer Bars: Manufacturer's standard perimeter stabilizers designed to accommodate seismic forces.
- J. Seismic Struts: Manufacturer's standard compression struts designed to accommodate seismic forces.
- K. Seismic Clips: Manufacturer's standard seismic clips designed and spaced to secure acoustical metal pans in place.
- L. Hold-Down Clips: Manufacturer's standard hold-down clips spaced to secure acoustical metal pans in place to molding and trim at perimeter.
- M. Exposed Metal Edge Moldings and Trim: Provide exposed members as indicated or as required to comply with seismic requirements of authorities having jurisdiction, to conceal edges of and penetrations through ceiling, to conceal edges of pans and runners, for fixture trim and adapters, for fasciae at changes in ceiling height, and for other conditions; of metal and finish matching acoustical metal pan ceiling units unless otherwise indicated.
 - 1. For Circular Penetrations of Ceiling: Fabricate edge moldings to diameter required to fit penetration exactly.

2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.
- C. High-Humidity Finish: Comply with ASTM C635/C635M requirements for "Coating Classification for Severe Environment Performance" where high-humidity finishes are indicated.

2.6 ALUMINUM FINISHES

- A. Mill Finish: AA-M10C10 (Mechanical Finish: as fabricated, unspecified; Chemical Finish: chemically cleaned).
- B. Lacquered Mill Finish: AA-M10C10R1x (Mechanical Finish: as fabricated, unspecified; Chemical Finish: chemically cleaned; Organic Coating: as specified below).
 - 1. Organic Coating: Manufacturer's standard clear organic coating.
- C. Clear Anodic Finish: AAMA 611, AA-M12C22A31, Class II, 0.010 mm or thicker.
- D. Clear Mirror Anodic Finish: AA-M21C12A212, 0.005 mm or thicker.
- E. Color-Coated Finish: Manufacturer's standard powder-coat baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.
- F. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

2.7 METALLIC-COATED STEEL SHEET FINISHES

- A. Color-Coated Finish: Manufacturer's standard powder-coat baked paint complying with coating manufacturer's written instructions for surface preparation, pretreatment, application, baking, and minimum dry film thickness.

2.8 STEEL SHEET FINISHES

- A. Electroplated Finish: Electroplating process complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, and minimum thickness to produce a coating uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unplated areas, and other visible defects.

- B. Bright-Reflective Finish: Manufacturer's standard chemical/mechanical bright-reflective metallic finish complying with finish manufacturer's written instructions for surface preparation, pretreatment, process, protective coating, and minimum thickness to produce a finish uniform in appearance and free of blisters, pits, roughness, nodules, burning, cracks, unfinished areas, and other visible defects.

2.9 STAINLESS STEEL FINISHES

- A. Surface Preparation: Remove tool and die marks and stretch lines, or blend into finish.
- B. Polished Finishes: Grind and polish surfaces to produce uniform finish, free of cross scratches.
 - 1. Run grain of directional finishes with long dimension of each piece.
 - 2. When polishing is completed, passivate and rinse surfaces. Remove embedded foreign matter and leave surfaces chemically clean.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical metal pan ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical metal pan ceilings.
- B. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical metal pans to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width pans at borders, and comply with layout shown on reflected ceiling plans and coordination drawings.

3.3 INSTALLATION

- A. General: Install acoustical metal pan ceiling assemblies to comply with ASTM C636/C636M and manufacturer's written instructions.
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension-system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 4. Secure wire hangers to ceiling suspension members or carrying channels and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that do not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 5. Secure flat, angle, channel, and rod hangers to ceiling suspension members or carrying channels and to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and the type of hanger involved. Install hangers in a manner that does not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 6. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, postinstalled mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 7. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 8. Do not attach hangers to steel deck tabs.
 9. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 10. Space hangers not more than **48 inches (1200 mm)** o.c. along each member supported directly from hangers unless otherwise indicated; provide hangers not more than **8 inches (200 mm)** from ends of each member.
 11. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members or carrying channels and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or postinstalled anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical metal pans.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than **16 inches (400 mm)** o.c. and not more than **3 inches (75 mm)** from ends, leveling with ceiling suspension system to a tolerance of **1/8 inch in 12 feet (3.2 mm in 3.6 m)**. Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension-system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Cut acoustical metal pan units for accurate fit at borders and at interruptions and penetrations by other work through ceilings. Stiffen edges of cut units as required to eliminate evidence of

buckling or variations in flatness exceeding referenced standards for stretcher-leveled metal sheet. Cut and treat edges to comply with manufacturer's written instructions.

- G. Install acoustical metal pans in coordination with suspension system and exposed moldings and trim. Comply with manufacturer's installation tolerances.
1. For lay-in, square-edge pans, install pans with edges fully hidden from view by flanges of suspension-system runners and moldings.
 2. For lay-in, reveal-edge pans on suspension-system runners, install pans with bottom of reveal in firm contact with top surface of runner flanges.
 3. For lay-in, reveal-edge pans on suspension-system members with box-shaped flanges, install pans with reveal surfaces in firm contact with suspension-system surfaces and panel faces flush with bottom face of runners.
 4. For torsion-spring-hinged pans, position pans according to manufacturer's written instructions.
 5. For snap-in pans, fit adjoining units to form flush, tight joints.
 6. Align joints in adjacent courses to form uniform, straight joints parallel to room axis in both directions unless otherwise indicated.
 7. Fit adjoining units to form flush, tight joints.
 8. Install directionally patterned or textured metal pans in directions indicated.
 9. Install sound-absorbent fabric layers in, and bond to, perforated metal pans.
 10. Install sound-absorbent pads in perforated metal pans over metal spacer grids.
- H. Install sound attenuation panels in areas indicated by reflected ceiling plans or room finish schedules. Lay panels directly on ceiling system and close major openings to form complete coverage in required areas. Lay second sound-absorbent pads on sound attenuation panels.
- I. Install hold-down clips where indicated.

3.4 FIELD QUALITY CONTROL

- A. Perform the following tests and inspections of completed installations of acoustical metal panel ceiling hangers, anchors, and fasteners in successive stages. Do not proceed with installations of acoustical metal panel ceiling hangers for the next area until test results for previously completed installations show compliance with requirements.
1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion, but no panels have been installed.
 - a. Within each test area, testing agency selects one of every 10 power-actuated fasteners and postinstalled anchors used to attach hangers to concrete and tests them for 200 lbf (890 N) of tension; it also selects one of every two postinstalled anchors used to attach bracing wires to concrete and tests them for 440 lbf (1957 N) of tension.
 - b. When tested fasteners and anchors do not comply with requirements, testing agency tests those fasteners and anchors not previously tested until 20 pass consecutively and then resumes initial testing frequency.
- B. Acoustical metal panel ceiling hangers, anchors, and fasteners will be considered defective if they do not pass tests and inspections.

- C. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical metal pan ceilings, including trim and edge moldings, after removing strippable, temporary protective covering, if any. Comply with manufacturer's written instructions for stripping of temporary protective covering, cleaning, and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage, including dented and bent units.

END OF SECTION 095133

SECTION 097200 - WALL COVERINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl wall covering.

1.2 ACTION SUBMITTALS

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

B. Shop Drawings: Show location and extent of each wall-covering type. Indicate pattern placement, seams and termination points.

C. Samples: Full width by 36-inch- (914-mm-) long section of wall covering from same print run or dye lot to be used for the Work, with specified treatments applied. Show complete pattern repeat. Mark top and face of fabric.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: Based on evaluation of comprehensive tests performed by a qualified testing agency, for wall covering.

1.4 CLOSEOUT SUBMITTALS

A. Maintenance Data: For wall coverings to include in maintenance manuals.

1.5 MAINTENANCE MATERIAL SUBMITTALS

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

1. Wall-Covering Materials: For each type, full-size units equal to 5 percent of amount installed.

1.6 QUALITY ASSURANCE

A. Fire-Test-Response Characteristics: As determined by testing identical wall coverings applied with identical adhesives to substrates according to test method indicated below by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Surface-Burning Characteristics: As follows, per ASTM E 84:
 - a. Flame-Spread Index: 25 or less.
 - b. Smoke-Developed Index: 50 or less.
2. Fire-Growth Contribution: Textile wall coverings complying with acceptance criteria of UBC Standard 8-2.
3. Fire-Growth Contribution: Textile wall coverings tested according to NFPA 265 and complying with test protocol and criteria in the 2003 IBC.

PART 2 - PRODUCTS

2.1 WALL COVERINGS

- A. General: Provide rolls of each type of wall covering from same print run or dye lot.

2.2 VINYL WALL COVERING

- A. Vinyl Wall-Covering Standards: Provide mildew-resistant products complying with the following:
 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. As indicated on drawing A0.20.
- B. Total Weight Excluding Coatings: 20.
- C. Width: 54 inches (1372 mm).
- D. Backing: Nonwoven fabric.
- E. Repeat: Reversible straight across match.
- F. Colors, Textures, and Patterns: Match Architect's samples.

2.3 ACCESSORIES

- A. Adhesive: Mildew-resistant, nonstaining, strippable adhesive, for use with specific wall covering and substrate application; as recommended in writing by wall-covering manufacturer.
- B. Primer/Sealer: Mildew resistant, complying with requirements in Section 099123 "Interior Painting" and recommended in writing by wall-covering manufacturer for intended substrate.
- C. Wall Liner: Nonwoven, synthetic underlayment and adhesive as recommended by wall-covering manufacturer.
- D. Seam Tape: As recommended in writing by wall-covering manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Clean substrates of substances that could impair bond of wall covering, including dirt, oil, grease, mold, mildew, and incompatible primers.
- B. Prepare substrates to achieve a smooth, dry, clean, structurally sound surface free of flaking, unsound coatings, cracks, and defects.
 - 1. Moisture Content: Maximum of 5 percent on new plaster, concrete, and concrete masonry units when tested with an electronic moisture meter.
 - 2. Plaster: Allow new plaster to cure. Neutralize areas of high alkalinity. Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 3. Metals: If not factory primed, clean and apply metal as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 4. Gypsum Board: Prime with primer as recommended in writing by primer/sealer manufacturer and wall-covering manufacturer.
 - 5. Painted Surfaces: Treat areas susceptible to pigment bleeding.
- C. Remove hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.
- D. Acclimatize wall-covering materials by removing them from packaging in the installation areas not less than 24 hours before installation.
- E. Install wall liner, with no gaps or overlaps, where required by wall-covering manufacturer. Form smooth wrinkle-free surface for finished installation. Do not begin wall-covering installation until wall liner has dried.
- F. Cut wall-covering strips in roll number sequence. Change roll numbers at partition breaks and corners.
- G. Install strips in same order as cut from roll.
- H. Install reversing every other strip.
- I. Install wall covering with no gaps or overlaps, no lifted or curling edges, and no visible shrinkage.
- J. Match pattern 72 inches (1830 mm) above the finish floor.
- K. Install seams vertical and plumb at least 6 inches (150 mm) from outside corners and 3 inches (75 mm) from inside corners unless a change of pattern or color exists at corner. No horizontal seams are permitted.
- L. Fully bond wall covering to substrate. Remove air bubbles, wrinkles, blisters, and other defects.

- M. Trim edges and seams for color uniformity, pattern match, and tight closure. Butt seams without any overlay or spacing between strips.
- N. Remove excess adhesive at finished seams, perimeter edges, and adjacent surfaces.
- O. Reinstall hardware and hardware accessories, electrical plates and covers, light fixture trims, and similar items.

END OF SECTION 097200

SECTION 097700 NON-PROGRESSIVE INTERIOR WALL PANEL SYSTEM

PART 1 – GENERAL

1.01 SECTION INCLUDES

- A. Interior wall panel system application.
- B. Trim and accessories for attaching wall panels, including fastenings, accessory features, connections to the building structure, and other items not mentioned specifically herein, and which are necessary to make a complete installation.

1.02 RELATED SECTIONS

- A. Documents affecting work in this section includes but is not limited to the General Conditions, Supplementary Conditions and Sections in Division 1 – General Requirements of these Specifications.
- B. 062023 – Interior Finish Carpentry.
- C. 079200 – Joint Sealants.
- D. 092600 - Gypsum Board Systems.
- E. 093013 – Ceramic Tiling
- F. 099123 – Interior Painting

1.03 QUALITY ASSURANCE

- A. Work Quality: All work of this Section to be manufactured and constructed, assembled and installed by skilled craft persons in finish carpentry. All such work to be accurately fabricated, assembled, joined and expertly finished in accordance with measurements taken on the job-site.
- B. Defective Work: All work, work not true to line, not in satisfactory operating condition, improperly installed, damaged or marred will not be accepted. Remedy, remove or replace defective work as directed by the Architect.
- C. Standards: All applicable Sections of the "Manual of Millwork" and current supplements published by the Woodwork Institute for the construction types and grades hereinafter specified. All modifications to such standards shown on the Contract Drawings and approved Shop Drawings or specified shall govern.
- D. Manufacturer: Provide wall panels produced by one manufacturer whose published product literature clearly indicates compliance with specifications.

1.04 SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- B. Shop Drawings:
 - 1. Include fabrication and installation layouts of wall panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, closures, and accessories; and special details.
 - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than **1-1/2 inches per 12 inches (1:10)**.
- C. Samples for Initial Selection: For each type of metal panel indicated with factory-applied finishes.
 - 1. Include Samples of trim and accessories involving color selection.
 - 2. Submit four samples, 3 1/2"x 3 1/2", of each color, and texture of specified products.
- D. Warranty Data: Submit standard warranty data.
- E. Mockup: Provide a minimum 4' x 4' full system mockup with trim, "T04" Tile and Trespa Panels for review. A portion of the actual work can also be submitted as a mockup, if approved it can be retained as a part of the work.

1.05 DELIVERY, STORAGE AND HANDLING

- A. Deliver and store materials in the manufacturer's original protective packaging. Store materials in an enclosed shelter providing protection from damage and exposure to the elements.

1.06 COORDINATION

- A. Do work of this Section in a fully coordinated and cooperative manner with work of other trades to provide complete and proper installation and to expedite the job without delays.
- B. Secure field measurements before preparation of shop drawings and fabrication where possible, for proper and adequate fabrication and installation of the work.
- C. Priming and back-painting of all carpentry and millwork is specified in Section 09900 - Painting. Do not set items until priming and back-painting have been completed.

- D. Where Interior wall panels are clad around outside corners of a room, the drywall installer should avoid installing drywall corner beads, as this makes shimming the interior wall panels very difficult. (See Section 092900).
- E. Protect all work against damage of any kind until final acceptance of the building. Repair or replace damaged work to the satisfaction of the Architect without additional cost to the Owner.
- F. Provide adequate ventilation and acclimate panels per Woodwork Institute Manual of Millwork.

1.07 WARRANTY

- A. Wall panel to be warranted against delamination for (10 Years). The factory authorized fabricator, product installer and material manufacturer must sign and date the Warranty documents and submit a copy to the Contractor for the warranty to be valid.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

- A. These specifications are based on Interior wall panels manufactured by Trespa North America and the wall panel trim and connectors manufactured by Wall Panel Systems, 877-333-4977. Represented locally by Specified Int+Ex:

Specified Int+Ex

Gaynor Sherer

Gaynor@specintex.com

(o) 281-655-8433

www.specintex.com

Wall Panel Systems, Inc.

Jesse Rich

JesseR@wpsusa.com

(o) 909-280-8582

www.wpsusa.com

- B. All panel products specified in this section shall be provided by Wall Panel Systems, CNC shop machining, mounting clips on the back of each panel, coordinate field dimensions with contractor/installer, assemblies' panels and frame support to be indicate clearly on WPS engineering shop drawings for architect review and installation purposes.

2.02 MATERIALS

- A. Basis of design: Attachment system to be WPS Face Mounted Non-Progressive Shadowline System by Wall Panel Systems, Inc. and panel material by Trespa North America Electron Beam Cure resin. Colors and surface texture as specified by Architect. Panels are to be fabricated as per Wall Panel Systems, Inc engineering shop drawings and details.
- B. Thickness: A thickness 3/8" for phenolic panels is approved for interior walls with WPS Face Mounted System concealed fasteners, clip non-progressive installations system.
- C. Panel color/texture: to be selected by Architect from Manufacturer's standard color pallet, this may include metallics, wood grains, & solid colors.
 - 1. Six (6) "WP01" - "WP06" Colors to be used per HAS standards. RE: A0.20 for finish information.
 - 2. Texture to be smooth.
- D. Other Wall Panel Materials:
 - 1. Tile: RE: Sheet A0.20 for tile product "T04" that is to be installed within the wall panel system.
 - 2. Signage Panel: RE: Sheet A4.01 for acyclic signage panel product that is to be installed within the wall panel system.

2.03 FABRICATION

- A. Interior panels can be sawn, cut, routed and drilled with the usual tools used to fabricate hardwoods (i.e. carbide tipped blades). Wall Panel Systems to fabricate all materials and attach clips to back of panels. Field modifications are possible by the installing contractor using hand tools that meet the above requirements.

2.04 SOURCE QUALITY CONTROL

- A. Panels shall be of material specifically designed for wall cladding. Fabricated panels shall comply with all current codes and regulations. Panels shall have uniform thickness (+0.03") and flatness (maximum difference of 0.03") for 10-foot span.
- B. Flame spread (ASTM E-84): Panels to be UL registered and labeled for quality consistency.
 - a. Class 1 or Class A.
 - b. Class 2 or Class B.
- C. Performance requirements:
 - 1. Modulus of elasticity: 1,500,000-psi minimum.
 - 2. Shear strength: 2000-psi minimum.
 - 3. Compressive strength: 24,000-psi minimum.
 - 4. Weight: 93 lbs. per cubic foot maximum.
 - 5. Tensile strength: 13,000-PSI, minimum.
 - 6. Flexural strength: 16,000-PSI minimum.

7. Surface Impact Resistance: 9 lb.
 8. Scratch Resistance: 0.8 lb.
- D. Panel Tolerance:
1. Thickness: 1/32", maximum.
 2. Length: 1/4", maximum.
 3. Width: 1/4", maximum.
 4. Non-porous surface and edges.
- E. Physical Properties:
1. Specific Gravity: 87 lbs. per cubic foot, minimum.
 2. Dimensional Stability: 0.03 in/ft, maximum.
 3. Water Absorption: 3% by weight, maximum.
 4. Vapor Diffusion: 30,000
- F. Optical Properties:
1. Color Stability: Gray scale 4 – 5 according to ISO 105A02-87, (3000 hours Xenon test 1200).
 2. SO (2) resistance: Gray scale 4 – 5 (50 cycles 0.0067%).

2.05 SUB-FRAME ASSEMBLY

- A. Face Mounted Shadowline clips and trim to be manufactured specifically to meet the following requirements:
1. Handle the weight of Interior wall panels.
 2. Fasteners for panel assembly to be designed to keep panels consistently flat at each joint.
 3. Capable of holding panels up to 6' high x 12' wide.
 4. Allow 3/8" ventilation gap between the wall and the back side of the panel clip, to prevent condensation behind the panels.
 5. System to allow interchanging of components at a later date, with a dry-fit installation. No liquid adhesives to be used.
- B. Trim and Clip Material
1. Where not seen: Al 6061-T6.
 2. Where visible: Al 6063-T5.
 3. Thickness: not less than 0.62".
- C. Fasteners to be self-tapping Type F, 8/32" x 3/8" plated steel.
- D. Panel trim for joints, edges and corners to be from Wall Panel Systems; Shadowline, Face Mounted System as shown on the drawings.
1. Finish:
 - a. Clear Satin Anodized

PART 3 – EXECUTION

3.01 INSTALLATION

- A. Install panels and fixing system as per approved shop drawings and specification.
- B. Install aluminum sub-frame to support the (FMS) clip sub-frame assembly.
- C. Maximum fixing distances:
 - a. 2 fixing points in one direction using:
 - i. 8 mm panel is 27”.
 - ii. 10 mm panel is 33”.
 - b. 3 or more fixing points in one direction:
 - i. 8 mm panel is 31”
 - ii. 10mm panel is 37”.
- D. The installation of the panel clip system shall be true and plumb.
- E. Face of the panels are to sit out from the face of the wall ¼” +/- shimming as required.
- F. Installed panels shall have vertical joints with splines routed directly in the center of the panel edge to ensure that all four intersecting panels are kept in the same plane.
- G. Exact sizes and dimensions of the trim to be coordinated with the drawings, field conditions and approved shop drawings.

3.02 PROTECTION

- A. After installation, the General Contractor shall protect the panels from damage. The panels shall be kept free from paint, plaster, cement scratches, or any other destructive forces.

3.03 CLEANING

- A. Panels to be cleaned with standard cleaning solution. Mild solvents may be used to remove stubborn marks and dirt.
- B. Repair or replace all damaged material to the satisfaction of the Architect and/or Contractor.
- C. Installed areas or portions of the work shall be inspected by Architect or General Contractor and approved immediately following completion of such areas.

END OF SECTION

SECTION 099123 - INTERIOR PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

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

- 1. Concrete.
- 2. Concrete masonry units (CMU).
- 3. Steel.
- 4. Cast iron.
- 5. Galvanized metal.
- 6. Aluminum (not anodized or otherwise coated).
- 7. Wood.
- 8. Gypsum board.
- 9. Plaster.

- B. Related Requirements:

- 1. Section 051200 "Structural Steel Framing" for shop priming of metal substrates with primers specified in this Section.
- 2. Section 099600 "High-Performance Coatings" for high-performance and special-use coatings.
- 3. Section 099113 "Exterior Painting" for surface preparation and the application of paint systems on exterior substrates.
- 4. Section 099300 "Staining and Transparent Finishing" for surface preparation and the application of wood stains and transparent finishes on interior wood substrates.

1.3 DEFINITIONS

- A. Gloss Level 1: Not more than 5 units at 60 degrees and 10 units at 85 degrees, according to ASTM D 523, a matte flat finish.
- B. Gloss Level 2: Not more than 10 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, a high-side sheen flat, velvet-like finish.
- C. Gloss Level 3: 10 to 25 units at 60 degrees and 10 to 35 units at 85 degrees, according to ASTM D 523, an eggshell finish.

- D. Gloss Level 4: 20 to 35 units at 60 degrees and not less than 35 units at 85 degrees, according to ASTM D 523, a satin-like finish.
- E. Gloss Level 5: 35 to 70 units at 60 degrees, according to ASTM D 523, a semi-gloss finish.
- F. Gloss Level 6: 70 to 85 units at 60 degrees, according to ASTM D 523, a gloss finish.

1.4 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include preparation requirements and application instructions.
- B. LEED Submittals:
 - 1. Product Data for Credit EQ 4.2: For paints and coatings, including printed statement of VOC content.
 - 2. Laboratory Test Reports for Credit EQ 4: For paints and coatings, documentation indicating that they 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."
- C. Samples for Initial Selection: For each type of topcoat product.
- D. Samples for Verification: For each type of paint system and in each color and gloss of topcoat.
 - 1. Submit Samples on rigid backing, 8 inches (200 mm) square.
 - 2. Step coats on Samples to show each coat required for system.
 - 3. Label each coat of each Sample.
 - 4. Label each Sample for location and application area.
- E. Product List: For each product indicated, include the following:
 - 1. Cross-reference to paint system and locations of application areas. Use same designations indicated on Drawings and in schedules.
 - 2. Printout of current "MPI Approved Products List" for each product category specified in Part 2, with the proposed product highlighted.
 - 3. VOC content.

1.5 CLOSEOUT SUBMITTALS

- A. Coating Maintenance Manual: Provide coating maintenance manual including area summary with finish schedule, area detail designating location where each product/color/finish was used, product data pages, material safety data sheets, care and cleaning instructions, touch-up procedures, and color samples of each color and finish used.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

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

1.7 QUALITY ASSURANCE

- A. Mockups: Apply mockups of each paint system indicated and each color and finish selected to verify preliminary selections made under Sample submittals and to demonstrate aesthetic effects and set quality standards for materials and execution.
1. Architect will select one surface to represent surfaces and conditions for application of each paint system specified in Part 3.
 - a. Vertical and Horizontal Surfaces: Provide samples of at least **100 sq. ft. (9 sq. m)**.
 - b. Other Items: Architect will designate items or areas required.
 2. Final approval of color selections will be based on mockups.
 - a. If preliminary color selections are not approved, apply additional mockups of additional colors selected by Architect at no added cost to Owner.
 3. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
 4. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Delivery and Handling: Deliver products to Project site in an undamaged condition in manufacturer's original sealed containers, complete with labels and instructions for handling, storing, unpacking, protecting, and installing. Packaging shall bear the manufacturer's label with the following information:
1. Product name and type (description).
 2. Batch date.
 3. Color number.
 4. VOC content.
 5. Environmental handling requirements.
 6. Surface preparation requirements.
 7. Application instructions.
- B. Store materials not in use in tightly covered containers in well-ventilated areas with ambient temperatures continuously maintained at not less than **45 deg F (7 deg C)**.
1. Maintain containers in clean condition, free of foreign materials and residue.
 2. Remove rags and waste from storage areas daily.

1.9 FIELD CONDITIONS

- A. Apply paints only when temperature of surfaces to be painted and ambient air temperatures are between 50 and 95 deg F (10 and 35 deg C).
- B. Do not apply paints when relative humidity exceeds 85 percent; at temperatures less than 5 deg F (3 deg C) above the dew point; or to damp or wet surfaces.
- C. Lead Paint: It is not expected that lead paint will be encountered in the Work.
 - 1. If suspected lead paint is encountered, do not disturb; immediately notify Architect and Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis-of-Design Product: Subject to compliance with requirements, provide Sherwin-Williams Company products indicated or comparable product from one of the following:
 - 1. Benjamin Moore & Co.
 - 2. Duron, Inc.
 - 3. Glidden Professional, Division of PPG Architectural Finishes, Inc.
 - 4. PPG Architectural Finishes, Inc.
 - 5. Pratt & Lambert.
 - 6. <Insert manufacturer's name>.
- B. Source Limitations: Obtain paint materials from single source from single listed manufacturer.
 - 1. Manufacturer's designations listed on a separate color schedule are for color reference only and do not indicate prior approval.

2.2 PAINT, GENERAL

- A. MPI Standards: Provide products that comply with MPI standards indicated and that are listed in its "MPI Approved Products List."
- B. Material Compatibility:
 - 1. Provide materials for use within each paint system that are compatible with one another and substrates indicated, under conditions of service and application as demonstrated by manufacturer, based on testing and field experience.
 - 2. For each coat in a paint system, provide products recommended in writing by manufacturers of topcoat for use in paint system and on substrate indicated.
- C. VOC Content: Products shall comply with VOC limits of authorities having jurisdiction **and, for interior paints and coatings applied at Project site, the following VOC limits, exclusive of colorants added to a tint base, when calculated according to 40 CFR 59, Subpart D (EPA Method 24).**
 - 1. Flat Paints and Coatings: 50 g/L.

2. Nonflat Paints and Coatings: 150 g/L.
 3. Dry-Fog Coatings: 400 g/L.
 4. Primers, Sealers, and Undercoaters: 200 g/L.
 5. Anticorrosive and Antirust Paints Applied to Ferrous Metals: 250 g/L.
 6. Zinc-Rich Industrial Maintenance Primers: 340 g/L.
 7. Pretreatment Wash Primers: 420 g/L.
 8. Floor Coatings: 100 g/L.
 9. Shellacs, Clear: 730 g/L.
 10. Shellacs, Pigmented: 550 g/L.
- D. Low-Emitting Materials: Interior paints and coatings shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- E. Colors: **As indicated in a color schedule** on the Drawing Sheet A0.20
1. **10** percent of surface area will be painted with deep tones.

2.3 SOURCE QUALITY CONTROL

- A. Testing of Paint Materials: Owner reserves the right to invoke the following procedure:
1. Owner will engage the services of a qualified testing agency to sample paint materials. Contractor will be notified in advance and may be present when samples are taken. If paint materials have already been delivered to Project site, samples may be taken at Project site. Samples will be identified, sealed, and certified by testing agency.
 2. Testing agency will perform tests for compliance with product requirements.
 3. Owner may direct Contractor to stop applying coatings if test results show materials being used do not comply with product requirements. Contractor shall remove noncomplying paint materials from Project site, pay for testing, and repaint surfaces painted with rejected materials. Contractor will be required to remove rejected materials from previously painted surfaces if, on repainting with complying materials, the two paints are incompatible.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Applicator present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work. Verify suitability of substrates, including surface conditions and compatibility with existing finishes and primers. Where acceptability of substrate conditions is in question, apply samples and perform in-situ testing to verify compatibility, adhesion, and film integrity of new paint application.
1. Report, in writing, conditions that may affect application, appearance, or performance of paint.

- B. Substrate Conditions:
 - 1. Maximum Moisture Content of Substrates: When measured with an electronic moisture meter as follows:
 - a. Concrete: 12 percent.
 - b. Masonry (Clay and CMU): 12 percent.
 - c. Wood: 15 percent.
 - d. Gypsum Board: 12 percent.
 - e. Plaster: 12 percent.
 - 2. Gypsum Board Substrates: Verify that finishing compound is sanded smooth.
 - 3. Plaster Substrates: Verify that plaster is fully cured.
 - 4. Spray-Textured Ceiling Substrates: Verify that surfaces are dry.
- C. Proceed with coating application only after unsatisfactory conditions have been corrected; application of coating indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Comply with manufacturer's written instructions and recommendations in "MPI Manual" applicable to substrates indicated.
- B. Remove hardware, covers, plates, and similar items already in place that are removable and are not to be painted. If removal is impractical or impossible because of size or weight of item, provide surface-applied protection before surface preparation and painting.
 - 1. After completing painting operations, use workers skilled in the trades involved to reinstall items that were removed. Remove surface-applied protection if any.
- C. Clean substrates of substances that could impair bond of paints, including dust, dirt, oil, grease, and incompatible paints and encapsulants.
 - 1. Remove incompatible primers and reprime substrate with compatible primers or apply tie coat as required to produce paint systems indicated.
- D. Concrete Substrates: Remove release agents, curing compounds, efflorescence, and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces to be painted exceeds that permitted in manufacturer's written instructions.
 - 1. Concrete Floors: Remove oil, dust, grease, dirt, and other foreign materials. Comply with SSPC-SP-13/NACE 6 or ICRI 03732.
- E. Masonry Substrates: Remove efflorescence and chalk. Do not paint surfaces if moisture content or alkalinity of surfaces or mortar joints exceed that permitted in manufacturer's written instructions.
- F. Steel Substrates: Remove rust, loose mill scale, and shop primer, if any. Clean using methods recommended in writing by paint manufacturer **but not less than the following:**

1. SSPC-SP 2, "Hand Tool Cleaning."
 2. SSPC-SP 3, "Power Tool Cleaning."
 3. SSPC-SP 7/NACE No. 4, "Brush-off Blast Cleaning."
 4. SSPC-SP 11, "Power Tool Cleaning to Bare Metal."
- G. Shop-Primed Steel Substrates: Clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material as used for shop priming to comply with SSPC-PA 1 for touching up shop-primed surfaces.
- H. Galvanized-Metal Substrates: Remove grease and oil residue from galvanized sheet metal fabricated from coil stock by mechanical methods to produce clean, lightly etched surfaces that promote adhesion of subsequently applied paints.
- I. Aluminum Substrates: Remove loose surface oxidation.
- J. Wood Substrates:
1. Scrape and clean knots, and apply coat of knot sealer before applying primer.
 2. Sand surfaces that will be exposed to view, and dust off.
 3. Prime edges, ends, faces, undersides, and backsides of wood.
 4. After priming, fill holes and imperfections in the finish surfaces with putty or plastic wood filler. Sand smooth when dried.
- K. Cotton or Canvas Insulation Covering Substrates: Remove dust, dirt, and other foreign material that might impair bond of paints to substrates.

3.3 APPLICATION

- A. Apply paints according to manufacturer's written instructions and to recommendations in "MPI Manual."
1. Use applicators and techniques suited for paint and substrate indicated.
 2. Paint surfaces behind movable equipment and furniture same as similar exposed surfaces. Before final installation, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 3. Paint front and backsides of access panels, removable or hinged covers, and similar hinged items to match exposed surfaces.
 4. Do not paint over labels of independent testing agencies or equipment name, identification, performance rating, or nomenclature plates.
 5. Primers specified in painting schedules may be omitted on items that are factory primed or factory finished if acceptable to topcoat manufacturers.
- B. Tint each undercoat a lighter shade to facilitate identification of each coat if multiple coats of same material are to be applied. Tint undercoats to match color of topcoat, but provide sufficient difference in shade of undercoats to distinguish each separate coat.
- C. If undercoats or other conditions show through topcoat, apply additional coats until cured film has a uniform paint finish, color, and appearance.

- D. Apply paints to produce surface films without cloudiness, spotting, holidays, laps, brush marks, roller tracking, runs, sags, ropiness, or other surface imperfections. Cut in sharp lines and color breaks.
- E. Painting Fire Suppression, Plumbing, HVAC, Electrical, Communication, and Electronic Safety and Security Work:
 - 1. Paint the following work where exposed in equipment rooms:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Tanks that do not have factory-applied final finishes.
 - h. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - 2. Paint the following work where exposed in occupied spaces:
 - a. Equipment, including panelboards.
 - b. Uninsulated metal piping.
 - c. Uninsulated plastic piping.
 - d. Pipe hangers and supports.
 - e. Metal conduit.
 - f. Plastic conduit.
 - g. Duct, equipment, and pipe insulation having cotton or canvas insulation covering or other paintable jacket material.
 - h. Other items as directed by Architect.
 - 3. Paint portions of internal surfaces of metal ducts, without liner, behind air inlets and outlets that are visible from occupied spaces.

3.4 FIELD QUALITY CONTROL

- A. Dry Film Thickness Testing: Owner may engage the services of a qualified testing and inspecting agency to inspect and test paint for dry film thickness.
 - 1. Contractor shall touch up and restore painted surfaces damaged by testing.
 - 2. If test results show that dry film thickness of applied paint does not comply with paint manufacturer's written recommendations, Contractor shall pay for testing and apply additional coats as needed to provide dry film thickness that complies with paint manufacturer's written recommendations.

3.5 CLEANING AND PROTECTION

- A. At end of each workday, remove rubbish, empty cans, rags, and other discarded materials from Project site.

- B. After completing paint application, clean spattered surfaces. Remove spattered paints by washing, scraping, or other methods. Do not scratch or damage adjacent finished surfaces.
- C. Protect work of other trades against damage from paint application. Correct damage to work of other trades by cleaning, repairing, replacing, and refinishing, as approved by Architect, and leave in an undamaged condition.
- D. At completion of construction activities of other trades, touch up and restore damaged or defaced painted surfaces.

3.6 INTERIOR PAINTING SCHEDULE

A. Concrete Substrates, Nontraffic Surfaces:

1. Latex System:

- a. Prime Coat: Primer sealer, latex, interior[, **MPI #3**]: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.
- b. Intermediate Coat: Latex, interior, matching topcoat.
- c. Topcoat: Latex, interior, flat[, (**Gloss Level 1**), **MPI #53 X-Green/#143 X-Green**]: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- d. Topcoat: Latex, interior, low sheen[, (**Gloss Level 2**), **MPI #44 X-Green/#144 X-Green**]: S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- e. Topcoat: Latex, interior, eggshell[, (**Gloss Level 3**), **MPI #52 X-Green/#145 X-Green**]: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
- f. Topcoat: Latex, interior, semi-gloss[, (**Gloss Level 4**), **MPI #43 X-Green**]: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
- g. Topcoat: Latex, interior, gloss[, (**Gloss Level 5**), **MPI #54**]: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat..

2. Water-Based Light Industrial Coating System:

- a. Prime Coat: Primer sealer, latex, interior[, **MPI #3**]: S-W Loxon Concrete & Masonry Primer Sealer, A24W8300, at 8.0 mils wet, 3.2 mils dry.
- b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
- c. Topcoat: Light industrial coating, interior, water based, eggshell[, (**Gloss Level 3**), **MPI #151**]: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
- d. Topcoat: Light industrial coating, interior, water based, semi-gloss[, (**Gloss Level 5**), **MPI #153**]: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.

3. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."

4. Concrete Stain System (Water-based) for Vertical Surfaces:
 - a. First Coat: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).
 - b. Second Coat: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).

- B. Concrete Substrates, Pedestrian Traffic Surfaces:
 1. Latex Floor Enamel System:
 - a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss[, **(maximum Gloss Level 3), MPI #60**]: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.

 2. Clear Acrylic System, Gloss Finish:
 - a. First Coat: S-W H&C Concrete Sealer Wet Look Water Base, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).
 - b. Second Coat: S-W H&C Concrete Sealer Wet Look Water Base, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).

 3. Concrete Stain System (Water-based):
 - a. First Coat: Low-luster opaque finish: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).
 - b. Second Coat: Low-luster opaque finish: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).

 4. Epoxy and Urethane Coatings: Refer to Section 099600 "High-Performance Coatings."
 5. Epoxy- and Urethane- Based Aggregate-Filled Floor Surfacing: Refer to Section 09 67 23 "Resinous Flooring."

- C. CMU Substrates:
 1. Latex System:
 - a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4 X-Green**]: S-W PrepRite Block Filler, B25W25, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat[, **(Gloss Level 1), MPI #53 X-Green/#143 X-Green**]: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - d. Topcoat: Latex, interior, low sheen[, **(Gloss Level 2), MPI #44 X-Green/#144 X-Green**]: S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - e. Topcoat: Latex, interior, eggshell[, **(Gloss Level 3), MPI #52 X-Green/#145 X-Green**]: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.

- f. Topcoat: Latex, interior, semi-gloss[, **(Gloss Level 4), MPI #43 X-Green**]: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - g. Topcoat: Latex, interior, gloss[, **(Gloss Level 5), MPI #54**]: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
2. Water-Based Light Industrial Coating System:
 - a. Block Filler: Block filler, latex, interior/exterior[, **MPI #4 X-Green**]: S-W PrepRite Block Filler, B25W25, at 100 to 200 sq. ft. per gal (2.4 to 4.9 sq. m per l).
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell[, **(Gloss Level 3), MPI #151**]: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss[, **(Gloss Level 5), MPI #153**]: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 3. Concrete Stain System (Water-based):
 - a. First Coat: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).
 - b. Second Coat: S-W H&C Concrete Stain Solid Color Water Based, at 50 to 300 sq. ft. per gal (1.2 to 7.4 sq. m per l).
 4. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."
 5. Epoxy and Urethane Coatings: Refer to Section 099600 "High-Performance Coatings."
- D. Metal Substrates (Aluminum, Steel, Galvanized Steel):
1. Latex System:
 - a. Prime Coat: Primer, rust-inhibitive, water based[, **MPI #107**]: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10 mils wet, 2.0 to 4.0 mils dry.
 - b. Intermediate Coat: Water-based acrylic, interior, matching topcoat.
 - c. Topcoat: Water-based acrylic, semi-gloss[, **(Gloss Level 5), MPI #147 X-Green**]: S-W Pro Industrial Acrylic Semi-Gloss Coating, B66-650 Series, at 2.5 to 4.0 mils dry, per coat.
 - d. Topcoat: Water-based acrylic, gloss[, **(Gloss Level 6), MPI #148 X-Green**]: S-W Pro Industrial Acrylic Gloss Coating, B66-660 Series, at 2.5 to 4.0 mils dry, per coat.
 2. Water-Based Dry-Fall System:
 - a. Top Coat: Dry-fall latex, flat[, **MPI #118**]: S-W Pro Industrial Waterborne Acrylic Dryfall Flat, B42-80 Series, at 6.0 mils wet, 1.7 mils dry.
 - b. Top Coat: Dry-fall latex, eggshell[, **MPI #131/155**]: S-W Pro Industrial Waterborne Acrylic DryFall Eg-Shel, B42-2 Series, at 6.0 mils wet, 1.9 mils dry.

- c. Top Coat: Dry-fall latex, semi-gloss[, **MPI #226**]: S-W Pro Industrial Waterborne Acrylic DryFall Semi-Gloss, B42-80 Series, at 5.8 mils wet, 2.3 mils dry.
 3. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer, rust-inhibitive, water based[, **MPI #107**]: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10.0 mils wet, 2.0 to 4.0 mils dry.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell[, (**Gloss Level 3**), **MPI #151**]: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss[, (**Gloss Level 5**), **MPI #153**]: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 4. Two-Component Epoxy and Epoxy High Build Systems: Refer to Section 099600 "High-Performance Coatings."
 5. Acrylic/Alkyd System:
 - a. Prime Coat: S-W Pro Industrial Pro-Cryl Universal Primer, B66-310 Series, at 5.0 to 10.0 mils wet, 2.0 to 4.0 mils dry.
 - b. Intermediate Coat: Water-based acrylic-alkyd, interior, matching topcoat.
 - c. Topcoat: Water-based acrylic-alkyd, semi-gloss, interior: S-W ProMar 200 Waterbased Acrylic-Alkyd Semi-Gloss, B34-8200 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - d. Topcoat: Water-based acrylic-alkyd, gloss, interior: S-W ProMar 200 Waterbased Acrylic-Alkyd Gloss, B35-8200 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
- E. Wood Substrates: Including exposed wood items not indicated to receive shop-applied finish.
 1. Latex System:
 - a. Prime Coat: Primer sealer, latex, interior[, **MPI #39**]: S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils wet, 1.4 mils dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, eggshell[, (**Gloss Level 3**), **MPI #52 X-Green/#145 X-Green**]: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - d. Topcoat: Latex, interior, semi-gloss[, (**Gloss Level 4**), **MPI #43 X-Green**]: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - e. Topcoat: Latex, interior, gloss[, (**Gloss Level 5**), **MPI #54**]: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 2. Acrylic/Alkyd System:
 - a. Prime Coat: Primer sealer, latex, interior: S-W Premium Wall & Wood Primer, B28W8111, at 4.0 mils wet, 1.8 mils dry.

- b. Intermediate Coat: Water-based acrylic-alkyd, interior, matching topcoat.
 - c. Topcoat: Water-based acrylic-alkyd, semi-gloss, interior: S-W ProMar 200 Waterbased Acrylic-Alkyd Semi-Gloss, B34-8200 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - d. Topcoat: Water-based acrylic-alkyd, gloss, interior: S-W ProMar 200 Waterbased Acrylic-Alkyd Gloss, B35-8200 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
3. Water-Based Light Industrial Coating System:
- a. Prime Coat: Primer sealer, latex, interior[, **MPI #39**]: S-W PrepRite ProBlock Primer Sealer, B51-620 Series, at 4.0 mils wet, 1.4 mils dry.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell[, (**Gloss Level 3**), **MPI #151**]: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss[, (**Gloss Level 5**), **MPI #153**]: S-W Pro Industrial Pre-Catalyzed Water Based Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
4. Two-Component Epoxy and Epoxy High Build Systems: Refer to Section 099600 "High-Performance Coatings."
- F. Wood Substrates, Pedestrian Traffic Surfaces:
1. Latex Floor Enamel System:
 - a. First Coat: Floor paint, latex, slip-resistant, matching topcoat.
 - b. Topcoat: Floor paint, latex, slip-resistant, low gloss[, (**maximum Gloss Level 3**), **MPI #60**]: S-W ArmorSeal Tread-Plex, B90 Series, at 1.5 to 2.0 mils dry per coat.
- G. [**Gypsum Board**] [**Plaster**] [**and**] [**Spray-Texture Ceiling**] Substrates:
1. Latex System:
 - a. Prime Coat: Primer, latex, interior[, **MPI #149 X-Green**]: S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
 - b. Intermediate Coat: Latex, interior, matching topcoat.
 - c. Topcoat: Latex, interior, flat[, (**Gloss Level 1**), **MPI #53 X-Green/#143 X-Green**]: S-W ProMar 200 Zero VOC Latex Flat, B30-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - d. Topcoat: Latex, interior, low sheen[, (**Gloss Level 2**), **MPI #44 X-Green/#144 X-Green**]: S-W ProMar 200 Zero VOC Latex Low Sheen Enamel, B24-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.
 - e. Topcoat: Latex, interior, eggshell[, (**Gloss Level 3**), **MPI #52 X-Green/#145 X-Green**]: S-W ProMar 200 Zero VOC Latex Eg-Shel, B20-2600 Series, at 4.0 mils wet, 1.7 mils dry, per coat.
 - f. Topcoat: Latex, interior, semi-gloss[, (**Gloss Level 4**), **MPI #43 X-Green**]: S-W ProMar 200 Zero VOC Latex Semi-Gloss, B31-2600 Series, at 4.0 mils wet, 1.6 mils dry, per coat.

- g. Topcoat: Latex, interior, gloss[, **(Gloss Level 5), MPI #54**]: S-W ProMar 200 Latex Gloss, B11-2200 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
- 2. Water-Based Light Industrial Coating System:
 - a. Prime Coat: Primer sealer, latex, interior[, **MPI #50 X-Green**]: S-W ProMar 200 Zero VOC Latex Primer, B28W2600, at 4.0 mils wet, 1.5 mils dry.
 - b. Intermediate Coat: Light industrial coating, interior, water based, matching topcoat.
 - c. Topcoat: Light industrial coating, interior, water based, eggshell[, **(Gloss Level 3), MPI #151**]: S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy, K45-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - d. Topcoat: Light industrial coating, interior, water based, semi-gloss[, **(Gloss Level 5), MPI #153**]: S-W Pro Industrial Pre-Catalyzed Waterbased Epoxy, K46-151 Series, at 4.0 mils wet, 1.5 mils dry, per coat.
 - 3. Two-Component Epoxy and Epoxy High Build Systems for Non-Traffic Surfaces: Refer to Section 099600 "High-Performance Coatings."

END OF SECTION 099123

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Room-identification signs.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Shop Drawings: For panel signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by others, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.
 - 4. Show locations of electrical service connections.
 - 5. Include diagrams for power, signal, and control wiring.
- C. Samples: For each exposed product and for each color and texture specified.
- D. Sign Schedule: Use same designations specified or indicated on Drawings or in a sign schedule.

1.3 INFORMATIONAL SUBMITTALS

- A. Sample warranty.

1.4 CLOSEOUT SUBMITTALS

- A. Maintenance data.

1.5 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PANEL SIGNS, GENERAL

- A. Regional Materials: Panel signs shall be manufactured within **500 miles (800 km)** of Project site.

2.2 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in Texas Department of Licensing and Regulations – Architectural Barriers Texas Accessibility Standards for signs.

2.3 SIGNS

- 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:

- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated or comparable product by one of the following:

1. Ace Sign Systems, Inc.
2. Advance Corporation; Braille-Tac Division.
3. Allen Industries, Inc.
4. Allen Markings International.
5. APCO Graphics, Inc.
6. ASE, Inc.
7. ASI Sign Systems, Inc.
8. Best Sign Systems Inc.
9. Bunting Graphics, Inc.
10. Clarke Systems.
11. Diskey Sign Company.
12. Fossil Industries, Inc.
13. InPro Corporation.
14. Mohawk Sign Systems.
15. Nelson-Harkins Industries.
16. Poblocki Sign Company, LLC.
17. Seton Identification Products.
18. Supersine Company (The); Division of Stamp-Rite, Inc.
19. Vista System.
20. Vomar Products, Inc.

- C. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:

1. Basis-of-Design Product: Per HAS Standard Signage Package.

2.4 ACCESSORIES

- A. Fasteners and Anchors: Manufacturer's standard as required for secure anchorage of signage, noncorrosive and compatible with each material joined, and complying with the following:
 - 1. Use concealed fasteners and anchors unless indicated to be exposed.
 - 2. For exterior exposure, furnish stainless-steel or hot-dip galvanized devices unless otherwise indicated.
 - 3. Exposed Metal-Fastener Components, General:
 - a. Fabricated from same basic metal and finish of fastened metal unless otherwise indicated.
 - 4. Sign Mounting Fasteners:
 - a. Concealed Studs: Concealed (blind), threaded studs welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
 - b. Projecting Studs: Threaded studs with sleeve spacer, welded or brazed to back of sign material or screwed into back of sign assembly, unless otherwise indicated.
 - c. Through Fasteners: Exposed metal fasteners matching sign finish, with type of head indicated, installed in predrilled holes.
- B. Adhesives: As recommended by sign manufacturer and with a VOC content of 70 g/L or less for adhesives used inside the weatherproofing system and applied on-site when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
- C. Adhesives: As recommended by sign manufacturer and that 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. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch (1.14 mm) thick, with adhesive on both sides.
- E. Bituminous Paint: Cold-applied asphalt emulsion complying with ASTM D 1187.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 2. Provide welds and brazes behind finished surfaces without distorting or discoloring exposed side. Clean exposed welded and brazed connections of flux, and dress exposed and contact surfaces.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Internally brace signs for stability and for securing fasteners.

5. Provide rebates, lugs, and brackets necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.
- B. Surface-Engraved Graphics: Machine engrave characters and other graphic devices into panel surface indicated to produce precisely formed copy, incised to uniform depth.
1. Engraved Metal: Fill engraved graphics with manufacturer's standard baked enamel.
 2. Engraved Opaque Acrylic Sheet: Fill engraved graphics with manufacturer's standard enamel.
 3. Face-Engraved Clear Acrylic Sheet: Fill engraved copy with manufacturer's standard enamel. Apply manufacturer's standard opaque background color coating to back face of acrylic sheet.
 4. Engraved Plastic Laminate: Engrave through exposed face ply of plastic-laminate sheet to expose contrasting core ply.
- C. Subsurface-Applied Graphics: Apply graphics to back face of clear face-sheet material to produce precisely formed image. Image shall be free of rough edges.
- D. Subsurface-Engraved Graphics: Reverse engrave back face of clear face-sheet material. Fill resulting copy with manufacturer's standard enamel. Apply opaque manufacturer's standard background color coating over enamel-filled copy.
- E. Shop- and Subsurface-Applied Vinyl: Align vinyl film in final position and apply to surface. Firmly press film from the middle outward to obtain good bond without blisters or fishmouths.
- F. Brackets: Fabricate brackets, fittings, and hardware for bracket-mounted signs to suit sign construction and mounting conditions indicated. Modify manufacturer's standard brackets as required.
1. Aluminum Brackets: Factory finish brackets with baked-enamel or powder-coat finish to match sign-background color unless otherwise indicated.
 2. Stainless-Steel Brackets: Factory finish brackets to match sign background finish unless otherwise indicated.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.
1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.

4. Corrosion Protection: Coat concealed surfaces of exterior aluminum in contact with grout, concrete, masonry, wood, or dissimilar metals, with a heavy coat of bituminous paint.

B. Mounting Methods:

1. Concealed Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place sign in position and push until flush to surface, embedding studs in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place sign in position and flush to surface, install washers and nuts on studs projecting through opposite side of surface, and tighten.
2. Projecting Studs: Using a template, drill holes in substrate aligning with studs on back of sign. Remove loose debris from hole and substrate surface.
 - a. Masonry Substrates: Fill holes with adhesive. Leave recess space in hole for displaced adhesive. Place spacers on studs, place sign in position, and push until spacers are pinched between sign and substrate, embedding the stud ends in holes. Temporarily support sign in position until adhesive fully sets.
 - b. Thin or Hollow Surfaces: Place spacers on studs, place sign in position with spacers pinched between sign and substrate, and install washers and nuts on stud ends projecting through opposite side of surface, and tighten.
3. Through Fasteners: Drill holes in substrate using predrilled holes in sign as template. Countersink holes in sign if required. Place sign in position and flush to surface. Install through fasteners and tighten.
4. Brackets: Remove loose debris from substrate surface and install backbar or bracket supports in position so that signage is correctly located and aligned.
5. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.
6. Two-Face Tape: Clean bond-breaking materials from substrate surface and remove loose debris. Apply tape strips symmetrically to back of sign and of suitable quantity to support weight of sign without slippage. Keep strips away from edges to prevent visibility at sign edges. Place sign in position, and push to engage tape adhesive.

- C. Remove temporary protective coverings and strippable films as signs are installed.

END OF SECTION 101423

SECTION 102113 - GLASS AND PHENOLIC TOILET COMPARTMENTS

GENERAL

SUMMARY

Work includes toilet compartment partitions, urinal screens, benches in women's restroom and unisex restroom and vanities in all restrooms.

Cubicle/Partition System: Frameless with glass panels.

Type: Overhead braced and floor supported. Patented self closing hardware.

Screens: Frameless glass panels.

Type: Bracket mounted.

REFERENCES

Federal Government Publications:

CARVART® by Soema Handcrafted Technology ® GLASS BOX (Rev. 1/9/16) 10 21 13 - 2 U.S. Architectural & Transportation Barriers Compliance Board. Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG), Washington, DC: GPO, 1991.

U.S. Architectural & Transportation Barriers Compliance Board. Americans with Disabilities Act (ADA), Accessibility Guidelines for Buildings and Facilities (ADAAG), Washington, DC: GPO, 1991.

Federal Specification. FS RR-P-1352C: Partitions, Toilets, Complete, Washington, DC: GSA, 1989.

SUBMITTALS

Manufacturer's Product Data: Provide product data for cubicles and screens indicated. Include material descriptions, color charts, hardware information, construction and anchoring details, component fabrication, and installation requirements.

Shop Drawings: Provide shop drawings indicating fabrication and installation of partition assemblies and screen attachment. Include layout plan, elevations, construction sections, panel details, and required attachment to adjacent construction.

Indicate locations of required reinforcement and cutouts for partition-mounted toilet accessories.

Samples: Submit 4" of glass in material and thickness specified for each color and finish indicated.

Mock-Up: Submit a mock-up of partitions. Include panel type specified, adjustable support legs, overhead stabilizing rail, divider panel connections, hardware, and wall angles.

Maintenance Kit: Provide manufacturer's standard maintenance kit, including special tools for adjusting hardware.

Quantity: One.

QUALITY ASSURANCE

Installer Qualifications: Engage an experienced installer who has been trained to install cubicle systems similar in design and extent to those indicated for this Project and who is acceptable to the cubicle system manufacturer.

Source Limitations: Obtain cubicle systems and screens from a single manufacturer with resources to provide materials of consistent quality in appearance and physical properties without delaying the Work.

DELIVERY, STORAGE, AND HANDLING

Deliver materials to Project site in undamaged condition.

Store and handle cubicle system components and related materials to prevent deterioration or damage due to moisture, temperature changes, contaminants, corrosion, breakage, chipping, or other causes.

PROJECT CONDITIONS

Field Measurements: Verify dimensions in areas of installation by field measurements before fabrication and indicate measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

WARRANTY

Cubicle System and Screen Warranty: Submit a written limited warranty executed by the manufacturer stating that the cubicle systems and screens are free from defects in materials and workmanship and agree to replace cubicle system and screen components that do not retain their original qualities within the specified warranty period.

Warranty Period: 2 years from date of Substantial Completion.

PRODUCTS

PARTITION SYSTEM AND SCREENS

Basis of Design - Product and Manufacturer: GLASS BOX, CARVART® by Soema Handcrafted Technology ®

MANUFACTURERS

Acceptable Manufacturer: CARVART: 1441 Broadway, 28th Floor, New York, NY 10018
Email: info@carvart.com Website: www.carvart.com Phone: 212-675-0030 Fax: 212-675-8175.

Substitutions: Not permitted.

Requests for substitutions will be considered in accordance with provisions of Section 01600.

MATERIALS

Glass 3/8" Low-Iron tempered laminated glass, PVB interlayer opaque with color, color TBD, 3/16" low iron tempered glass/ 3/16" low iron tempered glass.

Material Thickness: 3/8" nominal.

Color and Pattern: To be selected by the Architect from manufacturer's standard selections.

Wall Brackets: Manufacturers standard design for attaching panels and screens to walls and pilasters.

Finish: Clear-anodized, aluminum alloy T60 / 60

Hardware: Manufacturer's standard design, heavy-duty operating hardware.

Top: Doors secured with an automatic Oleo speed adjusting and self-closing shock-absorbing mechanism fitted with an internal 90° door blocking device.

Bottom: Doors secured by a rotating and adjustable pedestal on the floor.

Return Angle: Provide return angle connecting the hinge to both the front pilaster panels and divider panels. Angles shall be adhesive attached and thru-bolted with external rosette.

Door Latch: Ergonomically designed lock with stainless steel mechanism and internal securing lever fit the doors. Lock is completed with free/engaged indication device that can be opened from the outside using a coin or a screwdriver in an emergency.

Feet of the partitions (Box/Cubicles) are rotating and adjustable to secure floor height differences and stability. Feet height: 2 3/8" high

The Partitions are secured together by a top continuous round profile of anodized aluminum alloy T60 / 60, where the self-closing mechanism is secured.

Door Stop: The vertical panel is fitted with a full height profile submitted internally with a seal rubber to regulate the door stopping and prevent friction, for complete privacy

Fasteners: Stainless steel; concealed.

Fittings: Aluminum, clear anodized finish, and nylon.

Overhead Stabilizing Rail: Extruded aluminum connected to divider panels, integral door stop, and divider panels.

Finish: Bead Blasted, anodized.

Floor Support Legs: Extruded aluminum. Adjustable height with friction fit aluminum clamp attached to bottom edge of panels.

Finish: Bead Blasted, anodized.

Fasteners and Anchors: Stainless steel anchors with nylon grommets and aluminum fasteners with theft-resistant-type heads. Provide bolt type for through-bolt applications with external aluminum rosette.

ALUMINUM FINISH

Anodic Finish: Etched, medium matte, clear coating, 0.025 mm nominal thickness, aluminum alloy T60 / 60

FABRICATION

General: Fabricate doors, panels, pilasters, and screens for cubicle panel system. Fabricate panels with drilled holes for locks, accessories, and grab bars, as indicated.

Overhead-Braced-and-Floor-Supported Cubicle System: Provide manufacturer's standard supports and leveling mechanism cubicle panels to suit floor conditions. Install stabilizing rail and brackets to top of cubicle panels.

Wall-Hung Screens: Provide units in sizes indicated of same construction and finish as cubicle panels. Provide screens with angle brackets and through-bolt fastening.

Doors: Provide swinging doors for cubicles. Provide units with clear door opening dimensions required for cubicles indicated to be handicapped accessible.

- Patented self-closing top patch. Adjustable speed. Hold open at 90 degrees for easy of maintenance and cleaning. Doors have a full swing possibility.
- Top: Doors secured with an automatic Oleo speed adjusting and self-closing shock-absorbing mechanism fitted with an internal 90° door blocking device.
- Bottom: Doors secured by a rotating and adjustable pedestal on the floor.

Outward opening doors at accessible compartments shall be provided with a handle on the compartment side of the door.

EXECUTION

INSTALLATION

General: Install cubicle system and screens in accordance with manufacturer's written installation instructions. Install cubicle systems rigid, straight, plumb, and level. Secure units in position with manufacturer's recommended anchoring devices.

Locate wall bracket mounting hardware for mounting holes to occur in masonry or tile joints. Align brackets at pilasters with brackets at walls.

Overhead-Braced-and-Floor-Supported Cubicles: Set floor support legs level and plumb. Secure stabilizing rail to each pilaster. Hang doors and adjust so tops of doors are parallel with overhead rail when doors are in closed position.

Screens: Attach with anchoring devices according to manufacturer's written instructions and to suit supporting structure. Set units level and plumb and to resist lateral impact.

No sight lines into toilet compartments are permitted on the hinge and lock side of each door. Provide clearance of not more than one-quarter inch (1/4") between stiles and panels and three-eighths inch (3/8") between panels and walls.

ADJUSTING AND CLEANING

Hardware: Adjust hardware in accordance with manufacturer's instructions.

Cleaning: Clean cubicle components in accordance with manufacturer's instructions and recommendations.

SECTION 102123 - CUBICLE CURTAINS AND TRACK

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. Cubicle-curtain tracks and carriers.
- 2. Cubicle curtains.

B. Related Requirements:

- 1. Section 061053 "Miscellaneous Rough Carpentry" for supplementary wood framing and blocking for mounting items requiring anchorage.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

- 1. For each type of curtain fabric indicated, include durability, laundry temperature limits, fade resistance, applied curtain treatments, and fire-test-response characteristics.

B. Shop Drawings: For curtains and tracks.

- 1. Show layout and types of cubicles, sizes of curtains, number of carriers, anchorage details, and conditions requiring accessories. Indicate dimensions taken from field measurements.
- 2. Include details of blocking for track support.

C. Samples: For each exposed product and for each color and texture specified, 10 inches (254 mm) in size.

D. Samples for Initial Selection: For each type of curtain material indicated.

E. Samples for Verification: For each type of product required, prepared on Samples of size indicated below:

- 1. Curtain Fabric: Not less than 10 inches (254 mm) square and showing complete pattern repeat, from dye lot used for the Work, with specified treatments applied. Mark top and face of material.
- 2. Mesh Top: Not less than 10 inches (254 mm) square.

3. Curtain Track: Not less than 10 inches (254 mm) long.
4. Curtain Carrier: Full-size unit.

F. Product Schedule: For curtains and tracks. Use same designations indicated on Drawings.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For curtains, tracks, and hardware to include in operation and maintenance manuals.

1.5 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. Curtain Carriers and Track End Caps: Full-size units equal to 3 percent of amount installed for each size indicated, but no fewer than 10 units.
2. Curtains: Full-size units equal to 10 percent of amount installed for each size indicated, but no fewer than two units.

1.6 QUALITY ASSURANCE

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

1. Build mockup of typical cubicle as shown on Drawings.
2. Approval of mockups does not constitute approval of deviations from the Contract Documents contained in mockups unless Architect specifically approves such deviations in writing.
3. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

A. Cubicle Curtains: Provide curtain fabrics with the following characteristics:

1. Laundering: Launderable to a water temperature of not less than 160 deg F (71 deg C).
2. Flame Resistance: Provide fabrics identical to those that have passed NFPA 701 when tested by a qualified testing agency acceptable to authorities having jurisdiction.
 - a. Identify fabrics with appropriate markings of a qualified testing agency.

2.2 CUBICLE-CURTAIN SUPPORT SYSTEMS

- A. Extruded-Aluminum Curtain Track: Not less than 1-1/4 inches wide by 3/4 inch high (32 mm wide by 19 mm high).
 - 1. Track Minimum Wall Thickness: 0.058 inch (1.47 mm) Manufacturer's standard.
 - 2. Curved Track: Factory-fabricated, 12-inch- (305-mm-) radius bends.
 - 3. Finish: Satin anodized.
- B. Curtain Track Accessories: Fabricate splices, end caps, connectors, end stops, coupling and joining sleeves, wall flanges, brackets, ceiling clips, and other accessories from same material and with same finish as track.
 - 1. Suspended-Track Support: Not less than 5/8-inch- (16-mm-) square tube.
 - 2. End Stop: Removable with carrier hook.
 - 3. Switch Unit: Shuttle and coupling device for rerouting and securing cubicle curtain, with pull chain for switching track.
- C. Curtain Roller Carriers: Two nylon rollers and nylon axle with chrome-plated steel hook.
- D. Curtain Glide Carriers: One-piece nylon glide with chrome-plated steel hook.
- E. Breakaway Curtain Carriers: One-piece nylon breakaway curtain carriers designed to allow curtains to detach from tracks with a pulling force of no more than 5 lbf (22.2 N).
- F. Exposed Fasteners: Stainless steel.
- G. Concealed Fasteners: Stainless steel.

2.3 CURTAINS

- A. Fabric: Curtain manufacturer's standard, 100 percent polyester; inherently and permanently flame resistant, stain resistant, and antimicrobial.
 - 1. Pattern: RE: A0.20
 - 2. Width: RE: A0.20
 - 3. Color: RE: A0.20
- B. Curtain Grommets: Two-piece, rolled-edge, rustproof, nickel-plated brass; spaced not more than 6 inches (152 mm) o.c.; machined into top hem.
- C. Mesh Top: Not less than 20-inch- (508-mm-) high mesh top.
 - 1. Mesh: No. 50 nylon mesh.
- D. Beaded-Chain Curtain Drop: 6 inches (152 mm) long; nickel-plated steel with aluminum hook.
- E. PVC-Strip Curtain Drop: 16 inches (406 mm) long with chrome-plated steel hook.
- F. Snap Attachments: Provide manufacturer's standard nickel-plated brass snap attachments for modular panels.

- G. Curtain Tieback: Nickel-plated brass chain; one at each curtain termination.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install tracks level and plumb, according to manufacturer's written instructions.
- B. For tracks of up to **20 feet (6.0 m)** in length, provide track fabricated from single, continuous length.
 - 1. Curtain-Track Mounting: As indicated on Drawings.
- C. Surface-Track Mounting: Fasten tracks to ceilings at intervals recommended by manufacturer. Fasten tracks to structure at each splice and tangent point of each corner. Center fasteners in track to ensure unencumbered carrier operation. Attach track to ceiling as follows:
 - 1. Mechanically fasten directly to bottom of concrete deck with post-installed anchors.
 - 2. Mechanically fasten directly to finished ceiling with toggle bolts.
 - 3. Mechanically fasten to furring through suspended ceiling with screw and tube spacer.
 - 4. Mechanically fasten to suspended ceiling grid with screws.
 - 5. Attach track to suspended ceiling grid with manufacturer's proprietary clip.
- D. Suspended-Track Mounting: Install track with manufacturer's standard tubular aluminum suspended supports at intervals and with fasteners recommended by manufacturer. Fasten supports to structure. Provide supports at each splice and tangent point of each corner. Secure ends of track to wall with flanged fittings or brackets.
- E. Track Accessories: Install splices, end caps, connectors, end stops, coupling and joining sleeves, and other accessories as required for a secure and operational installation.
 - 1. Provide one locking switch unit for each pair of beds.
- F. Curtain Carriers: Provide curtain carriers adequate for **6-inch (152-mm)** spacing along full length of curtain plus an additional carrier.
- G. Cubicle Curtains: Hang curtains on each curtain track.

END OF SECTION 102123

SECTION 102800 - TOILET, BATH, AND LAUNDRY ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Public-use washroom accessories.
2. Public-use shower room accessories.
3. Underlavatory guards.
4. Custodial accessories.

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 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.

1.6 WARRANTY

A. Special Mirror Warranty: Manufacturer's standard form in which manufacturer agrees to replace mirrors that develop visible silver spoilage defects and that fail in materials or workmanship within specified warranty period.

1. Warranty Period: 15 years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PUBLIC-USE WASHROOM ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product 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. Accessory Schedule: Refer to architectural drawings for toilet accessory schedules.

2.2 UNDERLAVATORY GUARDS

- 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:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product by one of the following:
 - 1. Plumberex Specialty Products, Inc.
 - 2. Truebro by IPS Corporation.
- C. Underlavatory Guard:
 - 1. Description: Insulating pipe covering for supply and drain piping assemblies that prevent direct contact with and burns from piping; allow service access without removing coverings.
 - 2. Material and Finish: Antimicrobial, molded plastic, white.

2.3 CUSTODIAL ACCESSORIES

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis-of-Design Product: Subject to compliance with requirements, provide product indicated on Drawings or comparable product 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. Accessory Schedule: Refer to architectural drawings for toilet accessory schedule.

2.4 FABRICATION

- A. Keys: Provide universal keys for internal access to accessories for servicing and resupplying. Provide minimum of six keys to Owner's representative.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install accessories according to manufacturers' written instructions, using fasteners appropriate to substrate indicated and recommended by unit manufacturer. Install units level, plumb, and firmly anchored in locations and at heights indicated.
- B. Grab Bars: Install to withstand a downward load of at least 250 lbf (1112 N), when tested according to ASTM F 446.

END OF SECTION 102800

SECTION 123661.19 - QUARTZ AGGLOMERATE COUNTERTOPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section Includes:

- 1. Quartz agglomerate countertops.

- B. Related Requirements:

- 1. Section 224100 "Residential Plumbing Fixtures" for sinks and plumbing fittings.

1.3 ACTION SUBMITTALS

- A. Product Data: For countertop materials.

- B. Shop Drawings: For countertops. Show materials, finishes, edge and backsplash profiles, methods of joining, and cutouts for plumbing fixtures.

- 1. Show locations and details of joints.
 - 2. Show direction of directional pattern, if any.

- C. Samples for Initial Selection: For each type of material exposed to view.

- D. Samples for Verification: For the following products:

- 1. Countertop material, 6 inches (150 mm) square.

1.4 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For fabricator.

1.5 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For quartz agglomerate countertops to include in maintenance manuals. Include Product Data for care products used or recommended by Installer and names, addresses, and telephone numbers of local sources for products.

1.6 QUALITY ASSURANCE

- A. Fabricator Qualifications: Shop that employs skilled workers who custom-fabricate countertops similar to that required for this Project, and whose products have a record of successful in-service performance.
- B. Installer Qualifications: Fabricator of countertops.
- C. Mockups: Build mockups to demonstrate aesthetic effects and to set quality standards for fabrication and execution.
 - 1. Build mockup of typical countertop as shown on Drawings.
 - 2. Subject to compliance with requirements, approved mockups may become part of the completed Work if undisturbed at time of Substantial Completion.

1.7 FIELD CONDITIONS

- A. Field Measurements: Verify dimensions of countertops by field measurements after base cabinets are installed but before countertop fabrication is complete.

1.8 COORDINATION

- A. Coordinate locations of utilities that will penetrate countertops or backsplashes.

PART 2 - PRODUCTS

2.1 QUARTZ AGGLOMERATE COUNTERTOP MATERIALS

- A. Quartz Agglomerate: Solid sheets consisting of quartz aggregates bound together with a matrix of filled plastic resin and complying with ICPA SS-1, except for composition.
 - 1. Basis of design Product: Subject to compliance with requirements, provide Wilsonart; Wilsonart Quartz or a comparable product by one of the following:
 - a. Cosentino USA.
 - b. LG Hausys American, Inc.
 - 2. Colors and Patterns: match Architect's samples
- B. Particleboard: ANSI A208.1, Grade M-2.
- C. Plywood: Exterior softwood plywood complying with DOC PS 1, Grade C-C Plugged, touch sanded.

2.2 COUNTERTOP FABRICATION

- A. Fabricate countertops according to quartz agglomerate manufacturer's written instructions and the AWI/AWMAC/WI's "Architectural Woodwork Standards."
 - 1. Grade: Premium.
- B. Configuration:
 - 1. Front: Straight, slightly eased at top
 - 2. Backsplash: Straight, slightly eased at corner.
 - 3. End Splash: Matching backsplash.
- C. Countertops: 3cm thick, quartz agglomerate
- D. Fabricate tops with shop-applied edges and backsplashes unless otherwise indicated. Comply with quartz agglomerate manufacturer's written instructions for adhesives, sealers, fabrication, and finishing.
 - 1. Fabricate with loose backsplashes for field assembly.
- E. Joints: Fabricate countertops without joints.
- F. Joints: Fabricate countertops in sections for joining in field, with joints at locations indicated.
 - 1. Joint Locations: Not within 18 inches (450 mm) of a sink or cooktop and not where a countertop section less than 36 inches (900 mm) long would result, unless unavoidable.
 - 2. Joint Type: Bonded, 1/32 inch (0.8 mm) or less in width.
 - 3. Joint Type: Grouted, 1/16 inch (1.5 mm) in width.
 - 4. Joint Type: Sealant filled, 1/16 inch (1.5 mm) in width.
 - 5. Splined Joints: Accurately cut kerfs in edges at joints for insertion of metal splines to maintain alignment of surfaces at joints. Make width of cuts slightly more than thickness of splines to provide snug fit. Provide at least three splines in each joint.
- G. Cutouts and Holes:
 - 1. Undercounter Plumbing Fixtures: Make cutouts for fixtures in shop using template or pattern furnished by fixture manufacturer. Form cutouts to smooth, even curves.
 - a. Provide vertical edges, slightly eased at juncture of cutout edges with top and bottom surfaces of countertop and projecting 3/16 inch (5 mm) into fixture opening.
 - b. Provide vertical edges, rounded to 3/8-inch (10-mm) radius at juncture of cutout edges with top surface of countertop, slightly eased at bottom, and projecting 3/16 inch (5 mm) into fixture opening.
 - c. Provide 3/4-inch (20-mm) full bullnose edges projecting 3/8 inch (10 mm) into fixture opening.
 - 2. Counter-Mounted Plumbing Fixtures: Prepare countertops in shop for field cutting openings for counter-mounted fixtures. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

3. Fittings: Drill countertops in shop for plumbing fittings, undercounter soap dispensers, and similar items.
4. Counter-Mounted Cooktops: Prepare countertops in shop for field cutting openings for cooktops. Mark tops for cutouts and drill holes at corners of cutout locations. Make corner holes of largest radius practical.

2.3 INSTALLATION MATERIALS

- A. Adhesive: Product recommended by quartz agglomerate manufacturer.
 1. Basis of Design Product: Wilsonart Hard Surface Adhesive.
 2. Adhesive shall have a VOC content of 70 g/L or less.
- B. Sealant for Countertops: Comply with applicable requirements in Section 079200 "Joint Sealants."

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive quartz agglomerate countertops and conditions under which countertops will be installed, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of countertops.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install countertops level to a tolerance of 1/8 inch in 8 feet (3 mm in 2.4 m), 1/4 inch (6 mm) maximum. Do not exceed 1/64-inch (0.4-mm) difference between planes of adjacent units.
- B. Fasten countertops by screwing through corner blocks of base units into underside of countertop. Pre-drill holes for screws as recommended by manufacturer. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- C. Fasten subtops to cabinets by screwing through subtops into cornerblocks of base cabinets. Shim as needed to align subtops in a level plane.
- D. Secure countertops to subtops with adhesive according to quartz agglomerate manufacturer's written instructions. Align adjacent surfaces and, using adhesive in color to match countertop, form seams to comply with quartz agglomerate manufacturer's written instructions. Carefully dress joints smooth, remove surface scratches, and clean entire surface.
- E. Bond joints with adhesive and draw tight as countertops are set. Mask areas of countertops adjacent to joints to prevent adhesive smears.

1. Install metal splines in kerfs in countertop edges at joints where indicated. Fill kerfs with adhesive before inserting splines and remove excess immediately after adjoining units are drawn into position.
 2. Clamp units to temporary bracing, supports, or each other to ensure that countertops are properly aligned and joints are of specified width.
- F. Install backsplashes and end splashes by adhering to wall and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears.
- G. Install aprons to backing and countertops with adhesive. Mask areas of countertops and splashes adjacent to joints to prevent adhesive smears. Fasten by screwing through backing. Pre-drill holes for screws as recommended by manufacturer.
- H. Complete cutouts not finished in shop. Mask areas of countertops adjacent to cutouts to prevent damage while cutting. Make cutouts to accurately fit items to be installed, and at right angles to finished surfaces unless beveling is required for clearance. Ease edges slightly to prevent snipping.
1. Seal edges of cutouts in particleboard subtops by saturating with varnish.
- I. Apply sealant to gaps at walls; comply with Section 079200 "Joint Sealants."

END OF SECTION 123661.19

SECTION 22 05 23

VALVES, COCKS AND SPECIALTIES FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Furnish and install valves, cocks and specialties as indicated on drawings or specified herein.
- B. Valves, cocks and specialties may not be indicated in every instance on the drawings, but whether or not shown, all valves, cocks and check valves necessary to the proper operation of the system shall be furnished and installed by subcontractor in an approved manner and location. Pressure ratings given for valves are steam working pressure. Valves shall have rising stems except in locations where space is limited; in these locations non-rising stem valves of equal material and pressure class will be accepted.
- C. Alternates may or may not substantially change scope and general character of the work; and must not be confused with "change orders", "substitutions", and other similar provisions.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

- A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 WATER MAIN VALVES

- A. Water main valves are to be AWWA approved, gate valve, double disc, iron body, bronze trim, non-rising stem, flanged end, with 2" square wrench nut. Valve boxes

VALVES, COCKS AND SPECIALTIES FOR PLUMBING SYSTEMS

are to be cast iron adjustable type for top flush with ground surface. Furnish a box for each underground valve shown on drawings.

<u>Valves</u>	<u>Valve Boxes</u>
Mueller No. A2380-6	Alabama Pipe Co. E2602
Stockham Fig. G-612	James B. Clow F2450
Nibco F-619	Mueller H10360

2.2 BALL VALVES

- A. 2-1/2- inches and smaller: Threaded or soldered ends, port area equal to or greater than connecting pipe diameter, class 125, two piece bronze body, chrome plated bronze ball, blow-out proof bronze stem, teflon seat and seals.

<u>Threaded Pattern</u>	<u>Soldered Pattern</u>
Apollo Valves 70LF-100	70LF-200
Nibco T-585-70	S-585-70
Stockham LF-T-255-FB-P	LF-S-255-FB-P

2.3 GATE VALVES (THREADED)

- A. 3" and smaller threaded valves and 4" and smaller solder pattern valves, rising stem, iron wheel, rough brass body, solid wedge disc, screwed or union bonnet and finished gland nut - 150 psi class.

<u>Threaded Pattern</u>	<u>Soldered Pattern</u>
Crane 431	---
Powell 514S	1842S
Walworth 56	---
Lunkenheimer 2151	3150
Stockham B-122	B-124

2.4 GATE VALVES (FLANGED)

- A. 3-1/2" and larger; except for solder valves as noted above shall be flanged type with cast iron body, brass trim, brass seats, rising stem and iron wheel - 125 psi class.

<u>Flanged Pattern</u>
Crane 465-1/2
Powell 1793
Walworth 726F
Lunkenheimer 1430
Stockham G-623
or approved equivalent

2.5 CHECK VALVES (SWING)

- A. Check valves 3" and smaller shall have a pressure rating of not less than 200 psi threaded pattern and 125 psi solder pattern, wye pattern swing check with rough brass body, finished gland nut and regrinding bronze disc.
- B. Check valves larger than 3" shall be flanged pattern, 125 psi iron body swing check with renewable brass seat, disc and trim. Check valves on primary heating hot water or chilled water piping system shall be 200 psi WP brass or ferosteel body swing check valves, with renewable brass seat, disc and trim.

	Flanged Pattern	
	125 psi	200 psi
Crane	373	39E
Powell	559	576
Walworth	M-928F	M-970F
Lunkenheimer	1790	323
Stockham	G-931	---

2.6 CHECK VALVES (WAFER)

- A. Check valves 3" and larger flanged pattern shall have a pressure rating of 125 psi, globe type body, semm. steel body, stainless steel spring, bronze disc and bronze seat ring.

Williams-Hager	Figure 636
APCO	Series 600
Mueller	Nos. 105, 107, 109 and 113
Metraflex	Series 900

- B. Check valves on primary hot water piping systems shall be 200 psi, globe type body, semi steel body, stainless steel spring, bronze disc and bronze seat.

2.7 COCKS

- A. Provide tight shut off balancing cocks at locations indicated on drawings.
- B. Cocks 2" and smaller, square head bronze cocks 125 psi class with check.
 - Crane 254
 - Powell 955
 - Walworth 554
 - Lunkenheimer 454,
 - or approved equal
- C. Cocks over 2", lubricated plug valves with semi-steel body 175 psi class.

<u>Screwed 2" and 3"</u>	<u>Flanged 4" and over</u>
Powell F 2200	Powell F 2201
Walworth 1700	Walworth 1700F
ACF R 1430	ACF R 1431
or approved equivalent	

- D. Lubricated plug cocks over 6" shall have a geared or worm drive operator.
- E. Lubricated plug cocks may be used in lieu of globe or gate valves on heating hot water or chilled water steel piping systems to facilitate installation of insulation. All 6" or smaller chilled water piping valves located above finished ceilings (unless located over drip pan), or below ceiling in a finished area of the building shall be lubricated plug cocks. Provide handle or operator for each valve.

2.8 BACK FLOW PREVENTER (REDUCED PRESSURE)

- A. 3/4" to 4" size; ASSE Std. 1013, AWWA Std. C-506; unit shall have all bronze construction, stainless steel internal parts, test cocks and suitable for 175 psi supply water pressure. Unit shall be furnished with factory mounted bronze inlet strainer, union and non-rising stem gate valves (on inlet and outlet). Watts Series 900 Beeco or approved equal.
- B. 4" to 6" size; ASSE Std. 1013, AWWA Std. C-506; unit shall have iron body construction, epoxy coated internal water way, stainless steel internal parts, test cocks and stainless steel bolts. Unit shall be furnished with inlet strainer and non-rising stem gate valves (on inlet and outlet). Watts Series 900 Beeco or approved equal.

2.9 BACK FLOW PREVENTER (DOUBLE CHECK VALVE)

- A. 3/4" to 2"; ASSE Std 1015, AWWA Std. C-506; unit shall have bronze body, stainless steel internal parts, test cocks and rubber seating check valves. Unit shall be furnished with factory mounted bronze inlet strainer, union, and non-rising stem gate valves (on inlet or outlet). Watts Series 700 Beeco, or approved equal.
- B. 2-1/2" and 3"; ASSE Std. 1015, AWWA Std. C-506; unit shall have iron body, stainless steel internal parts, test cocks, and rubber seating check valves. Unit shall be furnished with flanged ends, factory mounted inlet strainer, union, stainless steel bolts and non-rising stem gate valves (on inlet and outlet). Watts Series 700 Beeco or approved equal.

2.10 DIELECTRIC UNIONS

- A. Epcos Sales, Inc., 3204 Sackett Avenue, Cleveland, Ohio; Capitol Manufacturing & Supply Company, Columbus; Patrol Valve Company, Cleveland, Ohio, or approved equal.

2.11 FLEXIBLE METAL HOSE

- A. American Brass Co., Mason Industries, Chicago Metal Hose Co., or approved equal, 300 psig WP design flexible metal hose constructed of brass with brass wire braid covering.

2.12 FLEXIBLE PLASTIC PIPE JOINTS

- A. Resist-O-Flex Co., Mercer Rubber Co., La Favorite Co., or approved equal, multiple bellows, guides, and restraining bolts or blocking. Joints shall be rated at 150 psig and 220°F continuous service.

2.13 STEEL PIPING SYSTEM STRAINERS

- A. Malleable or cast iron, 125 psig working pressure. Free area of strainer - not less than 300 per cent cross sectional area of pipe. Strainer mesh, perforation size, and pattern as follows:

<u>Pipe Size</u>	<u>Pattern</u>	<u>Mesh or Perforation Diameter</u>
to 2 in.	threaded wye	20 mesh
2 to 4 in.	threaded wye	0.045 inch dia.
5 to 10 in.	flanged wye	0.125 inch dia.
12 in. up	flanged basket	0.125 inch dia.

2.14 COPPER PIPING SYSTEM STRAINERS

- A. Copper piping system strainers solder pattern with removable bolted flange on strainer leg. Strainer 40 mesh bronze screen, with free area of screen at least 3 times cross sectional area of pipe.

2.15 ACCESS PANELS

- A. Access panels (Milcor) Inland-Ryerson Construction Products Co., (Boico) Birmingham Ornamental Iron Co., or approved equal. Steel panels and frames shall be furnished with prime coat of rust inhibitor enamel. See plans for sizes (12 x 12 min.). Access panel styles as follows:

Milco

Boico

Fire rated 1-1/2 hr. B. Label 1-1/2 hr. B. Label

2.16 SAFETY VALVES

- A. Safety Valves to be Manning, Maxwell & Moore, Watts Regulator, or Bell & Gossett Co., ASME rated as shown on the drawings and/or required by applicable codes.

- B. Refrigerant Safety Valves in accordance with USASI Code for refrigeration apparatus, and pipe discharge outside building.
- C. Protect water heaters with Watts, Beaton Cadwell or McDonnell Miller, combination automatic temperature and pressure relief valves (with manual lift lever). Relief capacity shall exceed input energy at 125 psig pressure and 210°F temperature.

2.17 AUTOMATIC AIR VENTS (AAV)

- A. Automatic Air Vents to be equal to:

<u>(150 psig W.P)</u>	<u>(75 psig W.P)</u>
Metraflex MV-15	Maid-O-Mist 7
Crane Co. 976	Bell & Gossett 7
Sarco 13W	Hoffman 79
Armstrong 1AV	

2.18 MANUAL AIR VENTS (MAV)

- A. Manual air vents shall be brass manual cock equal to Crane 700 series.

2.19 WATER HAMMER ARRESTERS

- A. Water hammer arresters (shock stops) shall be equal to those manufactured by Josam Manufacturing Company, Zurn Industries, Inc., Wade, Inc., MIFAB or Jay R. Smith Manufacturing Company.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install valves and cocks in horizontal piping with the valve stem in the vertical upright position.
- B. Install valves and cocks to provide adequate clearance to permit easy operation of the valve hand wheel and permit servicing of the valve packing.

*

- C. Provide blow down valve on 1-1/2" and larger strainers (except refrigerant piping). Use valve not less than 1/2 strainer blow down outlet size.

3.2 ACCESS PANELS

- A. Furnish adequate number of properly sized access panels (12" x 12" minimum size) to adequately service and maintain systems installed under each section of specifications.
- B. Access panels shall be installed and painted under other divisions of these specifications. Exact panel location shall be designated by the subcontractor performing the work of this Section.
- C. Access panels are not required in exposed grid or other types of readily removable ceilings.
- D. Access panels shall not compromise the fire rating of the wall.

3.3 SAFETY VALVES

- A. Safety valves to have valve spindle enclosure with gland seal to minimize leakage and manual lift lever to check discharge required. Cut discharge pipe from safety valve on a 45 degree angle, pipe to floor and direct toward or into floor drain (unless noted otherwise on the drawings).

3.4 AUTOMATIC AIR VENTS

- A. Install automatic air vents with inlet isolation cock at locations indicated on drawings and at high points of hot and chilled water piping systems. Pipe vent discharge to drain pan, plumbing trap or to outside of building.

3.5 WATER HAMMER ARRESTERS

- A. Install water hammer arresters (shock stops) at the locations indicated on the plans and in accordance with size and placement recommendations given in Plumbing and Drainage Institute Standard PDI-WH201.

3.6 BACKFLOW PREVENTERS

- A. Water service back flow preventers shall be installed above grade and in such a manner to prevent the discharge relief opening from becoming submerged by ground water. Provide suitable protection to prevent assembly from freezing.

END OF SECTION 22 05 23

SECTION 22 07 00

INSULATION FOR PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification Sections, apply to work of this section.

1.2 SCOPE

- A. Above grade domestic hot water supply and recirculating piping.
- B. Below grade domestic hot water supply and recirculating piping.
- C. Above grade waste lines and trap from ice machines and waste lines receiving condensate from air conditioning units to a point of connection to a soil line receiving waste from 4 or more plumbing fixtures.
- D. Interior storm water piping.
- E. Above grade domestic cold water piping in vented attic, vented ceiling spaces and vented soffits with 3/4" fiberglass and all service jacket.
- F. Above grade exterior domestic cold water piping.
- G. Handicap lavatory exposed hot water and waste piping.
- H. Above grade fire protection piping in vented attic, vented ceiling spaces and vented soffits with 3/4" fiberglass and all service jacket.
- I. Above grade domestic chilled water piping.
- J. Below grade domestic chilled water piping.
- K. Domestic water chilled evaporator, chilled water compression or expansion tank; and other cold surfaces with operating temperatures of less than 70 degrees F.
- L. Domestic chilled water pumps.
- M. Above grade water piping exposed in unheated areas.
- N. Alternates may or may not substantially change scope and general character of the

work; and must not be confused with "change orders", "substitutions", and other similar provisions.

1.3 RELATION TO OTHER WORK

A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials listed in subsequent paragraphs of this specification are those used as basis of design; alternate manufacturer's equivalent projects as listed herein will be accepted. The insulation contractor shall verify materials and comply with requirements of NFPA 90, with regard to a flame spread rating of 25 or less and; a smoke developed/fuel contributed value of less than 50.

2.2 MATERIALS

A. Insulation and accessory materials to be as manufactured by the listed manufacturers or approved equal:

1. Calcium Silicate: Owens Corning "Kaylo", Manville "Thermo-12".
2. Fiberglass: Owens Corning, Knauf, CertainTeed, or Manville.
3. Foamed Plastic Insulation: Armstrong "Armaflex", U.S. Rubber "Ensolex", Gustin Bacon "Ultra-Foam", Owens Corning "O-C" Halstead Industrial Products, or approved equal.
4. Cellular Glass: Fed. Spec. HH-I-551a.
5. Extruded Polyethylene Insulation: Nomaco Inc. "Thermacell, Sentinel Energy Savings Products Division of Packaging Energy Groups, Inc., "Senflex" or approved equal.
6. Insulating Finish Cement: JM No. 301, BH Improved Super Powerhouse Cement, The Ruberoid Co., No. 412, or approved equal.
7. Mastics, Sealers and Adhesives:

	Benjamin <u>Foster</u>	<u>Insulcoustic</u>	<u>Childers</u>	<u>J-M</u>
Cellular glass	30-45	40-10	CP-70	

bedding mastic

General purpose 35-00 Series Vi AC Mastic CP-10 375
mastic

Vapor barrier 30-35 IC-501 CP-30
sealant (indoor)

Adhesive 85-20 CP-89

Fire retardant 60-35 IC-531
sealer (outdoor)

Foamed Plastic 57
& Adhesive

Extruded Poly- Therma-Cel 950 Adhesive
ethylene

8. Pipe Jacketing and Valve Covers (Ultra Violet Resistant): Zeston PVC, CEEL-Tite, Proto Corp. (Lo Smoke), or approved equal.
9. Metal Jacketing and Fitting Cover: Aluminum 0.016 gage (minimum) smooth or corrugated, Childers Products Co., General Aluminum Supply Co. (Gasco), Alcorjac by Insulcoustic Co., or approved equal.
10. Molded Fiberglass Fitting Insulation: Molded Acoustical Products, Inc., West Easton, PA, 18042 or approved equal.

PART 3 - EXECUTION

3.1 GENERAL

- A. Insulation is not to be installed until the piping systems have been checked and found free of all leaks. Surfaces shall be clean and dry before attempting to apply insulation. A professional insulator with adequate experience and ability shall install insulation.
- B. Provide hanger or pipe support shields of 16 gage (minimum) galvanized steel over or embedded in the insulation. Shield shall extend halfway up the pipe insulation cover and at least 6" on each side of the hanger. Securely fasten shield with pipe straps at each end. Insulate pipe anchors adequately to prevent moisture condensation problems.
- C. Insulation installed in exposed locations such as water heater rooms, equipment rooms, air handling unit rooms, all exterior above grade areas, kitchens, laundries,

power houses, utility buildings, energy building or similarly identified locations where the insulation would be subject to physical damage shall be covered with metal jacketing. Elbows may be covered with fire rated and ozone resistant (for exterior locations) PVC covers in lieu of metal jacket.

3.2 WARM OR HOT SURFACES

- A. Insulate interior warm or hot surfaces with an operating temperature of over 120 degrees F and less than 400 degrees.
- B. These surfaces include hot water storage heater.
- C. Insulate with 1-1/2" thick calcium silicate blocks, securely wired on and covered with poultry wire. Apply a finish coat of 1/2" insulating finish cement over the poultry wire. Trowel the exterior smooth.
- D. Insulate hot surfaces operating at over 100 degrees F temperature with 3/4" V-rib spacing lath and 1-1/2" molded 85% magnesia or calcium silicate blocks wired on over the spacing lath. Apply poultry wire over the magnesia blocks and give a 1/2" coat of insulating finish cement. Trowel the exterior smooth.

3.3 EMERGENCY GENERATOR MUFFLER AND EXHAUST PIPING

- A. Shall be insulated with two 1-1/2" layers of calcium silicate block insulation. All joints shall be staggered and the blocks shall be installed with corrosive resistance stainless steel tie wires. The insulation shall be finished with a skim coat of Johns-Manville hydraulic setting insulation cement and covered with a layer of Underwriters grade cloth. The cloth shall be sized with Foster's 30-36 fire retardant coating or equal.

3.4 COLD SURFACES

- A. Cold surfaces with operating temperatures below 70 degrees F to be insulated with 1" thickness foamed plastic or extruded polyethylene insulation. Surfaces include, but not limited to, domestic water chiller, domestic chilled water air separator, domestic chilled water expansion tank, domestic chilled water pump, and refrigerant suction line intercooler. The foamed plastic sheets shall be applied over a heavy coating of Johns-Manville #57 adhesive. The insulation shall be finished with a heavy coat of white aerotube finish.

3.5 CONDENSATE PIPING FROM ICE MACHINES

- A. Insulate condensate piping and waste lines from ice machines with foamed plastic insulation or extruded polyethylene, one-half inch thickness.
- B. Mitre cut insulation to fit the pipe fittings. Use approved cement to seal all joints,

seams, and ends in the insulation.

3.6 HORIZONTAL RAIN WATER PIPING

- A. Shall be insulated with 1/2" thickness fiberglass pipe insulation. Prior to installing with insulation the pressure release paper shall be removed from the jacket laps. Pipe insulation shall be secured in place by applying pressure to the pressure sensitive closure system. Elbows shall be insulated with fiberglass inserted into 25/50 rated PVC (Aluminum) fitting covers.
- B. Insulation shall begin at the base of roof drain body and include piping elbows at change of directions from vertical to horizontal.

3.7 HORIZONTAL WASTE PIPING RECEIVING AIR-CONDITIONING CONDENSATE

- A. Shall be insulated with 1" thickness AP-T fiberglass pipe insulation. Prior to installing with insulation, the pressure release paper shall be removed from the jacket laps. The insulation shall be secured in place by applying pressure to the pressure sensitive closure system. All fittings shall be insulated with pipe insulation segments and finished with Foster's 30-35 vapor barrier coating or equal, reinforced with white open weave glass fabric.

3.8 DOMESTIC CHILLED WATER PIPING

- A. Insulate domestic chilled water piping as described in these paragraphs with cellular glass. (Cellular glass with a factory applied glassfab jacket is acceptable.) Mitre cut insulation and carefully fit to the pipe fittings. Piping 6 inch and smaller, use 1-1/2" thickness insulation; piping over 6 inch diameter, use 2" thickness insulation. All cellular glass shall be shop bore-coated with Keen's cement prior to shipment to the job site. All pipe insulation joints shall be buttered with Foster's GPM 3500 or equal. The insulation sections shall be wired in place with 16 gauge copper or stainless steel wires spaced approximately 9" on center. Valves and fittings shall be insulated with prefabricated or pre-formed sections of cellular glass insulation and finished the same as adjacent piping.
- B. Finish cellular glass insulation in concealed locations by applying a heavy coat of Foster's GPM 3500 vapor barrier sealant to the exterior surface of the cellular glass. Embed a layer of open weave glass fabric cloth in this sealant overlapping seams at least 2". Apply a finish coat of Foster's GPM 3500 and finish as smooth as possible. Note: Two coats of sealer will be required where factory applied glassfab jacket is used.
- C. Finish cellular glass in exposed interior locations such as air handling unit equipment rooms, boiler rooms, and chiller room as follows:
 - 1. Straight runs of 2" piping and larger - cover with 0.016" thickness smooth

aluminum weatherproof jacket with factory applied integral vapor barrier. Piping 2" and smaller - 0.010" thickness aluminum jacket with integral vapor barrier. Seal joints to preserve integrity of vapor barrier. Fasten jacket with 1/2" wide aluminum bands on not over 12" centers. Elbows, tees, reducers, valves and other special fittings - use prefab jacket.

3.9 UNDERGROUND PIPING

- A. Insulate all underground domestic hot and chilled water piping with 1-1/2" thickness cellular glass preformed split sectioned pipe insulation.
- B. Mitre cut insulation and carefully fit to the pipe fittings. All cellular glass to be shop bore-coated with Keen's cement prior to shipment to the job site. Apply cellular glass bedding mastic to all edges of the cellular glass insulation to fill any voids between joints in the insulation.
- C. Wire the Cellular glass in place with stainless steel or copper wire 9" on centers. Expansion joints in the insulation with 1/4" clearance shall be made 10' on centers. The expansion joints shall be filled with asphalt impregnated felt and covered with the jacket.
- D. Apply a heavy coat of vapor barrier sealant to outside of the cellular glass and embed a layer of open mesh glass fabric cloth into the mastic; carefully apply the cloth smoothly and overlap all transverse and longitudinal joints at least 2". Apply a second heavy and final coat of mastic over the cloth and finish to a reasonably smooth surface.
- E. All legs of underground expansion loops and expansion ells shall be additionally covered with 2" thickness fiberglass 7-1/4 pounds per cubic foot density fiberglass pipe insulation applied under the cellular glass and under the glass fabric.

3.10 ABOVE GROUND DOMESTIC COLD WATER, DOMESTIC HOT WATER AND DOMESTIC HOT WATER RECIRCULATION PIPING

- A. Shall be insulated with ASJ fiberglass pipe insulation. Prior to installing the insulation, the pressure release paper shall be removed from the jacket laps. The insulation shall be secured in place by applying pressure to the pressure sensitive closure system. All fittings shall be insulated with molded fiberglass pipe insulation segments and finished with Foster's 30-35 vapor barrier coating or equal, reinforced with a layer of white open weave glass fabric.
- B. Main pipe sizes 2-1/2" and smaller shall have 1" thickness insulation unless noted on the drawings.

- C. Pipe sizes 2-1/2" and larger shall have 1-1/2" thickness insulation.
- D. Branch runouts up to 2" shall have 1/2" thickness insulation.

3.11 HANDICAP LAVATORY EXPOSED HOT WATER AND WASTE PIPING

- A. Shall be insulated with foamed plastic insulation or extruded polyethylene, one-half inch thickness.
- B. Mitre cut insulation to fit the pipe, fittings and stops.
- C. Use approved cement to seal all joints, seams, and end in the insulation.

END OF SECTION 22 07 00

SECTION 22 11 13

WATER DISTRIBUTION PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section specifies the water distribution piping system, including potable cold, hot, and recirculated hot water piping, fittings, and specialties within the building to a point 5 feet outside the building.

1.3 DEFINITIONS

- A. Water Distribution Piping: A pipe within the building or on the premises which conveys water from the water service pipe or meter to the points of usage.
- B. Water Service Piping: The pipe from the water main or other source of potable water supply to the water distributing system of the building served.

1.4 QUALITY ASSURANCE

A. Codes and Standards:

1. ASTM A 120-84 Specifications for pipe.
2. ASTM B 88-83A Specifications for seamless copper water tube.
3. ANSI B16.4 Fittings, Flanges, and Valves.
4. ANSI B16.22 Fittings, Flanges, and Valves.
5. ASSE 1003 and 1003-1 - Performance Requirements for Water Pressure Reducing Valves.
6. AWWA C110-82 Standard for Fittings, Flanges, and Valves.
7. AWWA C600 - Standard for Installation of Gray and Ductile Cast-Iron Water Mains and Appurtenances.
8. AWWA C110-82 Standard for Gaskets.
9. AWWA C601 - Standard for Disinfecting Water Mains.
10. PDI WH-201 - Water Hammer Arresters.
11. Plumbing Code Compliance: Comply with applicable portions of BOCA Basic National Plumbing Code.
12. ASME Compliance: Fabricate and stamp pressure - Standards of these Organizations, the more stringent regulations shall govern.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Store pipe in a manner to prevent sagging and bending.

1.6 SEQUENCING AND SCHEDULING

- A. Coordinate the size and location of concrete equipment pads. Cast anchor bolt inserts into pad. Concrete, reinforcement, and form work requirements are specified in Division 03.
- B. Coordinate the installation of pipe sleeves for foundation wall penetrations.

1.7 SPARE PARTS

- A. Furnish to Owner, with receipt, one valve key for each key operated hydrant, bibb, or faucet installed.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer uniformity: Conform with the requirements specified in Basic Mechanical Requirements, under "Product Options."
- B. Manufacturer: Subject to compliance with requirements, provide water distribution piping products from one of the following:
 - 1. Balance Cocks:
 - a. Bell & Gossett ITT; Fluid Handling Div.
 - b. Taco, Inc.
 - 2. Pressure Regulating Valves:
 - a. Cash (A.W.) Valve Mfg. Corp.
 - b. Spence Engineering Co., Inc.
 - c. Watts Regulator Co.
 - 3. Water Meters:
 - a. Badger Meter, Inc.
 - b. Rockwell Intl.; Municipal & Utility Div.
 - c. Zurn Ind. Inc.; Hays Fluid Controls Div.

4. Relief Valves:
 - a. Cash (A.W.) Valve Mfg. Corp.
 - b. Watts Regulator Co.
 - c. Zurn Ind., Inc.; Wilkins-Regulator Div.
5. Water Hammer Arresters:
 - a. Amtrol, Inc.
 - b. Tyler Pipe; Sub. of Tyler Corp.
 - c. Zurn Ind., Inc.; Hydromechanics Div.

2.2 PIPE AND FITTINGS

A. Pipe Within Building (except below slab):

1. Pipe Sizes 2" and Smaller: Copper tubing. Conform to ASTM B88, Type L, hard temper, copper tube; ANSI B16.22 streamlined pattern wrought-copper fittings, with soldered joints using 95-5 tin-antimony solder.
2. Pipe Sizes Larger than 2": Galvanized steel pipe. Conform to ASTM A120, Schedule 40, seamless, galvanized steel pipe; with mechanical grooved pipe couplings and fittings.

B. Pipes Inside and Outside Building, Below Ground:

1. PVC plastic water pipe. Conform to AWWA C900, for Class 100, Polyvinyl chloride (PVC) water pipe;/ AWWA C110, for Class 100, cast-iron or ductile-iron fittings; mechanical joints.

2.3 VALVES

A. Gate Valves: Refer to Section 220523.

B. Balance Cocks:

1. Threaded Ends 2" and Smaller: Class 125, bronze body, bronze plug, screw driver operated, straight or angle pattern.
2. Soldered Ends 2" and Smaller: Class 125, bronze body, bronze plug, screw driver operated, straight or angle pattern.

C. Piping Specialties:

1. Water Hammer Arresters: Bellows type, with stainless steel casing and bellows, pressure rated for 250 psi, tested and certified in accordance with PDI Standard WH-201.

2. Basket Strainers: Cast-iron body, 125 psi flanges, bolted type or yoke type cover; with removable non-corrosive perforated strainer basket having 1/8" perforations and lift-out handle.
3. Flexible connectors: Stainless steel bellows with a woven flexible bronze wire reinforcing protective jacket; rated for 150 psig water working pressure, 250 degrees F operating temperature and suitable for up to maximum 3/4" misalignment. Connectors shall be a minimum of 12" long and have threaded or flanged ends; sweat ends are not acceptable.
4. Hose Bibbs: Bronze body, renewable composition disc, tee handle, 3/4" NPT inlet, 3/4" hose outlet.
5. Sill Faucets: Bronze body, with renewable composition disc, wheel handle, 3/4" solder inlet, 3/4" hose outlet.
6. Recessed Non-Freeze Wall Hydrants: Cast-bronze box, with chrome plated face, tee handle key, vacuum breaker, hinged locking cover, 3/4" inlet, and hose outlet. Bronze casing shall be length to suit wall thickness.
7. Pressure Regulating Valves: Single seated, direct operated type; having bronze body with integral strainer, and complying with requirements of ASSE Standard 1003. Select proper size for maximum flow rate and inlet and outlet pressures indicated.

D. Relief Valves:

1. Provide proper size for relief valve, in accordance with ASME Boiler and Pressure Vessel Codes, for indicated capacity of the appliance for which installed.
2. Combined Pressure-Temperature Relief Valves: Bronze body, test lever, thermostat, complying with ANSI Z21.22 listing requirements for temperature discharge capacity. Provide temperature relief at 180 degrees F, and pressure relief at 100 psi.

2.4 WATER METER

- A. Water meter: Compound type, conforming to AWWA Standards. Size meter and arrange piping and specialties to comply with utility company requirements.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all water distribution piping may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.
- B. Examine rough-in requirements plumbing fixtures and other equipment having water connections to verify actual locations of piping connections prior to installation.

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

3.2 JOINING PIPES AND FITTINGS

A. Copper Tubing: Solder joints in accordance with the procedures specified in ANSI B9.1.

3.3 PIPING INSTALLATION

A. Refer to the separate Division 22 section: Basic Piping Materials and Methods, for general piping installation instructions.

B. PVC piping, fittings and other PVC materials shall not be installed in air conditioning plenums or equipment rooms used as air conditioning plenums.

C. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement on, pump sizing, and other design considerations. So far as practical, install piping as indicated.

D. Install piping with 1/32" per foot (1/4 percent) downward slope towards drain point.

3.4 SERVICE ENTRANCE

A. Extend water distribution piping to connect to water service piping, of size and in location indicated for service entrance to building.

B. Install sleeve and mechanical sleeve seal at penetrations through foundation wall for watertight installation.

C. Install shutoff valve at service entrance inside building; complete with strainer, pressure gage, and test tee with valve.

D. Ductile-Iron Pipe: Install in accordance with AWWA C-60.

3.5 ROUGH-IN FOR WATER METER

A. Install rough-in piping and specialties for water meter installation in accordance with utility company's instructions and requirements.

3.6 INSTALLATION OF VALVES

A. Installation requirements for general duty valves are specified in a separate section of Division 22.

- B. Sectional Valves: Install sectional valves on each branch and riser, close to main, where branch or riser serves 2 or more plumbing fixtures or equipment connections, and elsewhere as indicated. For sectional valves 2" and smaller, use gate or ball valves; for sectional valves 2-1/2" and larger, use gate or butterfly valves.
- C. Shutoff Valves: Install shutoff valves on inlet of each plumbing equipment item, and on inlet of each plumbing fixture, and elsewhere as indicated. For shutoff valves 2" and smaller, use gate or ball valve; for shutoff valves 2-1/2" and larger, use gate or butterfly valves.

3.7 INSTALLATION OF PIPING SPECIALTIES

- A. Install backflow preventers at each connection to mechanical equipment and systems, and in compliance with the plumbing code and authority having jurisdiction. Locate in same room as equipment being connected. Pipe relief outlet without valves, to nearest floor drain.
- B. Install pressure regulating valves with inlet and outlet shutoff valves, and balance cock bypass. Install pressure gage on valve outlet.

3.8 EQUIPMENT CONNECTIONS

- A. Piping Runouts to Fixtures: Provide hot and cold water piping runouts to fixtures of sizes indicated, but in no case smaller than required by Plumbing Code.
- B. Mechanical Equipment Connections: Connect hot and cold water piping system to mechanical equipment as indicated. Provide connection. For connections 2-1/2" and larger, use flanges instead of unions.

3.9 FIELD QUALITY CONTROL

- A. Inspections:
 - 1. Do not enclose, cover, or put into operation water distribution piping system until it has been inspected and approved by the authority having jurisdiction.
 - 2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform test specified below in the presence of the plumbing official.
 - a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
 - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing official.

- c. Reinspections: Whenever the plumbing official finds that the piping system will not pass the test or inspection, make the required corrections and arrange System Test:
3. Test for leaks and defects all new water distribution piping systems and parts of existing systems, which have been altered, extended or repaired. If testing is performed in segments, submit a separate report for each test, complete with a diagram of the portion of the system tested.
4. Leave uncovered and unconcealed all new, altered, extended, or replaced water distribution piping until it has been tested and approved. Expose all such work for testing that has been covered or concealed before it has been tested and approved.
5. Cap and subject the piping system to a static water pressure of 50 psig above the operating pressure without exceeding the pressure rating of the piping system materials. Isolate the test source and allow to stand for a period of 4 hours. Leaks and loss in test pressure constitute defects which must be repaired.
6. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.

3.10 ADJUSTING AND CLEANING

A. Cleaning and Disinfecting:

1. Purge all new water distribution piping systems and parts of existing systems, which have been altered, extended, or repaired prior to use.
2. Use the purging and disinfecting procedure prescribed by the authority having jurisdiction, or in case a method is not prescribed by that authority, the procedure described in either AWWA C601, or AWWA D105, or as described below:
 - a. Flush the piping system with clean, potable water until dirty water does not appear at the points of outlet.
 - b. Fill the system or part thereof, with a water/chlorine solution containing at least 50 parts per million of chlorine. Isolate (valve off) the system, or part thereof, and allow to stand for 24 hours.
 - c. Drain the system, or part thereof, of the previous solution, and refill with a water/chlorine solution containing at least 200 parts per million of chlorine and isolate and allow to stand for 3 hours.
 - d. Following the allowed standing time, flush the system with clean potable water until chlorine does not remain in the water coming for the system.
 - e. Repeat procedures 2 weeks prior to occupancy.
 - f. 1-week prior to occupancy collect 10 water samples from various fixture throughout the building. Send to certified testing laboratory for the following tests at a minimum: a. Total Bacteria Test, b. Live Bacteria Culture Test for E.-Coli and Legionella-pneumophila. Obtain and document results prior to occupancy, if biological examination shows contamination notify owner,

- architect and engineer immediately.
- g. Submit additional water samples in sterile bottles to the authority having jurisdiction. Repeat the procedure if the biological examination made by the authority shows evidence of contamination.

B. Reports:

1. Prepare reports for all purging and disinfecting activities.

END OF SECTION 22 11 13

SECTION 22 11 16

PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. The work pertaining to this Division occurs within the confines of the building line, and within a boundary outside of the building line for a distance of five (5) feet, measured normal to the building line, or as indicated on the drawings.
- B. Alternates may or may not substantially change scope and general character of the work; and must not be confused with "change orders", "substitutions", and other similar provisions.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

- A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 PIPING SPECIALTIES

- A. Where it is desirable or necessary to support the pipe hangers to concrete, inserts shall be placed in the forms by the Mechanical Contractor prior to the time concrete is poured.
- B. Lead tamp-ins may be used when installed in a concrete or masonry wall or other like vertical surface to support a vertical hanger. Lead tamp-ins will not be permitted to support hangers to the underside of concrete slab.

- C. For parallel runs of above ground suspended piping, an acceptable trapeze-type hanger may be used. Provide permanent, non-conductive type wrapping between copper pipe and steel trapeze hangers.
- D. Pipes passing through walls, floors shall have sleeves of the same materials as the pipe. Sleeves shall allow insulated pipes to pass without changing the insulation thickness. Clearance around sleeves shall be packed with glass fiber after completion of pipe work. Sleeves in all floor slabs except slabs on grade shall have pipe sleeves extended 1 inch above finish floor to prevent water from running through sleeves to area below. Make watertight, caulk with sealant around each sleeve.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The contractor shall furnish all labor, materials, *including gases* equipment and instruments required to conduct tests of piping systems. Tests shall be as herein called for.
- B. PVC piping, fittings and other PVC materials shall not be installed in air conditioning plenums or equipment rooms used as air conditioning plenums.
- C. Tests shall be conducted and the inspection of the piping shall be made in the presence of the Architect and/or Engineers.
- D. Material and/or joints found defective shall be replaced and/or corrected and additional tests shall be conducted after correction of work.

3.2 PIPE SIZING, DRAWINGS AND SPECIFICATIONS

- A. It is intended that work covered by these specifications and drawings include everything requisite and necessary to make the various systems complete and operative, irrespective of whether or not every item is specifically provided for. Any omission of direct reference herein to any essential item shall not excuse contractor from complying with the above intent.
- B. Figured dimensions supercede scaled ones. Contractor shall take no advantage of, and shall promptly call the Owner's Representative's attention to any error, omission or inconsistency in specifications and drawings.
- C. Special attention is directed to requirements that equipment and materials stated in specifications and/or indicated on drawings shall be furnished, except if otherwise noted, completely installed, adjusted and left in safe and satisfactory operating condition. Accessories, appliances and connections necessary for operation of equipment shall be provided to satisfaction of the Owner's Representative.

- D. Materials, apparatus or equipment specified or otherwise provided for on drawings, addenda, or change orders issued subsequent to award of contract shall be same brand, type, quality and character originally specified unless otherwise provided.
- E. Layout of equipment, accessories, specialties and suspended, concealed or exposed piping systems are diagrammatic unless dimensioned. In preparing shop drawings, contractor shall check project conditions before installing work. If there are any interferences or conflicts, they shall be called to attention of the Owner's Representative immediately for clarification.
- F. The drawings indicate required size and points of termination of pipes and ducts and suggest proper routes to conform to structure, avoid obstructions and preserve clearances. However, it is not intended that drawings indicate all necessary offsets, and it shall be the work of this contractor to make the installation in such a manner as to conform to structure, avoid obstructions, preserve headroom and keep openings and passageways clear, without further obstruction or cost to the Owner.
- G. Shop drawings shall be furnished by this contractor, indicating all changes to meet space requirements, code requirements and as necessary to resolve all space conflicts.
- H. It is intended that all apparatus be located symmetrical with architectural elements, and shall be installed at exact height and locations as shown on the architectural drawings. Refer to architectural details in completing and correlating work.
- I. 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 furnished and installed under the contract, prior to submitting his bid. He shall exercise due and particular caution to determine that all parts of his work are made quickly and easily accessible.
- J. The contractor shall carefully examine any existing conditions, existing piping and ducts and premises and compare the drawing with the existing conditions, prior to submitting his bid.
- K. It cannot be too strongly emphasized that, except for work specifically excluded herein, every system shall be turned over to Owner installed completed, with components, ready for normal operation.
- L. In addition to work shown on mechanical drawings, see Architectural Drawings for existing work to be removed, relocated and/or modified. Modify existing systems by rerouting for systems to remain or remove the abandoned systems as required to accommodate new general construction, plumbing, electrical and mechanical work.
- M. Pipe sizes shall be minimum as allowed by local codes or as shown on the drawings, whichever is larger.

END OF SECTION 22 11 16

SECTION 22 11 19

**DOMESTIC COLD & HOT WATER SUPPLY PIPING
& HOT WATER CIRCULATING PIPING**

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. The work pertaining to this Division occurs within the confines of the building line, and within a boundary outside of the building line for a distance of five (5) feet, measured normal to the building line, or as indicated on the drawings.
- B. Alternates may or may not substantially change scope and general character of the work; and must not be confused with "change orders", "substitutions", and other similar provisions.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

- A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide valves and specialties as specified under additional Sections of this Specification.

2.2 PIPE

- A. The following schedule covers materials unless otherwise specified under a particular System Section.

1. Galvanized steel pipe, Schedule 40, ANSI B 125.2.
2. Copper tube, Type L, hard drawn, ASTM B 88.
3. Brass pipe or tube, chrome plated.

2.3 FITTINGS

- A. Steel Pipe: Malleable iron 150 lb. banded, galvanized to match pipe.
- B. Copper Tube: Wrought or cast brass solder joint.
- C. The 'T' drill extruded fitting method may not be used.
- D. Service material shall be brass compression fittings-angle ball cocks, ball corporations, etc. Flared fittings are acceptable under controlled conditions.

2.4 PIPE JOINTS

- A. Joints in copper piping shall be made with tin-antimony solder (95-5) and non-acid flux. Contractor shall furnish manufacturers literature documenting that the lead content (trace quantities) are within the guidelines of the local codes having jurisdiction as well as the Safe Drinking Water Act Amendment (SDWAA).
- B. Joints in threaded piping shall be made with teflon tape or non hardening pipe compound (seal-tite).

PART 3 - EXECUTION

3.1 GENERAL

- A. The design drawings are generally diagrammatic. They do not show every bend, offset, elbow or other fitting which may be required in the piping for installation in the space allotted. Careful coordination of the work is necessary to avoid conflicts.
- B. Run all water lines parallel or perpendicular to building lines.
- C. For piping requiring insulation, lay out and carefully install piping with sufficient clearances to permit proper application of the insulation. If the piping is such that a neat insulation job cannot be obtained with reasonable effort, the piping subcontractor shall relocate piping.
- D. Separate underground water piping and building sewer with undisturbed or compacted earth at least 10' horizontally if installed at the same level or lower than the sewer. Where water piping is closer than 10' to a sewer, place the bottom of the water pipe at least 18" above the top of the sewer, or the sewer shall be encased in a

concrete envelope as required by the Department of Health & Rehabilitative Services (State of Florida).

- E. Minimum cover for exterior underground piping is three feet over insulation or conduit unless otherwise noted on plans. Carefully excavate trench to smooth finished surface; if cut is too deep, backfill with clean earth and hand tamp to compact bottom. Make depression at joints to receive flanges, collars, and couplings. Provide continuous support for pipe or conduit. Backfill to be clean earth, free of rocks and debris completely enveloping pipe or conduit on both sides and top to a minimum thickness of 6". Carefully hand tamp backfill in 6" layers until 24" has been deposited over pipe or conduit.
- F. Place color coded 6" wide 0.004" thickness polyethylene printed plastic identification tape directly above all underground piping systems approximately 12" below finished grade. Tapes shall be continuously printed with "CAUTION" in large bold letters. Printed second line with type of service below. Yellow tape is to be used for water, (Print type of water on tape; i.e., domestic cold water.)

3.2 HANGERS AND SUPPORTS

- A. Vertical Piping shall be supported at its base and no greater than every story height.
- B. Horizontal Piping (Suspended) shall be supported at not more than eight (8) foot intervals. Supports shall be adequate to maintain alignment and prevent sagging.
- C. Supports shall be connected to the building structure not from other equipment, ducts or conduits.

3.3 JOINTING PIPE

- A. All pipe lines shall be correctly aligned before joints are made.
- B. Squarely cut pipe and properly ream to remove all constriction and burrs before making up the joints.
- C. Threaded Pipe: Ream all pipe after cutting and before threading. Use non-hardening pipe compound or tape on male threads only at each joint and tighten joint to leave not more than 3 threads exposed.
- D. Copper Tube: Ream all pipe after cutting squarely, clean outside of tube ends and inside of fittings and tin end to be soldered. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.

- E. Provide nipples of same material and weight as pipe used. Provide extra strong nipples when length of unthreaded part of standard weight nipple is less than 1-1/2".
- F. Run water supply main to point indicated on plans.

3.4 AIR CHAMBERS

- A. 20 pipe diameters, but not less than 12". Provide at each fixture, risers and ends of supply lines.

3.5 WATER HAMMER ARRESTERS

- A. Water hammer arresters (shock stops) shall be installed at the locations on the plans and in accordance with PDI Standard WH-201. Provide access panels so located to permit ease of service.

3.6 VALVES

- A. Provide valves to isolate each riser, and branch line. See also Section 220523 for requirements.

3.7 REDUCERS

- A. Screwed bushings are prohibited, except where available space prevents use of reducing couplings. Pipe reductions on horizontal, hot water piping shall be made with eccentric reducers. Top of hot water piping shall be flat for venting.

3.8 TESTS

- A. Apply a water pressure test to all parts of the water supply system before the piping is concealed and before the fixtures and equipment are connected. Use a hydrostatic pressure of not less than 100 psig or 150% of system operating pressure, applied to the system for a period of four hours. There shall be no leaks at any point in the system at this pressure.
- B. Leave concealed work uncovered until required tests have been completed, but if necessary, make tests on portions of the work and those portions of the work may be concealed after being inspected and approved. Make repairs of defects that are discovered as a result of inspection or tests with new materials. Caulking, welding or other such sealing methods of screwed joints, cracks or holes will not be accepted. Repeat tests after defects have been eliminated.

C. Complete all field testing prior to insulation, wrapping and/or backfill.

3.9 STERILIZATION

A. As soon as the water piping has been thoroughly flushed out, sterilize the lines by introducing into them a solution of calcium hypochlorite or chloride of lime. Open and close all valves while system is being chlorinated. After the sterilizing agent has been applied for 24 hours, test for residual chlorine at the ends of the lines. If less than 10 parts per million is indicated, repeat the process. When tests show at least 10 parts per million of residual chlorine, flush out the system until all traces of the chemical used are removed. Make necessary connections to sterilized piping.

3.10 PIPE PROTECTIONS

- A. Paint all uninsulated piping underground with two coats of asphaltic paint. (Manual wiping is not acceptable)
- B. Wrap pipe that touches metal or is exposed to masonry with a layer of 6 mil polyene film or 15 lb. felt.
- C. Spirally wrap all pipe lines embedded in concrete with two layers of 30 lb. felt.
- D. Coat all exposed threads on galvanized steel pipe after assembly with two coats of zinc chromate. Remove pipe thread lubricants prior to applying paint.

END OF SECTION 22 11 19

SECTION 22 13 16

SANITARY SEWER, STORM WATER & SANITARY VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. The work pertaining to this Division occurs within the confines of the building line, and within a boundary outside of the building line for a distance of five (5) feet, measured normal to the building line, or as indicated on the drawings.
- B. Alternates may or may not substantially change scope and general character of the work; and must not be confused with "change orders", "substitutions", and other similar provisions.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

- A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 MATERIAL

- A. The following schedule covers materials unless otherwise specified under a particular System Section.

2.2 PIPE

- A. Cast-iron soil pipe service weight, centrifugally cast, ANSI A112.5.1. 2" Through 15" size, bell and spigot joint.

- B. Cast-iron soil pipe service weight, centrifugally cast, ANSI A112.5.1. 1-1/2" through 10" size, "non-hub" joint.
- C. Reinforced concrete pipe (RCP) 12" through 144" bell and spigot pattern with O-ring rubber gaskets, ASTM C76.
- D. Copper type DWV.
- E. Brass pipe or tube, chrome plated.
- F. PVC Type DWV, ASTM D2665-78. 1-1/2" through 6" size.

2.3 PIPING APPLICATIONS

A. For above ground soil waste and vent piping, use any of the following materials:

- 1. Cast iron soil pipe service weight "NO-HUB" joints.
- 2. Copper type DWV.
- 3. Brass pipe or tube, chrome plated. This shall be provided for all above ground p-traps. PVC p-traps are not acceptable.
- 4. PVC type DWV, ASTM D2665-78.

B. For below ground soil waste and vent piping, use any of the following materials:

- 1. Grease line: Cast iron soil pipe service weight bell and spigot. PVC shall not be acceptable.
- 2. Sanitary waste:
 - a. Cast iron soil pipe service weight bell and spigot.
 - b. PVC type DWV, ASTM D2665-78. (Note: In HVAC plenums, PVC piping shall not be installed.)
- 3. Storm (Refer to size limitation in Section 2.2):
 - a. Cast iron soil pipe service weight bell and spigot.
 - b. PVC type DWV, ASTM D2665-78.
 - c. Reinforced concrete pipe.

2.4 FITTINGS

A. Cast-Iron Soil Pipe:

- 1. Underground: Provide fittings of same weight and manufacture as pipe in which installed. Joints shall be bell and spigot push-on type neoprene gasket or "NO HUB" type conforming to CIPI Standard 301 unless noted otherwise on drawings.

2. Above ground and in buildings: "NO-HUB" type conforming to CIPI Standard 301 unless noted otherwise on the drawings.

B. Threaded Drainage Pipe: Cast-iron, recessed.

C. Copper DWV: Cast or wrought solder joint DWV drainage fittings.

D. PVC Type DWV: ASTM D-2665, NSF Seal of Approval, Solvent-cement joint.

2.5 PIPE JOINTS

A. Bell and spigot type joint shall be made with push-on compression type, neoprene gasket conforming to ASTM A-74.

B. No-hub type joints shall be constructed of 24 gage type 304 stainless steel, with gasket guides, type 304 stainless steel screw clamp, and matching neoprene (ASTM C-564) gasket that shall interlock with housing.

C. Joints in copper piping shall be made with tin-antimony solder (95-5) silver solder and non-acid flux.

D. Joints in threaded piping shall be made with teflon tape or non hardening pipe compound (Seal-tite).

2.6 VENT FLASHING

A. Furnish 4 lb. lead flashing, material as recommended by roofing system manufacturer, or copper pitch pans for all vents through the roof. Type of flashing used shall be compatible with piping material.

2.7 IDENTIFICATION

A. Below grade piping identification and warning tape shall be 0.004 inch thick polyethylene, printed with a continuous two line message. Tapes used for non magnetic piping materials shall have a metallic core. Acceptable manufacturer is Seton Name Plate Corporation or approved equal.

B. Above ground piping identification tape shall conform to ANSI and ASME A13.1 2007.

PART 3 - EXECUTION

3.1 GENERAL

- A. The design drawings are generally diagrammatic. They do not show every bend, offset, elbow or other fitting which may be required in the piping for installation in the space allotted. Careful coordination of the work is necessary to avoid conflicts.
- B. PVC piping, fittings and other PVC materials shall not be installed in air conditioning plenums or equipment rooms used as air conditioning plenums.
- C. Joints and connections shall be made permanent and watertight.
- D. Run piping to sewer connection point outside of building or as indicated on drawings.
- E. Install 3" and larger horizontal soil and waste piping to 1/8" per foot slope. Piping 2" and smaller shall be installed at a slope of 1/4" per foot. Run horizontal vent lines to a minimum grade back to stacks and vertical vent lines as direct and free from bends as possible.
- F. For piping requiring insulation, lay out and carefully install piping with sufficient clearances to permit proper application of the insulation. If the piping is such that a neat insulation job cannot be obtained with reasonable effort, the piping subcontractor shall relocate piping.
- G. Separate underground water piping and building sewer with undisturbed or compacted earth at least 10' horizontally if installed at the same level or lower than the sewer. Where water piping is closer than 10' to a sewer, place the bottom of the water pipe at least 18" above the top of the sewer, or the sewer shall be encased in a concrete envelope as required by the Department of Health & Rehabilitative Services (State of Florida).
- H. Minimum cover for exterior underground piping is three feet over conduit unless otherwise noted on plans. Carefully excavate trench to smooth finished surface; if cut is too deep, backfill with clean earth and hand tamp to compact bottom. Make depression at joints to receive bells, collars, and couplings. Provide continuous support for pipe or conduit. Backfill to be clean earth, free of rocks and debris completely enveloping pipe or conduit on both sides and top to a minimum thickness of 6". Carefully hand tamp backfill in 6" layers until 18" has been deposited over pipe or conduit.
- I. Place color coded 6" wide 0.004" thickness polyethylene printed plastic identification tape directly above all underground piping systems approximately 12" below finished grade. Tapes shall be continuously printed with "CAUTION" in large bold letters. Printed second line with type of service below. Red tape is to be used for sewer, (Print type of water on tape; i.e., storm water.)
- J. Where condensate piping is indicated, piping shall be extended to the nearest catch basin/yard drain. A cast iron back water valve shall be provided with epoxy-coated steel access housing.

3.2 HANGERS AND SUPPORTS

- A. Vertical Piping shall be supported at its base and no greater than every story height, not to exceed 20 foot intervals.
- B. Horizontal Piping (Suspended) shall be supported at each bend; at not more than five (5) foot intervals; except that pipe exceeding five (5) feet in length may be supported at not more than ten (10) foot intervals. Supports shall be adequate to maintain alignment and prevent sagging and shall be made directly behind the bell or coupling, where possible, not near the center of the pipe.
- C. Supports shall be connected to the building structure not from other equipment, ducts or conduits.
- D. Horizontal pipe and fittings six inches and larger shall be suitably braced to prevent horizontal movement. This should be done at every branch opening or change of direction by the use of braces, blocks, rodding or other suitable method, to prevent movement.
- E. Where components are suspended in excess of eighteen inches by means of non-rigid hangers, they should be suitably braced against movement horizontally, often called sway bracing.

3.3 LINE AND GRADE

- A. Install gravity lines at uniform grade to low point after field verification of low point invert.
- B. Run piping straight, plumb and grade in the direction indicated on the drawings.

3.4 JOINTING PIPE

- A. All pipe lines shall be correctly aligned before joints are made.
- B. Squarely cut pipe and properly ream to remove all constriction and burrs before making up the joints.
- C. Threaded Pipe: Ream all pipe after cutting and before threading. Use non-hardening pipe compound on male threads only at each joint and tighten joint to leave not more than 3 threads exposed.

- D. Copper Tube: Ream all pipe after cutting squarely, clean outside of tube ends and inside of fittings and tin end to be soldered. Apply non-acid solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
- E. Joining "NO-HUB" cast iron soil pipe and fittings shall be in accordance with recommended practices described by the coupling manufacturers.
- F. Provide nipples of same material and weight as pipe used. Provide extra strong nipples when length of unthreaded part of standard weight nipple is less than 1-1/2".
- G. Provide reducing fittings (reducing bushings shall not be used) where changes in pipe sizes occur.
- H. Provide dielectric unions or flanges between copper and steel piping and between brassware and steel. Do not use steel and copper piping in the same system without such isolation.

3.5 PIPE PROTECTION

- A. Paint all uninsulated piping underground (except cast iron) with two coats of asphaltic paint (Manual wiping is not acceptable).
- B. Wrap soil pipe that touches metal or is exposed to masonry with a layer of 6 mil polyethylene film or 15 lb. roofing felt.
- C. Spirally wrap all pipe lines embedded in concrete with two layers of 30 lb. roofing felt.

3.6 TESTS

- A. A water test shall be applied to the sanitary and storm drainage systems either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening and the system filled with water to point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest openings of the section under test, and each section shall be filled with water, but no section shall be tested with less than 10 ft. head of water. In testing successive sections at least the upper 10 ft of the next preceding section shall be tested, so that no joint or pipe in the building (except the uppermost 10 ft of the system) shall have been submitted to a test of less than a 10 ft head of water. The water shall be kept in the system, or in the portion under test, for at least 30 minutes before inspection starts; the system shall then be tight at all points.
- B. An air test shall be made by attaching an air compressor or testing apparatus to any suitable opening and after closing all other inlets and outlets to the system, forcing air

into the system until there is a uniform gauge pressure of 5 psi or sufficient to balance a column of mercury ten inches in height. This pressure shall be held without introduction of additional air for a period of at least 30 minutes.

C. Complete all field testing prior to insulation, wrapping and/or backfill.

3.7 VENT FLASHING

A. Extend lead type flashing 12" beyond pipe in all directions and carry to top of pipe with at least 2" return inside of pipe.

B. Install PVC pipe flashing in accordance with flashing manufacturer's recommendation.

C. Flashing for PVC piping shall be installed in accordance with manufacturer's instructions.

D. Install flashing materials as required by roofing system manufacturer's details and methods.

END OF SECTION 22 13 16

SECTION 22 13 17

CLEANOUTS AND CLEANOUT ACCESS COVERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification sections, apply to work of this section.
- B. Alternates may be or may not substantially change scope and general character of the work; and must not be confused with "change orders", "substitutions", and other similar provisions.

1.2 SCOPE

- A. Furnish and install cleanouts as shown on drawing or specified herein.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

- A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleanouts and cleanout access covers shall be of the type and materials as scheduled on the drawings.
- B. Provide all necessary bolts and appurtenances to effect a complete installation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install all cleanouts and cleanout access covers in accordance with the manufacturers instructions.
- B. Exterior cleanouts below grade shall be extended to finish grade. Pour a concrete pad 18" x 18" x 6" thick around cleanout; slope top down approximately 2" from cleanout to edge of pad so that edge of pad is flush with grade.
- C. Cleanouts shall be of the same nominal size as the pipes to which they are connected up to 4" in diameter; and not less than 4" for larger pipes.
- D. Cleanouts shall be provided at not more than 50 feet apart in horizontal drainage lines of 4" nominal diameter, and at not more than 75 feet apart for larger diameter pipe.
- E. At change in direction: Cleanouts shall be provided at each change of direction of the building drain when the angle of change is 90 degrees.
- F. At base of stacks: Cleanouts shall be provided at or near the base of each vertical stack.
- G. Direction of cleanout: All cleanouts shall be installed so that the cleanout opens in a direction opposite to the flow of the drainage line, or at a right angle to the line.
- H. Concealed cleanouts in wall shall be provided with removable access panel.
- I. Where access cleanout boxes or covers are installed in the floor, the top surface shall be scoriated and the cover secured, but removable when necessary. Polished brass. Install carpet type covers in carpeted areas.

END OF SECTION 22 13 17

SECTION 22 13 21

DRAINAGE AND VENT SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section specifies building sanitary and vent piping systems.
- B. Related Sections:
 - 1. Separate sections in Division-02 specify sanitary sewage systems, and trenching and backfilling.
 - 2. Separate sections in Division-07 specify flashing and sheet metal and joint sealers.
 - 3. Division-23 Basic Mechanical Requirements section applies to the work of this section.
 - 4. Separate sections of Division-22 specify Basic Piping Materials and Methods, Hangers and Supports, Expansion Compensation, piping system requirements, pipe insulation, and plumbing equipment.

1.3 DEFINITIONS

- A. Drainage System: Includes all the piping within a public or private premises which conveys sewage or other liquid wastes to a point of disposal. It does not include the mains of public sewer systems or a private or public sewage treatment or disposal plant.
- B. Vent System: A pipe or pipes installed to provide a flow of air to or from a drainage system, or to provide a circulation of air within such system to protect trap seals from siphonage and back pressure.

1.4 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. Plumbing Code Compliance: Comply with applicable portions of the Florida Building Code.

1.5 SEQUENCING AND SCHEDULING

- A. Coordinate the installation of flashing and roof penetrations.
- B. Coordinate flashing materials installation of roofing, waterproofing, and adjoining substrate work.
- C. Coordinate with installation of sanitary and storm sewer systems as necessary to interface building drains with drainage piping systems.
- D. Coordinate the installation of drains in poured-in-place concrete slabs, to include proper drain elevations, installation of flashing, and slope of slab to drains.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer Uniformity: Conform with the requirements specified in Basic Mechanical Requirements.
- B. Drainage Piping Specialties, including expansion joints, drains, trap primers, and vandal-proof vent caps:
 - 1. Josam Mfg. Co.
 - 2. Zurn Ind.,Inc; Hydromechanics Div.
 - 3. Wade Division, Tyler Pipe

2.2 ABOVE GROUND DRAINAGE AND VENT PIPE AND FITTINGS

- A. Hubless cast-iron soil pipe: Conform to CISPI Standard 301, Service weight, cast-iron soil pipe and fittings, with neoprene gaskets conforming to CISPI Standard 310.
- B. Rain water leader piping above grade may be PVC meeting AWWA C900 Class 100. Joints shall be mechanical using elastomeric gaskets. Use of PVC in return air plenums (ie, office area) and through fire rated assemblies will not be permitted.

2.3 UNDERGROUND BUILDING DRAIN PIPE AND FITTINGS

- A. Pipe sizes 15" and smaller: Cast-iron soil pipe. Conform to ASTM A74, for Extra-Heavy weight, hub-and-spigot soil pipe and fittings, with neoprene compression gasket joints conforming to ASTM C564. Pipe and fittings shall have a heavy coating of coal tar varnish or asphaltum on both inside and outside surfaces.

2.4 DRAINAGE PIPING SPECIALTIES

- A. Trap Primers: Bronze body valve with automatic vacuum breaker, with ½" connections matching piping system, complying with ASSE 1018.
- B. Expansion Joints: Cast-iron body with adjustable bronze sleeve, bronze bolts with wing nuts.
- C. Cleanout Plugs: Cast-bronze or brass, threads complying with ANSI B2.1, countersunk head.
- D. Floor Cleanouts: Cast-iron body and frame, with clean-out plug and adjustable round top as follows:
 - 1. Nickel-Bronze Top: Manufacturer's standard cast unit with a standard non-slip scored or abrasive finish.
 - 2. Cast-iron Top: Manufacturer's standard cast unit with a standard non-slip scored or abrasive finish.
- E. Wall Cleanouts: Cast-iron body adaptable to pipe with cast-bronze or brass cleanout plug; stainless steel cover including screws.
- F. Flashing Flanges: Cast-iron watertight stack or wall sleeve with membrane flashing ring. Provide under-deck clamp and sleeve length as required.
- G. Vent Flashing Sleeves: Cast-iron caulking type roof coupling for cast-iron stacks, cast-iron threaded type roof coupling for steel stacks, and cast-bronze stack flashing sleeve for copper tubing.
- H. Floor Drains:
 - 1. Floor drain type designations and sizes are indicated on Drawings; See fixture schedules.
- I. Roof Drain:
 - 1. Roof drain type designations and sizes are indicated on the drawings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all drainage and vent piping and specialties may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.

- B. Verify all existing grades, inverts, utilities, obstacles, and topographical conditions prior to installations.
- C. Examine rough-in requirements for plumbing fixtures and other equipment having drain connections to verify actual locations of piping connections prior to installation.
- D. Examine walls, floors, roof, and plumbing chases for suitable conditions where piping and specialties are to be installed.
- E. Do not proceed until unsatisfactory conditions have been corrected.

3.2 JOINING PIPES AND FITTINGS

- A. Copper Tubing: Solder joints in accordance with the procedures specified in ANSI B9.1.
- B. Cast-Iron Soil Pipe: Make lead and oakum caulked joints, compression joints, and hubless joints in accordance with the recommendations in the CISPI Cast Iron Soil Pipe and Fittings Handbook, Chapter IV.

3.3 INSTALLATION

- A. Refer to the separate Division-22 section: Basic Piping Materials and Methods, for general piping installation instructions.
- B. Install supports and anchors in accordance with Division-23 Basic Mechanical Materials and Methods section "Supports and Anchors".
- C. General Locations and Arrangements: Drawings (plans, schematics, and diagrams) indicate the general location and arrangement of the piping systems. Location and arrangement of piping layout take into account many design considerations. So far as practical, install piping as indicated.
- D. Make changes in direction for drainage and vent piping using appropriate 45-degree wyes, half-wyes, or long sweep quarter, sixth, eighth, or sixteenth bends. Sanitary tees or short quarter bends may be used on vertical stacks of drainage lines where the change in direction of flow is from horizontal to vertical, except use long-turn tees where two fixtures are installed back to back and have a common drain. Straight tees, elbows, and crosses may be used on vent lines. No change in direction of flow greater than 90 degrees shall be made. Where different sizes of drainage pipes and fittings are connected, use proper size, standard increasers and reducers. Reduction of the size of drainage piping in the direction of flow is prohibited.
- E. Make joints of "No-Hub" cast iron soil pipe with coupling assembly using torque

wrench pre-set at 60 inch pounds.

- F. Install Thrust blocks at the bottom of the waste stack, condensate stack and rain leader pipe.
- G. Install sleeve and mechanical sleeve seal through foundation wall for watertight installation.

3.4 INSTALLATION OF PIPING SPECIALTIES

- A. Install expansion joints on vertical risers as indicated and as required by the plumbing code.
- B. Above Ground Cleanouts: Install in above ground piping as indicated:
 - 1. As required by plumbing code.
 - 2. At each change in direction of piping greater than 45 degrees.
 - 3. At minimum intervals of 50' for piping 3" and smaller, 75' piping 4" and larger.
 - 4. At base of each vertical soil or waste stack.
- C. Cleanouts Covers: Install floor and wall cleanout covers for concealed piping, types as indicated.
- D. Flashing Flanges: Install flashing flange and clamping device with each stack and cleanout passing through waterproof membranes.
- E. Vent Flashing Sleeves: Install on stacks passing through roof, secure over stack flashing in accordance with manufacturer's instructions.

3.5 INSTALLATION OF TRAP PRIMERS

- A. Install trap primers with piping pitched towards drain trap, minimum of 1/8" per foot (1 percent). Adjust trap primer for proper flow.

3.6 CONNECTIONS

- A. Piping Runouts to Fixtures: Provide drainage and vent piping runouts to plumbing fixtures and drains, with approved trap, of sizes indicated; but in no case smaller than required by the plumbing code.
- B. Locate piping runouts as close as possible to bottom of floor slab supporting fixtures or drains.

3.7 FIELD QUALITY CONTROL

- A. Inspections:

1. Do not enclose, cover, or put into operation drainage and vent piping system until it has been inspected and approved by the authority having jurisdiction.
2. During the progress of the installation, notify the plumbing official having jurisdiction, at least 24 hours prior to the time such inspection must be made. Perform tests specified below in the presence of the plumbing official.
 - a. Rough-in Inspection: Arrange for inspection of the piping system before concealed or closed-in after system is roughed-in, and prior to setting fixtures.
 - b. Final Inspection: Arrange for a final inspection by the plumbing official to observe the tests specified below and to insure compliance with the requirements of the plumbing code.
3. Reinspections: Whenever the piping system fails to pass the test or inspection, make the required corrections, and arrange for reinspection by the plumbing official.

3.8 PIPING SYSTEM TEST

- A. Test for leaks and defects all new drainage and vent piping systems.
- B. Leave uncovered and unconcealed all new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose all such work for testing, that has been covered or concealed before it has been tested and approved.
- C. Drainage and Venting System Testing Procedures:
 1. Rough Plumbing: Test the piping of plumbing drainage and venting systems upon completion of the rough piping installation. Tightly close all openings in the piping system, and fill with water to the point of overflow, but not less than 10 feet head of water. Water level shall not drop during the period from 15 minutes before the inspection starts, through completion of the inspection. Inspect all joints for leaks.
 2. Finished Plumbing: After the plumbing fixtures have been set and their traps filled with water, their connections shall be tested and proved gas and water-tight. Plug the stack openings on the roof and building drain where it leaves the building, and introduce air into the system equal to a pressure of 1" water column. Use a "U" tube or manometer inserted in the trap of a water closet to measure this pressure. Air pressure shall remain constant without the introduction of additional air throughout the period of inspection. Inspect all plumbing fixture connections for gas and water leaks.
- D. Repair all leaks and defects using new materials and retest system or portion thereof until satisfactory results are obtained.

3.9 ADJUSTING AND CLEANING

- A. Clean interior of piping. Remove dirt and debris as work progresses.
- B. Clean drain strainers, domes, and traps. Remove dirt and debris.

3.10 PROTECTION

- A. Protect drains during remainder of construction period, to avoid clogging with dirt and debris, and to prevent damage from traffic and construction work.
- B. Place plugs in ends of uncompleted piping at end of day or whenever work stops.

END OF SECTION 22 13 21

SECTION 22 40 00

PLUMBING FIXTURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.
- B. Related Sections:
 - 1. Separate grab bars and toilet accessories not an integral part of plumbing fixtures are specified in Division-10.
- C. This Section specifies plumbing fixtures and trim. The types of fixtures specified included the following:
 - 1. Lavatories (including wheelchair type);
 - 2. Service Sinks;
 - 3. Water Closets;
 - 4. Urinals;
 - 5. Mop Basins;
 - 6. Drinking Fountains;
 - 7. Faucets;
 - 8. Flush Valves;
 - 9. Fixture Supports (including wheelchair type);
 - 10. Toilet Seats;
 - 11. Electric Water Heater;

1.2 QUALITY ASSURANCE

- A. Codes and Standards:
 - 1. ASHRAE Standard 18: "Method of Testing for Rating Drinking Water Coolers with Self-Contained Mechanical Refrigeration Systems."
 - 2. ARI Standard 1010: "Drinking-Fountains and Self-Contained Mechanically-Refrigerated Drinking-Water Coolers."
 - 3. ANSI Standard A117.1: "Specifications for Making Buildings and Facilities Accessible To and Usable By Physically Handicapped People."
 - 4. Public Law 90-480: "Architectural Barriers Act of 1968."

5. UL Standard 399: "Drinking-Water Coolers."

B. Delivery, Storage, and Handling:

1. Store fixtures where environmental conditions are uniformly maintained within the manufacturer's recommended temperatures to prevent damage.
2. Store fixtures and trim in the manufacturer's original shipping containers. Do not stack containers or store in such a manner that may cause damage to the fixture or trim.

C. Sequence and Scheduling:

1. Schedule rough-in installations with the installation of other building components.

1.3 MAINTENANCE

A. Extra Stock:

1. Furnish special wrenches and other devices necessary for servicing plumbing fixtures and trim to Owner with receipt in a quantity of one device for each 10 fixtures.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturer uniformity shall be as specified in Section 230500: Basic Mechanical Requirements under Product Options.

1. Subject to compliance with specified requirements, provide plumbing fixtures of one of the following:
 - a. Lavatories, Water Closets, Urinals, Bath Tubs:
 - (a) TOTO
 - (b) Crane Co.
 - (c) Eljer Plumbingware Div.; Household International Co.
 - (d) Kohler Co.
 - (e) American Standard.
 - b. Faucets:
 - (a) Gorhe

- (b) Kallista
- (c) Chicago Faucet Co.
- (d) Eljer Plumbingware Div.; Household International Co.
- (e) Kohler Co.

c. Flush Valves:

- (a) TOTO
- (b) Sloan Valve Co.
- (c) Zurn Industries, Inc.; Hydromechanics Div.

d. Water Closet Seats:

- (a) TOTO
- (b) Bemis Mfg. Co.
- (c) Beneke Corp.

e. Water Coolers:

- (a) Elkay Mfg. Co.
- (b) Filtrine Manufacturing Co.
- (c) Haws Drinking Faucet Co.

f. Service Sinks:

- (a) Crane Co.
- (b) Eljer Plumbingware Div.; Household International Co.
- (c) Kohler Co.
- (d) Fiat

g. Fixture Supports:

- (a) Josam Mfg. Co.
- (b) Kohler Co.
- (c) Zurn Industries, Inc.; Hydromechanics Div.

- 2.2 FIXTURES (See schedule)
- 2.3 WATER COOLERS (See schedule)
- 2.4 FAUCETS (See schedule)
- 2.5 FLUSH VALVES (See schedule)
- 2.6 FIXTURE SUPPORTS (See schedule)

2.7 ELECTRIC WATER HEATER (See schedule)

2.8 FITTINGS, TRIM AND ACCESSORIES

- A. Toilet Seats: elongated, solid white plastic, closed back/open front, less cover, and having stainless steel check hinge and replaceable bumpers.

2.9 ESCUTCHEONS

- A. Chrome-plated cast brass with set screw.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify all dimensions by field measurements. Verify that all plumbing fixtures may be installed in accordance with pertinent codes and regulations, the original design, and the referenced standards.
- B. Examine rough-in for potable water and waste piping systems to verify actual locations of piping connections prior to installing fixtures.
- C. Examine walls, floors, and cabinets for suitable conditions where fixtures are to be installed.
- D. Do not proceed until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install plumbing fixtures level and plumb, in accordance with fixture manufacturer's written instructions, rough-in drawings, and pertinent codes and regulations, the original design, and the referenced standards.
- B. Comply with the installation requirements of ANSI A11.1 and Public Law 90-480 with respect to plumbing fixtures for the physically handicapped.
- C. Fasten plumbing fixtures securely to supports or building structure. Secure supplies behind or within wall construction to provide rigid installation.
- D. Set shower receptor and mop basins in a leveling bed of cement grout.
- E. Install a stop valve in an accessible location in the water connection to each fixture.
- F. Install escutcheons at each wall, floor, and ceiling penetration in exposed finished

locations and within cabinets and millwork.

- G. Seal fixtures to walls and floors using silicone sealant as specified in Section 079200. Match sealant color to fixture color.

3.3 FIELD QUALITY CONTROL

- A. Test fixtures to demonstrate proper operation upon completion of installation and after units are water pressurized. Replace malfunctioning units, then retest.
- B. Inspect each installed unit for damage. Replace damaged fixtures.

3.4 ADJUSTING

- A. Adjust water pressure at drinking fountains, faucets, shower valves, and flush valves to provide proper flow and stream.
- B. Replace washers of leaking or dripping faucets and stops. Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.

3.5 CLEANING

- A. Clean fixtures, trim, and strainers using manufacturer's recommended cleaning methods and materials.

3.6 PROTECTION

- A. Provide protective covering for installed fixtures, water coolers, and trim.
- B. Do not allow use of fixtures for temporary facilities unless expressly approved in writing by the Owner.

3.7 ROUGH-IN SCHEDULE (Refer to Drawings)

3.8 MOUNTING HEIGHTS SCHEDULE – Coordinate with architectural plans.

<u>Fixture</u>	<u>Typical Mounting Height</u>
Water Closet	15" floor to rim
Wheelchair Water Closet	18" floor to rim
Standard Urinals	22" floor to rim
Accessible Urinals	17" floor to rim
Adult Standard Water Cooler	40" floor to rim
Wheelchair Water Cooler	35" floor to rim
Adult Standard Drinking Fountains	40" floor to rim
Wheelchair Drinking Fountain	35" floor to rim

END OF SECTION 22 40 00

SECTION 22 40 05

PLUMBING FIXTURES AND TRIM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Special Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Furnish and install plumbing fixtures indicated on drawings or specified herein.
- B. All plumbing fixtures shall be "First Quality" as defined and set forth in Commercial Standard CS77-28 as promulgated by the U.S. Department of Commerce. All fixtures are to be white vitreous china unless otherwise specifically noted. Where enameled iron fixtures are specified, they shall be furnished with acid resisting enamel.
- C. Fixtures shall be properly protected from damage during construction and shall be cleaned in accordance with manufacturer's instruction under this section of the specifications.
- D. Fixtures and fittings proposed shall be from one manufacturer and of similar character in any room or location. Escutcheons, handles, etc., on the different fixtures shall be of the same design.
- E. The fixture numbers and types are scheduled on the drawings, and are used to indicate type and quality of fixtures desired. Acceptable fixture manufacturers are as follows: American Standard, Eljer and Kohler. Fixture manufacturers not listed herein will be considered subject to the general requirement outlined in Section 230100 General Mechanical Provisions.
- F. Alternates may or may not substantially change scope and general character of the work; and must not be confused with "change orders", "substitutions", and other similar provisions.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and to all other applicable portions of the Drawings and Specifications.

1.4 SUBMITTALS

- A. Submit manufacturer's data for review before any work is commenced.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Flush valves and water closet seats shall be as scheduled on the drawings.
- B. All exposed metal not otherwise specified shall be polished chromium on brass or bronze. All supply valves shall have renewable seats and discs. All hot and cold water supply to fixtures shall be provided with stops. Provide P-trap with cleanout for each lavatory and sink except as specifically noted.
- C. All seats shall be solid, white, open front seat with checking and self sustaining, stainless steel hinge.
- D. Chair carriers and combination chair carriers and fittings shall be as scheduled on the drawings.
- E. Chrome-plated. Provide where exposed piping passes through finished surfaces. Escutcheons for extended sleeves shall be of the type designed for that purpose.
- F. Provide a concealed hanger type lavatory chair carrier with short foot mounted in the chase to support lavatories shown on walls of a chase.
- G. Provide through toggle bolts, 1/8" thickness steel backing plate, and wall hangers for support of lavatories on 6" or thicker concrete block walls.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Layout fixtures as indicated on the drawings.
- B. Carefully install fixtures in accordance with manufacturer's data with sufficient clearances to coordinate with accessories, specialties and equipment specified in other divisions of these specifications and/or as shown on the drawings.
- C. Hangers and carriers shall be installed in accordance with manufacturer's recommendations and in accordance with good practice and workmanship.
- D. Clean all exposed metal surfaces from grease, dirt, paint or other foreign material.

- E. Fixtures shall be properly protected from damage during construction and shall be cleaned in accordance with manufacturer's instruction under this section of the specification.
- F. Fixtures, chrome-plated piping, fittings and trim shall be polished before requesting acceptance of the system.

END OF SECTION 22 40 05

SECTION 23 01 00

GENERAL MECHANICAL PROVISIONS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE OF DIVISION

- A. Work shall include all materials, equipment and labor necessary for a complete and properly functioning mechanical installation in accordance with all applicable codes, and contract drawings and specifications. Work shall include all work specified in Division-22, Plumbing and Division-23, HVAC.
- B. Pay for all required licenses, fees, inspections and permits.

1.3 RELATION TO OTHER WORK

- A. Work Not in Divisions 22 and 23: Related work not included in this division consists of requirements given in the following as may be included in the contract documents:
 - 1. Other divisions which may include work (such as concrete, steel, painting, ceiling systems, structure and other work) related to the work of Divisions 22 and 23.
- B. Work of Divisions 22 and 23: Any or all sections of Divisions 22 and 23 may include a paragraph or paragraphs under the heading, "Relation to other Work". Where such a paragraph is indicated and work directly related to the section is listed or described, such work shall be considered as relating directly to the indicated section. Any related work (directly related or otherwise) which may be omitted by reference from the "Relation to Other Work" paragraph of such section(s), shall be provided as necessary and required whether or not such work is included by reference. Such listing or description of related work within a section is given only as a convenience to the Contractor; omission of other related sections or described work does not in any way exclude the provision of such work.

1.4 CODES

- A. Install all work in accordance with the latest edition of all applicable regulations and governing codes, including the regulations of the utility companies serving the project.

- B. Where a conflict in code requirements occurs the more stringent requirement shall govern.

1.5 STANDARDS

- A. All equipment and devices shall bear U.L. label, the label of an industry recognized approved testing agency or A.G.A. certification for said item of equipment or device.
- B. All electrical devices must be U.L. approved.

1.6 DRAWINGS

- A. Architectural and structural drawings take precedence over mechanical drawings with reference to the building construction. Mechanical drawings are diagrammatic and indicate the general arrangement and extent of work. Architectural drawings indicate more exactly the desired relationship between diffusers, registers, lighting fixtures, equipment, electric panels and devices, plumbing fixtures, and other items which remain exposed in the completed building. Exact locations and arrangement of materials and equipment shall be determined, with the acceptance of the Architect/Engineer, as work progresses to conform in the best possible manner with the surroundings and with the adjoining work of other trades. Where locations of equipment, devices or fixtures are controlled by architectural features, establish such locations by referring to dimensions on Architectural drawings and not by scaling drawings.

1.7 DISCREPANCIES

- A. In case of differences between drawings and specifications, or where drawings and specifications are not clear or definite, the subject shall be referred to Architect/Engineer for clarification and instructions.

1.8 ELECTRICAL PROVISIONS

- A. Work of Divisions 22 and 23 shall include the electrical requirements which are indicated to be integral with mechanical work and which can be summarized to include (but not necessarily be limited to) the following:
 1. Motors.
 2. Motor starters.
 3. Wiring from mechanical equipment to electrical work termination (junction box or disconnect switch).
 4. Control switch, pilot lights, interlocks and similar devices.
 5. Electrical heating coils and similar elements in mechanical equipment.
 6. Electrical work specified in Division-23 for the HVAC control system.
 7. Drip pans to protect electrical work.

- B. Motors, Starters, Switches: Provide with all motorized mechanical equipment unless otherwise indicated.
- C. Drip Pans: Where possible, do not run mechanical piping directly above electrical (or electronic) equipment which is sensitive to moisture; otherwise provide drip pans under mechanical piping. Locate pan below piping, and extend 6" on each side of piping and lengthwise 18" beyond equipment. Fabricate pans 2" deep, of reinforced sheet metal with rolled edges and soldered or welded seams; 20 gage copper, or 16 gage steel with 2 oz. zinc finish hot dipped after fabrication. Provide 3/4" copper drainage piping, properly discharged.
- D. Motors: Unless specifically specified otherwise in the section covering the driven equipment (or the equipment drives), motors shall comply with the following:
 - 1. Three Phase: NEMA design B, three-phase, squirrel cage induction type designed for 1800 rpm synchronous speed for operation in 40°C ambient at 1.15 service factor at constant speed on the scheduled voltage. Motors shall be insulated with Class B insulation material and shall be cast iron, drip proof, horizontal foot mounted type with ball bearings. Two speed motors shall be provided as scheduled and shall be two winding type.
 - 2. Single Phase: Squirrel cage induction type designed for 1800 rpm synchronous speed for operation in 40°C ambient at 1.15 service factor at constant speed on the scheduled voltage. Motors shall be insulated with Class B insulation materials and shall be two winding capacitor start type with steel enclosure, drip proof, horizontal foot mount and ball bearings.
 - 3. Electric motors which are designated to be high efficiency type shall also comply with the section describing high efficiency motors.
- E. Scheduled Horsepower: The horsepowers scheduled or specified are those nominal sizes estimated to be required by the equipment when operating at specified duties and efficiencies. In the case of pumps, these horsepowers are non-overloading and may also include provisions for future planned impeller changes. If the actual horsepower for the equipment furnished differs from that specified or shown on the drawings, it shall be the Contractor's responsibility to insure that proper size feeders, breakers, starters, etc. are provided at no change in contract price.
- F. Any TEFC motors shall have Class F insulation.
- G. Drip proof protected motors shall have Class B insulation.
- H. Manufacturer: Electric motors, complying with the requirements of this Section and the installation and performance requirements of the plans, by the following manufacturers are acceptable:
 - 1. Reliance Electric
 - 2. Gould Electric

3. General Electric
4. Westinghouse

1.9 ELECTRICAL/MECHANICAL WORK

A. Definitions: Definitions for the purpose of mechanical/electrical control and power coordination are as follows: (Note: The use of the words, "Provide", "furnish" and "install" are intended only for use in describing the coordination indicated by this paragraph and do not necessarily have the same definitions when used outside of the context of this paragraph.) Any items which do not fall within the scope of this paragraph shall be coordinated as individually specified.

1. "Furnish" means to procure an item and to deliver it to the project for installation.
2. "Install" means to determine (in coordination with others as necessary) the appropriate intended location of an item and to set and connect it in place.
3. "Provide" means to both furnish and install.
4. Power Circuit: Circuit which carries main electric power to apparatus to which the power circuit is connected.
5. Control Circuit: Circuit which carries electrical signals directing the performance of a controller but which does not carry the main electric power. (See NEC, Section 430-71.) Such circuits shall also include those which serve a dual control and power function (e.g., a line voltage thermostat circuit which both activates and powers a small fan motor).
6. Controller: A device, or group of devices, which serves to govern, in some predetermined manner, electric power delivered to apparatus to which the controller is connected and includes any switch or device normally used to start and stop a motor. (See NEC, Article 100, Definitions, "Controller", and Section 430-81(a).)
7. Control Device: A device which reacts to an operating condition (pressure, temperature, flow, humidity, etc.) and which initiates transmission of an electrical control signal which causes operation of a controller or which causes operation of pressure switches, etc.
8. Auxiliary Control Device: A device (such as a low voltage control transformer, electric relay, etc.) which is located in a control circuit and which carries or responds to (but does not initiate) an electrical control signal initiated by a control device.

B. Work of Division-23 includes (but is not necessarily limited to):

1. Provide:
 - a. All controllers which are generally manufactured or shipped as integral with Division-23 equipment (such as starters packaged with air cooled chillers, etc.).

- b. All electric motors and other electrical power consuming equipment (such as electric air heating coils, electric boilers, electric hot water heaters, etc.) which are specified in Division 22 or 23.
- c. All control circuits (including conduit and boxes) from the Division-26 panels to point of use including the necessary circuit breakers.
- d. All other control circuits, including conduit and boxes.
- e. All control connections to equipment.
- f. All control connections to controllers, switches, motors and other mechanical systems electrical power consuming equipment (such as electric air heating coils, electric boilers, electric hot water heaters, etc.).
- g. Auxiliary control devices.
- h. All control devices (thermostats, pressure switches, flow switches, humidistats, etc.) and make control circuit connections thereto.
- i. Any and all pneumatic and electronic and electric control devices and electric or pneumatic connections thereto.

2. Furnish:

- a. All controllers which are generally manufactured and/or shipped as separate but companion items to Division-23 equipment (such as centrifugal chiller starters which are matched with the chillers but are not physically an integral part of the chiller assembly.)

C. Work of Division-26 includes (but is not necessarily limited to):

1. Provide:

- a. All power circuits, including conduit and boxes.
- b. All power connections to controllers, switches, motors and other mechanical systems electrical power consuming equipment (such as electric air heating coils, electric boilers, electric hot water heaters, etc.).
- c. All remote motor disconnects (remote from the related controller) at all locations required by NEC and connections thereto except those disconnects which are specified in Division-23 to be provided as part of the equipment itself.

- d. All controllers (except those which are generally manufactured or shipped as separate but companion items to Division-23 equipment such as centrifugal chiller starters).

2. Install:

- a. All controllers which are generally manufactured and/or shipped as separate but companion items to Division-23 equipment (e.g., chiller starters).

1.10 AUXILIARIES AND ACCESSORIES

- A. Include all auxiliaries and accessories for complete and properly operating systems.

1.11 INVESTIGATION OF SITE

- A. Check site and existing conditions thoroughly before bidding. Advise Architect/Engineer of discrepancies or questions noted before bidding.

1.12 ASBESTOS

- A. Should asbestos, or any other hazardous waste material, be encountered during the execution of the work, or should the presence of asbestos or any other hazardous material be suspected, immediately notify the Owner and suspend all work in the affected area. The Owner will activate an assessment study to determine the presence of asbestos, or other hazardous material, and evaluate what condition it is in. Removal of asbestos, or other hazardous material, if required, will be conducted by a qualified Contractor, and will be done under separate contract.

1.13 COORDINATION

- A. Provide all required coordination and supervision where work of this division connects to or is affected by work of others.

1.14 PROVISIONS FOR OPENINGS

- A. Provide all openings required for work performed under Division-23. Provide sleeves or other approved methods to allow passage of items installed under any Section of Division-23.

1.15 INTERRUPTION OF EXISTING SERVICES

- A. Any interruption of existing services shall be coordinated in advance with the Owner's Representative. Shutdown time and duration of critical services shall be decided by the Owner. Contractor shall provide shutoff valves at point of tie-in to minimize downtime.

1.16 CLEANING AND PROTECTION

- A. General: Refer to Division 1.
- B. Emergency Contacts: Prior to the beginning of the project, provide the Owner with a list of names, emergency telephone and beeper numbers of individuals who can be contacted during working and non-working hours, including weekends, for assistance throughout the warranty period if leaks, equipment failure or other damages occur. Update the list throughout installation and warranty to provide continuous availability of responsible parties to the Owner. If the Owner cannot contact the responsible party during an emergency situation, the Owner may effect emergency repairs through other means and may backcharge for the costs of repair material and labor incurred.
- C. Ductwork: Keep the interior of the duct system free from dirt and rubbish and other foreign matter. All fan motors, switches, and other items, shall also be protected from dirt, rubbish and other foreign matter during building construction. Thoroughly clean all components of the ductwork and remove all dirt, scale, oil and other foreign substances which may have accumulated during the installation process.
- D. Housekeeping: Keep interiors of duct and pipe systems clean and free from dirt, rubbish and foreign matter. Close open ends of piping and ductwork at all times throughout the installation. Install 30% efficient filter media over each return air grille and open return duct opening; change media regularly during construction when dirty to keep duct interiors clean. Prevent dust, debris and foreign material from entering the piping and ductwork.
- E. Equipment: All mechanical equipment provided shall be thoroughly cleaned of all dirt, oil, concrete, etc. Any dents, scratches or other visible blemishes shall be corrected and the appearance of the equipment made "like new" and to the satisfaction of the Architect/Engineer.
- F. Upon completion, and before final acceptance of the work, all debris, rubbish, leftover materials, tools and equipment shall be removed from the site.
- G. Protection of Work Until Final Acceptance: Protect all materials and equipment from damage, entrance of dirt and construction debris from the time of installation until final acceptance. Any materials and equipment which are damaged shall be repaired to "as new" condition or replaced at the direction of the Architect/Engineer. Where factory finishes occur and damage is minor, finishes may be touched up. If, in the opinion of the Architect/Engineer the damage is excessive, factory finish shall be replaced to "new" condition.

1.17 SHOP DRAWINGS

- A. Submit shop drawings for all items, services and systems included in the project.

B. Shop drawings shall clearly show the following:

1. Technical and descriptive data in detail equal to or greater than the data given in the item specification. Indicate all characteristics, special modifications and features. Where performance and characteristic data is shown on the drawings or specified, submitted data shall be provided in a degree which is both quantitatively and qualitatively equal to that specified and shown so that comparison can be made. Present data in detail equal to or greater than that given in item specification and include all weights, deflections, speeds, velocities, pressure drops, operating temperatures, operating curves, temperature ranges, sound ratings, dimensions, sizes, manufacturers' names, model numbers, types of material used, operating pressures, full load amperages, starting amperages, fouling factors, capacities, set points, chemical compositions, certifications and endorsements, operating voltages, thicknesses, gauges and all other related information as applicable to particular item.
2. Exceptions to or deviations from the contract documents. Should Architect/Engineer accept any items having such deviations which are not clearly brought to Architect/Engineer's attention, in writing, on item submittal, then Contractor is responsible for correction of such deviations regardless of when such deviations are discovered.

C. Additional Requirements: See specific sections of the Specifications for any additional requirements.

1.18 SHOP DRAWINGS TECHNICAL INFORMATION BROCHURE

- A. Submit within thirty days after Notice to Proceed. Each brochure shall consist of an adequately sized, hard-cover, 3-ring binder for 8-1/2" x 11" sheets. Provide correct designation on outside cover and on spine of binder, i.e., mechanical. All shop drawings shall be submitted at one time; partial submittals will not be accepted.
- B. First sheet in the brochure shall be a photocopy of the "Division-23 Index" for these specifications. Second sheet shall be prepared by the Contractor and shall list Project addresses for this Project for Contractor and all major subcontractors and suppliers.
- C. Provide reinforced separation sheets tabbed with the appropriate specifications section reference number and typed index for each section.
- D. Shop drawing technical and descriptive data shall be inserted in the brochure in proper order on all items. Mark the appropriate specification section or drawing reference number in the right hand corner of each item. Provide complete information, including, but not limited to, wiring and control diagrams, scale drawings showing that proposed substitute equipment will fit into allotted space (indicate all service access, connections, etc.), test data, and other data required to

determine if equipment complies fully with the specifications. All typewritten pages shall be on contractor or equipment manufacturer printed letterhead.

- E. At the end of the brochure, provide and insert a copy of the specifications for Division-23 and all addenda applicable to this Division.
- F. Submit not less than six brochures. Provide separate tag marking on an individual copy for the Owner, Architect, Engineer, Contractor, Subcontractor (two copies).
- G. Contractor shall review the brochure before submitting. Submittal information on each item in each brochure shall bear the Contractor's stamp of approval, initials of checker and date checked by him. No request for payment of or substitutions will be considered until brochure has been reviewed by the Contractor and submitted for checking.

1.19 SHOP DRAWINGS FOR PIPING SYSTEMS AND DUCT SYSTEMS

- A. Shop drawings for piping systems and duct systems shall be done on reproducible transparencies and shall be of sufficient scale to verify clearances and equipment locations. Shop drawings shall show all required maintenance and operational clearances required. Cost of shop drawing preparation and reproduction shall be borne by the Contractor. Title drawings shall include identification of project and names of Architect, Engineer, Contractor, subcontractor and/or supplier, date, be numbered sequentially and shall indicate the following:
 - 1. Architectural and structural (as required) backgrounds with room names and numbers, etc., including but not limited to plans, sections, elevations, details, etc.
 - a. Fabrication and Erection dimensions.
 - b. Arrangements and sectional views.
 - c. Necessary details, including complete information for making connections with other work.
 - d. Kinds of materials and finishes.
 - e. Descriptive names of equipment.
 - f. Modifications and options to standard equipment required by the contract.
 - g. Leave blank area, size approximately 4 by 2-1/2 inches, near title block (for Engineer's shop drawing stamp imprint).
- B. In order to facilitate review of drawings, insofar as practicable, they shall be noted, indicating by cross reference the contract drawings, note, and/or specification paragraph numbers where item(s) occur in the contract documents.

- C. Also provide shop drawings, using sepias of the architectural reflected ceiling plans, which indicate locations of the following (to be verified by Contractor): Air distribution devices, sprinkler heads, lights and access panels.
- D. See specific sections of specifications for further requirements.

1.20 AIR HANDLING UNIT AND DUCTWORK CONFIGURATION SHOP DRAWINGS

- A. Contractor shall submit a shop drawing for each air handling unit. Such shop drawings shall meet the following requirements:
 - 1. Be drawn at not less than a scale of 1/4" = 1'-0". Contractor may elect to use a larger scale if he desires (i.e., if drawing of unit is at 1/4" = 1'-0", 1/2" = 1'-0" may be used.).
 - 2. Clearly show all proposed ductwork configuration changes (sizes, routing, and similar differences) which are different in any respect from the Drawings. Extent of shop drawings shall show all ductwork to and from each unit beginning with and terminating at those points where ductwork is intended to remain unchanged as shown on Drawings.
 - 3. Where proposed changes affect any other work such as structure, housekeeping pads, piping, equipment, electrical work or any other work, shop drawings shall clearly show those proposed changes.
 - 4. Proposed changes shall be at no additional change in contract price.
 - 5. Where Drawings show units in plan only, shop drawings shall show proposed units in plan and also in elevation.
 - 6. Shop drawings shall also show exact locations of related work (such as bar joists, columns, beams, sound attenuators, and like items) which affect the proposed ductwork routing and unit location and configuration.
 - 7. Each section of each air handling unit shall be clearly identified (i.e., coil section, fan section, filter section, mixing box section, etc.).
- B. Failure to submit these shop drawings together at the same time with the air handling unit shop drawings will result in total disapproval of the proposed air handling units. Time delays or other reasons will not be considered.

1.21 ELECTRONIC FILES

- A. CADD files will be available on a limited basis to qualified firms at the Architects prerogative. The cost of the files will be \$100 per sheet. Recipients are cautioned that these files may not accurately show actual conditions as constructed. Users are responsible to verify actual field conditions. These files are not intended to be used as shop drawings.

1. A request for CADD files should be delivered in writing along with payment for such files. Files will not be processed until payment is received.

1.22 OPERATING INSTRUCTIONS

- A. Submit for checking a specific set of written operating instructions on each item which requires instructions to operate. After acceptance, insert information in each Technical Information Brochure. Refer also to other sections which may describe operating instructions.

1.23 MAINTENANCE INFORMATION

- A. Submit for acceptance Maintenance Information consisting of manufacturer's printed instruction and parts lists for each major item of equipment. After acceptance, insert information in each Technical Information Brochure. Refer also to other sections which may describe maintenance.

1.24 MANUFACTURER'S CHECK-OUT

- A. Check out by Manufacturer's Representative (for major items of equipment): At completion of construction and after performance verification information as above-mentioned has been gathered, submitted and accepted, provide one copy of this information to the manufacturer's representative. Work required under this section shall include having the representative examine the performance verification information, check the equipment in the field while it is operating, and sign a Check-Out Memo for record. Submit a copy of the memo on each major item of equipment for each brochure. Accepted memos shall be inserted on each brochure with the performance verification information and submittal data. Memos shall be submitted and accepted before Instruction in Operation to Owner or a request for final inspection.

1.25 SYSTEM GUARANTEE

- A. The work required under Division-23 shall include a one year guarantee. This guarantee shall be by the Contractor to the Owner to replace for the Owner any defective workmanship, equipment, or material which has been furnished under this Contract at no cost to the Owner for a period of one year from the date of acceptance of the System. This guarantee shall also include reasonable adjustments of the system required for proper operation during the guarantee period. Explain the provisions of guarantee to Owner at the "Instruction in Operation Conference".

1.26 INSTRUCTION TO OWNER

- A. Submit all required items for checking one week before final inspection of the building is scheduled. When all items are accepted and placed in the proper brochures, the Contractor shall give notice in writing that he is ready to give the Owner an "Instruction in Operation Conference". After the above mentioned request is received the Contractor will be notified of the time the conference can be held with the Owner. At the conference, the Contractor shall review with the Owner all appropriate information. At the end of the conference, seven copies of a memo certifying Instruction in Operation and Completed Demonstration shall be signed by the Contractor, Subcontractor and Owner and one copy inserted in each brochure.

1.27 MATERIALS AND EQUIPMENT

- A. Each bidder represents that his bid is based upon the materials and equipment described in this division of the specifications.
 - 1. Submittal shall include the name of the material or equipment for which it is to be substituted, substituted equipment model numbers, drawings, cuts, performance and test data and any other data or information necessary for the Architect/Engineer to determine that the equipment meets all specification and requirements. If the Architect/Engineer accepts any proposed substitutions, such acceptance will be set forth in writing.
 - 2. Substituted equipment with all accessories installed or optional equipment where permitted and accepted, must conform to space requirements. Any substituted equipment that cannot meet space requirements, whether accepted or not, shall be replaced at the Contractor's expense. Any modifications of related systems of this or other trades as a result of substitutions shall be made at the Contractor's expense, and Contractor shall so state in his written request for substitution.

1.28 ACCEPTABLE MANUFACTURERS

- A. Acceptable Manufacturers: Materials and Equipment specified in these contract documents are accepted only in regards to general performance and quality. It shall be the Contractor's responsibility to insure that acceptable materials and equipment meet or exceed the efficiencies, capacities, electrical characteristics, performance and quality of the equipment herein specified. Acceptable equipment must also generally conform, without extensive modification of related systems to the accessories, weights, space and maintenance requirements, etc., of the specified equipment. Any modification to related systems of this or other trades shall be made at the Contractor's expense and the Contractor shall be responsible for coordination between trades. Any difference in capacity, efficiency, electrical characteristics, weights or quality of product, etc., between specified materials and equipment and acceptable alternates shall be submitted to the Architect/Engineer for acceptance within 30 days of Notice to Proceed.

PART 2 - PRODUCTS

2.1 Section part not applicable.

PART 3 - EXECUTION

3.1 Section part not applicable.

END OF SECTION 23 01 00

SECTION 23 05 00

BASIC MECHANICAL MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section, in addition to the following:

1.2 SCOPE

- A. Materials listed herein are general mechanical materials to be used under the Division 22 and 23 sections of the specifications unless specifically noted otherwise in the particular section or on the drawings.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 22 and 23 and to all other applicable portions of the Drawings and Specifications. This section relates to all sections of Division 23 as may be applicable to the work of each section.

1.4 STANDARDS

- A. Quality and weight of materials shall comply with requirements and specifications of the appropriate standards of the American Society of Testing and Materials.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT, GENERAL

- A. All materials and equipment shall be new and without blemish or defect.
- B. Equipment and materials shall be products which will meet with the acceptance of the agency inspecting the work. Where acceptance is contingent upon having the products examined, tested and certified by Underwriters Laboratory or other recognized testing laboratory, the product shall be so examined, tested and certified.
- C. Where no specific indication as to the type or quality of material or equipment is indicated, a standard item or system shall be furnished with all options, features and capabilities to meet the project requirements.

D. Performance and Capacity:

1. Performance as delineated in schedules and in the specifications shall be interpreted as minimum performance. In some cases equipment may be sized to allow for future requirements or for other reasons which may not be stated on the Drawings or in the Specifications; provide equipment and systems with the capacities, capabilities and features indicated to provide the maximum or minimum (as appropriate) conditions.

E. Operating conditions and capacities must be as follows:

1. No overloading.
2. No operation at conditions outside of maximum and minimum limits recommended by the manufacturer and accepted by the Architect/Engineer.
3. Compatible with all systems.

F. Unless otherwise specified, all equipment and materials furnished must be as follows:

1. Recommended by the manufacturer for the application.
2. Installed in accordance with the manufacturer's recommendations for the application except where specifications and drawings clearly indicate otherwise.

2.2 ACCESS DOORS AND PANELS

A. Locations: Provide access doors and panels (access units) as necessary for access to items which are concealed and which may require service or maintenance or other reason for accessibility. Examples of such items include, but are not limited to, the following: valves, cleanouts, pipe unions, expansion joints and connectors, dampers, coils, junction boxes, duct heaters, terminal units, HVAC control system devices and similar types of items.

B. Access units: Shall be manufactured by the Milcor Division of Inland-Ryerson, Boico, Nystrom or Ventfabrics. Types are as follows (Milcor style designations are used for example only):

<u>Location</u>	<u>Door/Panel Type</u>
Drywall	Style "DW"
Masonry or tile	Style "M-stainless"
Acoustical tile	Style "AT"
Plaster	Style "K"
Fire-rated walls	Style "Fire Rated"***

(**or as indicated below)

C. Fire Rated Units:

1. Frame and panel assembly shall bear a U.L. label reading, "frame and door assembly, rating 1-1/2-hour (B), temperature rise 30 minutes 250°F maximum".
2. Have an automatic closing device and mechanism to release the latch bolt from the inside.
3. Acceptable Manufacturers: Boico Style F, Inryco/Milcor Style VA, Nystrom Style APFR.

D. Non-fire Rated Units:

1. Steel panels and frames.
2. Locks and latches shall be as appropriate for the location and shall be cam-lock type latches, flush screw driver operated locks or cylindrical locks.
3. Provide two keys for all doors. All doors shall be keyed the same.

E. Other Requirements:

1. Doors and panels installed in glazed or ceramic tiled surfaces, in toilet rooms or in kitchens shall be stainless steel.
2. Unless otherwise indicated, finish shall be rust inhibitive prime coat.

F. Sizes:

1. Minimum size: 8" x 8".
2. Sizes of each unit shall be individually selected to allow the recommended and required service and maintenance and accessibility functions to be accomplished. These functions shall generally include, for example, valve removal, damper linkage resetting, control adjustment, lubrication, repair, replacement and similar tasks as may be necessary and recommended for the concealed item.
3. Sizes shall be of the following increments (unless otherwise approved) to allow the accessibility function to be accomplished: 8" x 8", 8" x 12", 12" x 12", 12" x 16", 16" x 16", 16" x 24", 24" x 24", 24" x 36", 30" x 30", 36" x 36" or 36" x 48".
4. No size smaller than 16" x 24" shall be allowed when a person must pass through the access opening in order to accomplish the desired accessibility function.
5. Every attic or furred space in which mechanical equipment is installed shall be accessible by an opening and passageway as large as the largest piece of the equipment and in no case less than 22 x 36 inches continuous from the opening to the equipment and its controls. The opening to the passageway shall be located not more than 20 feet from the equipment measured along the center line of such passageway.

2.3 PAINTING AND MARKING

- A. All paint and materials used for painting shall be manufacturer's "first quality" product. For additional paint material requirements, refer to Section 099101, Painting.

B. Marking: Refer also to sections describing identification of mechanical systems.

2.4 PIPE HANGERS AND SUPPORTING DEVICES

A. General: Refer to other sections of Division 23 for any requirements which may be additional to this section. Comply with the more stringent requirement if more than one method is specified or shown.

B. Pipe supporting devices specified herein shall apply to all Division 22 and 23 piping unless modified in subsequent sections of Division 22 and 23 (ie., vibration isolation) or detailed on the drawings.

1. Pipe hangers for copper pipe shall be copper or copperplated and for steel pipe shall be zinc-plated, clevis type hangers.
2. Hangers for pressure piping shall be clevis type or accepted as equivalent. Pipe hangers shall be capable of vertical adjustment after erection of the piping. Piping shall not be hung from fire and/or smoke walls.
3. Vertical piping supports shall be constructed of carbon steel with rounded ears and two or four holes for clamping bolts. Steel, galvanized and cast iron piping riser clamps shall have galvanized finish. Copper and brass piping riser clamps shall have electro-plated copper or PVC coating finish.
4. Acceptable Manufacturers are Grinnell, PHD Manufacturing Inc., Fee and Mason, Michigan and Elcen.

C. Beam clamps may be used when supporting piping from steel structures.

D. Concrete inserts shall be placed in forms as work of Division 22 and 23 prior to the time that concrete is poured.

E. Lead tamp-ins may be used when installed in a concrete or masonry wall or other like vertical surface to support a vertical hanger. Lead tamp-ins will not be permitted to support hangers to the underside of a concrete slab.

F. For parallel runs of above ground suspended piping, an acceptable trapeze-type hanger may be used. Provide permanent, non-conductive type wrapping between copper pipe and steel trapeze hangers.

G. Powder set type fasteners or inserts shall not be used.

2.5 FLOOR, WALL OR CEILING PLATES OR ESCUTCHEONS IN EXPOSED AREAS

A. Shall be chrome-plated. Escutcheons for extended sleeves shall be of the type designed for that purpose. Split ring escutcheons will not be allowed.

- B. Escutcheons to be as manufactured by Guarantee Specialty Mfg. Co., Cleveland, Ohio; American Sanitary Mfg. Co., Abingdon, Ill., or Beaton Cadwell.
- C. Provide escutcheons or fabricated plates or collars at each location where pipe or duct passes through a finished surface. Escutcheons for flush sleeves shall be equivalent to Benton & Caldwell No. 3A chromium plated brass; for sleeves extending above floor shall be equivalent to Benton & Caldwell No. 36 chrome plated brass. Collars or plates for ducts and large diameter insulated pipe shall be fabricated of 18 gage galvanized copper bearing sheet steel, secured to structure and neatly fitted around duct or pipe.

2.6 SLEEVES

- A. General: Lay out work and set sleeves in new or existing construction so that minimum cutting, drilling and patching is required. Seal all sleeves not used during construction period with grout. Seal unused penetrations and sleeves through fire rated barriers to prevent passage of smoke and heat using an Underwriters' Laboratories approved method; sealing method must be rated at least equivalent to the barrier being penetrated. Submit proposed method to show proof of UL approval.
- B. Pipe Sleeves, Special Considerations: The following conditions require pipe sleeves as indicated:
 - 1. Where subject to hydrostatic pressure: Sleeves installed in walls and floors subject to hydrostatic (water) pressures shall be "Link Seal" (Thunderline Corp) Type WS or accepted as equivalent.
 - 2. Where piping is existing: When fire rated walls are to be erected where there is existing piping, provide Proset fire rated split wall system pipe sleeves, or accepted equivalent.
 - 3. Where penetration is part of air duct or plenum system: Do not use plastic pipe for sleeves where floor being penetrated is part of an air plenum so that no fire or smoke hazard is introduced by use of plastic.
 - 4. Where penetration is through fire rated barriers: Provide mild steel sleeves for penetrations of fire rated barriers.
- C. Pipe Sleeves in Walls and Partitions:
 - 1. Sleeves Above Grade: Use schedule 40 mild steel pipe or schedule 80 CPVC pipe. Provide sleeves built into wall, partition or beam of size to allow penetration by carrier pipe and insulation covering with not less than 1/4 inch minimum clear space between outer surface of carrier pipe covering (or carrier pipe surface if no covering is provided) and inner surface of sleeve.
 - 2. Sleeves Below Grade in Exterior Walls: Schedule 40 steel hot dipped galvanized after fabrication or cast iron sleeve with not less than 1/4-inch x 3-inch center flange (water stop) around the exterior face of the wall.

3. Penetrations of fire rated barriers shall have only mild steel sleeves; plastic is not allowed.
- D. Pipe Sleeves in Floors Above Grade: Use schedule 40 mild steel pipe or schedule 80 CPVC pipe. Provide sleeves built into wall, partition or beam of size to allow penetration by carrier pipe and insulation covering with not less than 1/4 inch minimum clear space between outer surface of carrier pipe covering (or carrier pipe surface if no covering is provided) and inner surface of sleeve. Set sleeves before floor is poured; extend not less than 1/2-inch above finished floor.
 - E. Pipe Sleeves in Floors on Grade: Sleeves shall be Schedule 40 steel or Schedule 80 CPVC plastic. Set sleeves before floor is poured. Size sleeves to allow penetration by carrier pipe and insulation covering with not less than 1/4 inch minimum clear space between outer surface of carrier pipe covering (or carrier pipe surface if no covering is provided) and inner surface of sleeve. Extend sleeve not less than 1/2 inch above finished floor.
 - F. Duct Sleeves: Sleeves or openings sized to pass mechanical ducts and covering shall be of framed steel construction in roof, wall, and partitions.
 - G. Sealing of Sleeves:
 1. Pipe Sleeves Below Grade and On Grade: Caulk annular space between pipe and sleeve using approved caulking material to a minimum one inch deep. Result shall be a water tight and vermin proof penetration.
 2. Pipe and Duct Sleeves Above Grade: Openings around pipes, ducts and other conduit passing through sleeves shall be made draft free and vermin-proof by solidly packing with mineral wool or fiberglass or by other such approved method.
 3. Pipe and Duct Sleeves Through Fire Rated Barriers: All penetrations through fire rated barriers (both walls and floors) shall comply with Division-07 or be as specified in this Division.
- 2.7 FIRE/SMOKE RATED FLOOR, PARTITION OR WALL PENETRATION SEALANT
- A. Seal shall be composed of fire barrier product, putty, or caulking materials used either in combination or singularly. Acceptable Manufacturers are 3M Corporation or Dow Corning.
- 2.8 EXCAVATION AND BACKFILL
- A. Provide as necessary to accomplish work specified. Perform in accordance with applicable State and Local codes and accepted good practice and in accordance with other applicable sections or divisions.

2.9 BELT DRIVES

- A. General: Equip each motor driven machine not direct connected with V-belt drive. Belts shall be of correct cross section to fit properly in sheave grooves and shall be carefully matched for each drive. Sheaves shall be cast iron or steel, bored to fit properly on shafts and secured with keys of proper size. The rating of each drive shall be as recommended by manufacturer for service but shall be at least 1.5 times nameplate rating of motor.
- B. Speed Adjustment: Adjust fan speed by change(s) in sheave size as necessary to obtain proper design air flow with fan in its installed location. Fans may be first fitted with variable pitch drives until proper speed adjustment is made and then fitted with proper fixed pitch drive size, or alternate sizes of fixed pitch drives may be used until proper fan needed to deliver necessary air quantity.
- C. Vibration of Air Handling Equipment and Fan Units: For air handling equipment and fans driven by motors 5-hp or greater, field vibration levels will not be acceptable if the maximum vibration velocity or displacement measurement exceeds the following values (when measurements are taken at the bearing supports using a vibration analyzer with the filter set at the operating fan speed):

<u>Fan Speed (RPM)</u>	<u>Maximum Vibration Level</u>
800 or Less	5 Mils (0.127 mm) max. displacement
801 and Greater	0.20 in/sec. (5 mm/s) max. velocity

- D. Belt and Coupling Guards: Each belt drive shall be equipped with an OSHA approved guard. Guards shall be constructed of #12 U.S. standard gage 3/4-inch diamond mesh wire screen, or equivalent, welded to one inch steel angle frames, and shall enclose all belts and sheaves. Tops and bottoms of guards shall be of substantial sheet metal or not less than #18 U.S. standard gage. Braces or supports must not "bridge" sound and vibration isolators. Guards shall be designed with adequate provision for movement of motor required to adjust belt tension. Means shall also be provided to permit oiling, use of speed counters, and other maintenance and testing operations with guard in place. All direct drive equipment shall have coupling guards in accordance with Florida Department of Business Regulation safety regulations and OSHA.

2.10 BEARINGS

- A. All bearings shall be 200,000-hour rated unless otherwise specified.

PART 3 - EXECUTION

3.1 EQUIPMENT ACCESS

A. Access Doors and Panels:

1. Locations: Provide access unit at the following locations.
 - a. Where additionally specified in other sections of this Divisions 22 and 23 and where specifically indicated on the drawings.
 - b. Where not specifically indicated on the drawings but where the work to be provided will require accessibility for purposes as described or as recommended by the manufacturer of the concealed item.
 - c. At all locations where concealed equipment, fixtures, devices and similar items require accessibility for service, inspection, maintenance, repair, replacement and where such concealed item would not otherwise be accessible for such functions without the provision of an appropriately sized access unit.

B. Installation:

1. Definitions: For the purpose of coordination of responsibility, the following words are defined to describe the intended coordination.
 - a. "Furnish" means to procure an item and deliver it to the project for installation.
 - b. "Install" means to determine (in coordination with others as necessary) the intended appropriate location of an item and to set, connect and otherwise fix in place in a manner to allow intended operation and use.
 - c. "Provide" means to both furnish and install fully and completely in all aspects.
2. Furnishing Access Units: Access units shall be furnished as work of the Division which governs the item which is intended to be made accessible by the access unit.
3. Installing Access Units: Access units shall be installed as work of the Division which governs the surface, barrier, partition or other building component in and on which the access unit is to be placed.
4. Determination of Locations:
 - a. Where the work of Divisions 22 or 23 requires that the access unit be provided (i.e., both furnished and installed), then the responsibility for determination of

the location at which the access unit is to be placed is also work of Divisions 22 and 23.

- b. Where the work of Divisions 22 or 23 requires that access unit be furnished for installation as work of another Division, then the responsibility for determination of the location at which the access unit is to be installed shall be work of Divisions 22 and 23. Conversely, where the work of one Division requires that an access unit be only installed, then the responsibility for determination of the location of which the access unit is to be installed shall be work of Divisions 22 or 23 which furnishes the access unit.

5. Determination of Sizes:

- a. Unless an access unit size is indicated on the drawings or otherwise specified, the size of each access unit shall be determined as work of the Division which either provides or furnishes the access unit.
- b. Sizes for access units which are provided or furnished as work of this Division shall be in compliance with sizing criteria of this Division.

3.2 PAINTING

- A. Paint all exposed piping, insulation, equipment, structural bases, racks, in equipment rooms and on roof, furnished under Divisions 22 and 23 of these specifications. All exposed metal surfaces shall be given one prime coat and two finish coats. All insulated surfaces shall be given one sizing coat of glue sizing (omit this step if factory applied finish is suitable to receive prime coat), one prime coat and one finish coat. Factory painted or finished items do not require field painting but shall require "touch-up" with matching paint or finish where scratched.
- B. Pipe hangers, saddles, supports, riser clamps and accessories shall be painted to match their piping.
- C. Equipment not completely accessible for painting when set in place shall be thoroughly cleaned and painted before installation and suitably protected.
- D. Piping concealed need not be painted.

3.3 HANGERS AND INSERTS

- A. Refer also to other sections which may describe additional requirements for hanging and supporting. Comply with the more stringent requirement if more than one method is specified or shown.

- B. Provide and properly locate hangers to adequately support piping and equipment. Arrange hangers to permit expansion and contraction.
- C. The size of hanger for non-insulated pipes shall be suitable for pipe size to be supported. For insulated piping, the size of the hanger shall be suitable for the pipe size, plus the insulation and a 16-gauge half-circle galvanized sheet metal insulation saddle.
- D. Isolation of copper pipe from steel hangers to consist of wrapping pipe at, and 1" each side of contact surface with not less than two layers of adhesive type plastic electrical insulating tape.
- E. Pipe supports for piping 2" diameter and below may be supported directly from Epicure steel decking using Epicure standard hangers (200 lb. max. load). Piping above 2" shall be supported from steel beams.
- F. Locate pipe supports as follows unless noted in other sections of these specifications or on the drawings:
 - 1. Horizontal cast iron pipe inside building - supported on each length of pipe.
 - 2. Vertical cast iron pipe inside building - supported at each floor level and at the base.
 - 3. Horizontal steel piping and copper tubing 1" diameter and under - support on 6' centers.
 - 4. Horizontal steel piping and copper tubing above 1" through 1-1/2" diameter - support on 8' centers.
 - 5. Horizontal steel piping and copper tubing larger than 1-1/2" diameter -support on 10' centers, except 24" diameter piping shall be supported by main roof beams (20' O.C. maximum).
 - 6. Support vertical cast iron, steel and copper piping at each floor penetration not to exceed 20 foot intervals.

3.4 ANCHORS

- A. Install a suitable anchor on piping to prevent movement from expansion and contraction by welding or clamping securely to pipe at fitting or coupling. Approval of the Architect/Engineer of method of anchorage must be obtained before installation of work. Properly anchor piping to remove strains on equipment which would be caused by expansion and contraction. Adequately insulate anchors on piping, with operating fluid temperatures below 75°F, to prevent moisture condensation problems.

3.5 EXPANSION AND CONTRACTION PROVISIONS

- A. Piping is designed with offsets and loops to provide for expansion and contraction. At such points, piping shall be cold sprung to equalize expansion when at operating temperatures. Install piping to maintain grade at all operating temperatures.

3.6 FLASHING

- A. Flashing shall be done as work of other divisions.

3.7 SLEEVES FOR PIPING

- A. Provide sleeves for all piping where pipe penetrations in walls, floors or other building structure are required. Sleeves in poured concrete shall have water tight seams and joints.
- B. Extend sleeves through walls, partitions and ceilings to finished surface. Extend sleeves through finished floors to not less than 1/4 inch above finished surface. Extend sleeves in concrete floors in chases to not less than 1 inch above floor top surface. Sleeves installed above finished ceilings as part of fire/smoke rated wall assemblies shall extend not less than 1" beyond both wall faces.
- C. Provide sleeves of adequate size to permit clearance for pipe movement and proper grading and sloping of pipes. Provide sleeves for insulated pipe of adequate size to clear insulation.
- D. Caulk space between sleeve's inner surface and pipe's outer surface (including insulation surface if pipe is insulated) with approved with fire rated safing material. Provide flexible fire retardant sealant if pipe is subject to expansion or contraction. Final result shall be an approved fire and smoke stop at pipe and sleeve assembly.
- E. Sleeves in walls and slabs subject to hydrostatic pressures shall be water tight at twice the hydrostatic pressure expected to be encountered at the location of the penetration.

3.8 SLEEVES FOR DUCTWORK

- A. Ductwork sleeves shall be provided in accord with current SMACNA recommendations or as otherwise detailed on Drawings. Refer also section describing duct systems.

3.9 ESCUTCHEONS

- A. Provide chrome plated brass escutcheons (for 1/4 or 1 inch projecting sleeves as required) at each point where an uninsulated pipe passes thru a finished surface.

3.10 CONCRETE BASES AND STRUCTURAL STEEL

- A. Concrete bases and structural steel to support equipment and piping installed under each specification section or division and not specifically shown on the structural or architectural plans shall be furnished for this work.

3.11 SEALANT

- A. Fire/smoke sealant shall be installed in strict compliance with the manufacturer's installation instructions.

END OF SECTION 23 05 00

SECTION 23 05 15

INSTRUCTIONS AND MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide complete written and verbal operating and maintenance instruction to the Owner for all mechanical systems.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Divisions 22 and 23 and to all other applicable portions of the Drawings and Specifications.
- B. This section directly relates in particular to sections which describe the following:
 - 1. Valves and piping systems components requiring maintenance and which are involved in the dynamic function of the systems.
 - 2. Pumps and related flow devices.
 - 3. Plumbing equipment (heat exchangers, packaged systems, etc.)
 - 4. HVAC equipment (all air handling equipment, terminal units, filter assemblies, etc).
 - 5. Control systems.

PART 2 - PRODUCTS

2.1 INSTRUCTIONS AND MAINTENANCE MANUALS

- A. Provide three Instructions and Maintenance Manuals, each complete as follows:
 - 1. Hardback three-ring loose-leaf binders.
 - 2. Title sheet with job name, Contractor's, subcontractor's control subcontractor and related contractor's or material supplier's names, addresses and phone numbers.
 - 3. Index of contents.

4. A signed copy of acknowledgment of instructions to the Owner or his authorized representative. Two additional copies of the signed acknowledgment shall be sent directly to the Architect as soon as possible after receipt.
5. Typewritten operating instructions for the Owner's personnel describing the following for each piece of equipment and systems:
 - a. How to start and stop each piece of equipment.
 - b. How to set equipment and systems for normal operation.
 - c. Normal restarting procedures before contacting the service contractor.
 - d. Complete description of functions and operations of each piece of equipment including description of how equipment operates in conjunction with automatic control systems.
 - e. Instructions for cleaning, oiling, greasing, fueling and similar tasks.
6. Approved shop drawings and submittal data and parts and maintenance booklet for each item of material and equipment furnished under this Division, including (but not limited to) the following:
 - a. Spare parts list and source of supply for each equipment item.
 - b. List of valves with location, service, size, model and operating position.
 - c. Diagrams clearly indicating automatic control hook-up.
7. Any as-built wiring diagrams as called for in other sections of this division as needed to show how equipment controls interface with related systems.
8. Copies of certificates of inspection.
9. Guarantees.

PART 3 - EXECUTION

3.1 VERBAL INSTRUCTION

- A. Provide verbal, hands-on, operating and maintenance instruction to Owner's authorized personnel for each equipment item and system. Instruction shall be given by competent personnel.
 1. Duration: Total instruction period for all systems of this Divisions 22 and 23 shall be not less than fifteen (15) working days. The Owner reserves the right to audio-tape or video-tape the instruction procedure.

3.2 MANUFACTURERS' SERVICE REPRESENTATIVES

A. Verbal instruction at the site for the following equipment items and systems shall be given jointly by the contractor and the authorized manufacturer's service representative. (Contractor and manufacturer's service representative shall provide instruction to Owner for each equipment item of no less duration than the hours indicated in parenthesis. Duration shall be greater if otherwise specified).

1. Water Cooled Chillers. (48 hours)
2. Pumps. (16 hours)
3. Heat Exchanger. (8 hours)

4. Air Handling Units. (48 hours)
5. Exhaust Fans. (24 hours)
6. Terminal Units. (8 hours)

END OF SECTION 23 05 15

SECTION 23 05 29

HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SCOPE

- A. Provide all angles, brackets, clamps, anchors, inserts, rods, braces, frames, hangers nuts and bolts, and other miscellaneous steel and hardware items as may be required for the proper support of equipment, piping systems, HVAC systems, plumbing systems and fire protection systems.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Divisions 22 and 23 and to all other applicable portions of the Drawings and Specifications.
- B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Piping systems.
 - 2. Duct systems.
 - 3. Equipment items.

1.4 SHOP DRAWINGS

- A. Refer to Section entitled "General Mechanical Provisions". Provide specific data on hangers, stands, clamps, rollers, guides, shields, anchors and their proposed application. Submit detailed shop drawings, showing method of support and anchoring for all piping and equipment as follows:
 - 1. Piping Systems
 - 2. Scaled single line piping plans superimposed on structural construction drawings. Scale shall be minimum 1/4" = 1'-0". Piping which is three inch (3") diameter and smaller may be omitted from these shop drawings. Drawings shall clearly indicate the location and type of each and every insert, hanger, stand, support, guide, isolator and anchor; and shall also indicate the size, type locations and method of attachment for all miscellaneous structural steel required.

3. Sectional drawings, sketches and other details as may be required to clearly communicate the method of support, anchoring, guiding and vibration isolation.
4. Show details of any typical floor or wall penetrations including: riser clamp, pipe sleeve, and provisions for water stop to prevent the water travel between penetrations.

1.5 INDUSTRY STANDARDS

- A. Where compliance with an industry, society or association standard is specified or indicated, certification of such compliance shall be submitted with shop drawings.

1.6 MANUFACTURER

- A. Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:
 1. F&S Manufacturing Corp.
 2. Fee and Mason Manufacturing Co.

PART 2 - PRODUCTS

2.1 HANGERS

- A. Hangers In Contact With Copper Piping: Shall be copper plated or teflon coated. Hangers shall be Fed. Spec. WW-H-171E, Type 9. Acceptable: Grinnell Fig. 97 or 97C, or equivalent.
- B. Hangers (other than in Contact with Copper Piping): Shall have manufacturer's standard finish. Hangers shall be of the following types:
 1. Pipe 3" and Larger: Fed. Spec. WW-H-171E, Type 1. Acceptable: Grinnell Fig. 260 or equivalent.
 2. Pipe 2-1/2" and Smaller: Fed. Spec. WW-172E, Type 6. Acceptable: Grinnell Fig. 104 or equivalent.

2.2 ISOLATORS

- A. Refer to the Section, if included in this Division, which describes vibration isolation.

2.3 PIPE ROLLER STANDS

A. Shall be Fed. Spec. WW-H-171D, Type 47. Acceptable: Grinnell Fig. 171, or equivalent.

2.4 PIPE ROLLER HANGERS

A. Pipe Roller Hangers: Shall be Fed. Spec. WW-H-171E, Type 42. Acceptable: Grinnell Fig. 171, or equivalent.

2.5 PIPE ALIGNMENT GUIDES

A. Acceptable: Grinnell Fig. 256, or equivalent.

2.6 PIPE RISER CLAMPS

A. Pipe Riser Clamps: Shall be Fed. Spec. WW-H-171D, Type 8.

2.7 INSULATION SHIELDS

A. Shall be Fed. Spec. WW-H-171D, Type 41. Acceptable: Grinnell Fig. 167, or equivalent.

2.8 BEAM CLAMPS

A. Fed. Spec. WW-H-171D, Type 29. Acceptable: Grinnell Fig. 292 with links, or equivalent.

2.9 INSERTS

A. Preset Type: Malleable iron with removable interchangeable nuts having lateral adjustment of not less than one and five-eighths inches. Continuous inserts shall have a capacity of 2,000 lb. per foot and shall be hooked over reinforcing. Acceptable: C-B Universal Fig. 282; Unistrut Products Co., P3200 or P3300; B-Line Systems, Inc., Series B- 32.1, or equivalent.

2.10 ROD

A. Carbon steel, black threaded bolt ends or continuous thread, sized with safety factor of five (5). Acceptable: Grinnell Fig. 140 or 146, or equivalent.

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to Section entitled "General Mechanical Provisions". All inserts, fasteners, hangers and supports shall be installed in strict accordance with manufacturer's instructions. Fasteners for outdoor use shall be hot dipped galvanized or stainless steel. Fasteners in cooling tower yards shall only be stainless steel.

3.2 PIPE

- A. General: Hangers shall be spaced to prevent sag and to permit proper drainage. All piping shall be run parallel with the lines of building, unless otherwise indicated on drawings. The hanger spacing and placement shall be such that after the covering (insulation and finish) is applied, there will be not less than 1/2" clear space between finished covering and other surfaces, including the finished covering of parallel adjacent pipes. Hangers for insulated pipes shall be sized to encompass the insulation, finish and metal insulation shield (a metal insulation shield shall be provided for each hanger or support). Vertical piping shall be supported with pipe riser clamps at every floor penetration, unless specifically indicated otherwise on the drawings. Hangers and supports shall not be placed at greater than the following intervals:

1. Pipe 1" and Smaller: Eight foot (8') centers and not more than two feet (2') from a change in direction (offsets, elbows, and tees).
2. Pipe 1-1/4" through 2-1/2": Ten foot (10') centers and not more than two feet (2') from a change in direction (offsets, elbows and tees).
3. Pipe 3" and Larger: Fourteen foot (14') centers and not more than two feet (2') from a change in direction (offsets, elbows, and tees).

3.3 EQUIPMENT

- A. Equipment supports shall be as otherwise indicated on the drawings or in the specifications.

3.4 DUCTWORK

- A. Refer to Sections describing ductwork.

3.5 POWDER (GUNPOWDER) ACTUATED FASTENERS

- A. Not allowed.

3.6 STEEL DECKING

- A. On projects where floor or roof slabs are installed over steel decking, drill or punch web of steel decking and insert hangers with washers before the concrete fill is poured in place. Hangers shall be plumb within one-half inch (1/2") in four feet (4') and spaced as required for service intended.

END OF SECTION 23 05 29

SECTION 23 05 93

PERFORMANCE VERIFICATION, PRELIMINARY

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawing and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Put all work in a state of readiness for final performance verification.
- B. Final performance verification shall not begin until the systems are complete and operable in all respects and all related building systems are complete.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.
- B. Refer to the section which describes "Performance Verification, Final".

PART 2 - PRODUCTS

This section not applicable.

PART 3 - EXECUTION

3.1 WATER SYSTEMS

- A. Prepare each water system for balancing in the following manner:
 - 1. Open all valves to the full position, including coil stop valves; close bypass valves, and open return line balancing cocks.
 - 2. Clean all strainers.
 - 3. Examine fluid in each system to determine that it has been treated and is clean.
 - 4. Check pumps for proper rotation.
- B. Check expansion tanks for full capacity of water and the absence of air lock.

- C. Check all air vents at high points of system for proper installation and free operation. Remove all air from circulating system.
 - 1. Set all temperature controls for full heat or full cooling (as applicable) from all coils.
 - 2. Check for proper operation of any automatic bypass valves.

3.2 STEAM SYSTEMS

- A. Prepare steam systems for balancing in the following manner:
 - 1. Open all valves to the full position in a gradual and modulated manner as appropriate for steam system start-up.
 - 2. Clean all strainers, traps and control valves.
 - 3. Examine system to determine that it has been treated and is clean.
 - 4. Check condensate return system pumps for proper rotation.
 - 5. Check tanks, heat exchangers and other vessels for full capacity of water and the absence of air lock.
 - 6. Check all air vents for proper installation for free operation.
 - 7. Remove all air from circulating system.
 - 8. Set all temperature controls for full heat.
 - 9. Check for proper operation of any automatic valves.

3.3 AIR SYSTEMS

- A. Prepare the air side for balancing in the following manner:
 - 1. All fans, blowers, and air handling equipment shall be mechanically checked and available to operate under design conditions.
 - 2. All splitters, volume dampers, fire dampers, and vanes shall be in their neutral positions.
 - 3. All grilles, diffusers, and like items, shall be installed with dampers, vanes, and blades in their neutral positions.
 - 4. All controls, whether they are electronic, electric or pneumatic or a combination thereof, shall be mechanically checked and ready to operate under design code in an operable and non-overloading condition.

3.4 ADDITIONAL REQUIREMENTS

- A. Complete Installation: The Contractor shall complete the equipment and system installation to the satisfaction of the Architect/Engineer (who will be the sole judge of its state of readiness) prior to advising, the writing, that final performance verification is ready to begin. The Contractor is hereby advised that the Certificate of Substantial Completion will not be issued prior to the completion of final performance

verification work and that he should therefore, schedule all other work accordingly allowing no less than 60 days for completion of final performance verification.

- B. Clean, Flush and Fill Systems: The Contractor shall include the cleaning, flushing, filling, and venting of all hydronic and steam systems; the setup, check-out, and startup of chemical treatment systems; and the setup, checkout and startup of all equipment as work to be complete prior to the start of final performance verification.
- C. Correction of Defects: The Contractor shall promptly and properly correct all defects in workmanship, material, installation and equipment of which he is aware prior to requesting that final performance verification work begin. Once the final performance verification work has begun, the Contractor shall promptly correct all defects in workmanship, materials, installation, and equipment as they are called to his attention by Architect/Engineer.
- D. Drive Changes: Changes in pulleys or belts required for correct final balance during testing shall be made at no additional cost.
- E. Scheduling and Coordination: The Contractor shall be responsible for proper scheduling and coordination of work involved in preliminary performance verification. This shall include, but is not necessarily limited to the timely provision of: mechanics, tools, equipment, correction of defects, equipment manufacturer's representatives, test modules, and all other items which may be required.
- F. Report: Submit a written report describing and certifying in detail all preliminary performance verification items and tasks that have been performed. Approval of this report by the Architect/Engineer will precede final performance verification.

END OF SECTION 23 05 93

SECTION 23 05 94

PERFORMANCE VERIFICATION, FINAL

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide the services of an independent test and balance agency to verify the performance of the complete heating, ventilating and air conditioning systems as described by Division 23. Performance verification shall be accomplished by established testing and balancing procedures as described in this section.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.

1.4 TEST AND BALANCE AGENCY

- A. All performance verification shall be performed by an independent test and balance agency (herein referred to as the "T & B Agency") which is fully certified by and a current member of the Associated Air Balance Council (AABC).

1.5 CONTRACTUAL RELATIONSHIP

- A. Performance verification shall be performed as a service of the T & B Agency directly to the Contractor with no other subcontractors as part of the agreement.
- B. Performance verification is specified in this Division 23 only because it relates predominantly to Division 23 work. However, the inclusion in this Division 23 of this section covering performance verification shall not preclude the contractual agreement of the T & B Agency from contracting directly to the Contractor with no other subcontractors as part of such agreement.

1.6 AGENCY APPROVAL

- A. Submit the name and qualifications of the proposed T & B Agency to the Architect/Engineer for approval within thirty (30) days of Notice to Proceed.

B. Include AABC National Project Certification Performance Guaranty.

1.7 WORK INCLUDED

A. The T & B Agency shall provide all labor, supervision, professional services, tools, test equipment and instruments (except as otherwise specified) to perform the following work and all other work of this section:

1. Review the automatic temperature control and air terminal unit specifications for their respective and combined effects on the testing and balancing procedures for the air and hydronic systems.
2. Where in the opinion of the T & B Agency conditions may exist in the system design or construction that may have the potential of adversely affecting system performance, then the T & B Agency shall identify the condition and submit in writing recommended correctives for consideration by the Architect/Engineer.
3. During construction, review those shop drawings which have relevance to performance verification to confirm that the required piping, ductwork and equipment, and their respective specialties and accessories such as gauges, valves, dampers, access doors, etc., are properly selected, sized and located to permit proper and complete testing and balancing to be accomplished.
4. Perform site inspections to verify compliance with documents, and observe pressure tests on ductwork.
5. Perform a complete air and hydronic test and balance of all heating, ventilating, air conditioning and exhaust air systems and all water and steam systems shown and described on the Construction Documents and as further described herein.
6. Submit Equipment Test and Systems Balance Report.
7. Furnish specifications to Contractor for properly sized fixed sheaves on fan systems after proper RPM has been established.

1.8 EXISTING SYSTEMS

- A. Prior to balancing and testing the new systems, obtain test data on those existing systems which may be affected by the new work. Then, after the new work is provided, rebalance (if and as necessary) those existing systems so that they operate at the same conditions under which they were operating prior to the new work.
- B. The above test data shall be provided as part of the test and balance report. The test data shall include the water and air flow rates and temperatures entering and leaving any equipment items which are part of the existing heating, ventilating and air conditioning system. However, only the fluid affected by the new work need be tested (for example, an air handling unit which is unaffected on its airside but which is affected on its waterside need only have water data obtained). Also, if a piping system branch serves a group of units, then only the flow at the existing branch need be measured and not necessarily the flow at each air handling unit served by the

branch (unless measurement at each unit is the only way to obtain the branch total flow).

1.9 GUARANTY

- A. The T & B Agency shall include a warranty period of ninety (90) days after completion and acceptance of test and balance work. During the warranty period, the Architect/Engineer may request a re-check or re-setting of any system component requiring testing and balancing. The T & B Agency shall provide technicians, instruments, and tools to assist the Architect/Engineer in conducting any test that he may require during this time. The foregoing shall be in addition to the A.A.B.C. National Project Certification Performance Guaranty which shall also be provided.

PART 2 - PRODUCTS

2.1 GENERAL

- A. The tangible product of this section shall include the reports and documentation necessary to verify the systems' performance.

2.2 REPORT

- A. The T & B Agency shall in the course of his work record the information herein specified. Recorded test data shall be at the final balanced condition for each system. Recorded data shall be arranged by system using the appropriate designation as established on the Construction Documents. Four (4) copies of the final report signed, bound and indexed shall be submitted to the Architect/Engineer for his approval or comments.
- B. Where actual measurements recorded for the final balance show deviations of more than 10% from the design, the T & B Agency shall note same in the report and submit recommendations for corrective action to the Architect/Engineer for his consideration.
- C. In those cases where recorded data can be reasonably interpreted to be inaccurate, inconsistent and/or erroneous, the Architect/Engineer may request additional testing and balancing. The T & B Agency shall at no additional cost perform such retesting and rebalancing as directed by and in the presence of the Architect/Engineer.
- D. Where, in the opinion of the T & B Agency, there is excessive vibration, movement or noise from any piece of equipment, ductwork, pipes, etc., the T & B Agency shall note same in the report and submit recommendations for action to the Architect/Engineer.

E. The T & B Agency shall verify that each thermostat and the devices it is controlling, such as control valves, motorized dampers, VAV boxes, etc., operate in the exact sequence required.

F. Test Data: Include the following data in the Systems Test and Balance Report:

1. Motors:

Manufacturer
Model and serial number
Rated amperage and voltage
Rated horsepower
Rated RPM
Corrected full load amperage
Measured amperage and voltage
Calculated BHP
Measured RPM
Sheave size, type and manufacturer

2. Fans:

Manufacturer
Model or Serial number, BI or Air Foil - number of blades
Rated CFM, measured CFM
Rated RPM, measured RPM
Measured pressures - Inlet and Outlet Static Pressure
Pulley size, type and manufacturer
Belt size and quantity
Rated TSP
Operating TSP & operating ESP (at discharge side of Supply Fan or suction side of Exhaust/Return Fan)

3. Pumps:

Manufacturer
Model or Serial number, impeller size
Rated RPM, measured RPM
Rated head, measured head
Rated pressures
Measured discharge pressure (full flow and no flow)
Measured suction pressure (full flow and no flow)
Measured GPM
Operating head

Operating RPM

4. Air Systems (including inlets and outlets):

Provide single line diagrammatic plan locating each air inlet and outlet and its reference number.

Grille or diffuser reference number and manufacturer.

Grille or diffuser location.

Design velocity.

Design CFM.

Effective area factor and size.

Measured velocity.

Measured CFM

Terminal Unit CFM

G. Other Report Requirements: Where any systems have equipment or components which are not covered by the above, then the Final Test and Balance Report shall include the following data as applicable to such equipment or systems to confirm actual operation:

1. All inlet and outlet areas.
2. All applicable duct, pipe and coil sizes.
3. Outside, inside, mixed and supply air conditions.
4. All fluid velocities, flow rates, temperatures and pressures at appropriate locations.
5. All speeds.
6. All voltage and ampere ranges.
7. Descriptions of each test method used.

2.3 INSTRUMENTATION

A. All test and balance equipment and instruments to be furnished by the T & B Agency shall have been calibrated within six (6) months of use on this work. A list of equipment and instruments to be used shall be submitted to the Architect/Engineer prior to commencing test and balancing operations and shall include equipment and/or instruments, name, manufacturer, serial number and certification of last calibration date. Instruments without calibration adjustment capability shall be accompanied with manufacturer's certification of accuracy. Test and balance equipment and instruments furnished by the Contractor to the T & B Agency shall be accompanied with certification as required above. The T & B Agency shall be responsible for the protection from damage due to accident, abuse or misuse, all equipment and instruments provided by the Contractor, and shall return same in good working condition at the completion of the test and balance work to the Contractor. The T & B Agency shall repair at his expense to original condition and accuracy or replace with like equipment and instruments damaged in the work.

2.4 DIAGRAMS

- A. Provide a schematic diagram (i.e., one-line) of duct system(s) tested. Indicate on the diagram the relative location of all air distribution devices, VAV boxes, heating/cooling coils, points of data measurements (i.e., pitot traverse, temperature, static pressure) fans, air handling units, and similar equipment included in the system. Diagram shall identify each component tested. Said identification shall utilize the conventions shown on the drawings (i.e., AHU-1 or SF-6) and correlate with the data sheets provided in the Test and Balance Report.

2.5 LOGS AND FORMS

- A. Logs and forms shall clearly indicate following:
 - 1. All inlet and outlet areas.
 - 2. All applicable duct, pipe and coil sizes.
 - 3. Outside, inside, mixed and supply air conditions.
 - 4. All fluid velocities, flow rates, temperatures and pressures at significant locations (e.g., fluid pressures before and after each pump and fan, temperatures and pressures at supply and return headers and at chiller and boiler inlets and outlets, etc.).
 - 5. All fan speeds.
 - 6. All motor ampere ranges.
 - 7. Descriptions of each test method used.
- B. Associated Air Balance Council log and data forms.

PART 3 - EXECUTION

3.1 GENERAL

- A. Sheaves: The Contractor shall provide applicable fans with V-belt drives and fixed pitch sheaves. In order to provide the properly sized fixed pitch sheave, the Contractor shall initially provide fans with V-belt drives, variable pitch sheaves. The Contractor, upon completion of system balancing by the T & B Agency, will replace these adjustable pitch sheaves with fixed sheaves of the size and type specified by the T & B Agency. The Contractor shall tag the adjustable sheaves, transmit same to Owner, and receive written receipt by Owner of acceptance of these sheaves.
- B. Load Conditions: All testing and balancing of systems shall be undertaken with maximum attainable load. Testing and balancing of all air handling systems shall be accomplished with ceiling tile in place and enclosing partitions and doors erected.

- C. Observe all equipment and exposed piping for noise, movement or vibrations under normal operating conditions and report excesses to the Architect and Owner.
- D. Where patented measuring stations are installed, each of these is to be read and recorded. In the hydronic systems, the permanent devices, such as flow tubes with mercury manometers, annular ring systems, venturi tubes with portable meters, etc. must be used for final measurements after they are completed, calibrated and in satisfactory condition.

3.2 PERFORMANCE VERIFICATION, PRELIMINARY

- A. The Contractor, prior to commencement of the balancing by the T & B Agency, shall verify in writing:
 - 1. That strainers have been removed and cleaned.
 - 2. That all air filters have been installed and are in clean condition.
 - 3. That expansion tanks have been inspected and that the system is not air bound and is completely filled with water.
 - 4. That all air vents at coils and high points of the piping systems have been inspected and are installed and operating freely.
 - 5. That all automatic valves, hand valves, and balancing valves have been left or fixed in the open position for full flow through all devices.
 - 6. That all linkages between valves or dampers and their actuators are secure.
 - 7. That all pumps and fans are operating at the specified RPM.
- B. The Contractor shall confirm in writing that the systems as scheduled for balancing, are operational and complete and that all piping and ductwork have been pressure tested and accepted and all affected piping systems have been cleaned, flushed and refilled with prescribed treated water and vented.

3.3 PROTECTION OF WORK

- A. The Contractor shall protect all mechanical devices during the testing and balancing period. The activities of the T & B Agency will include but not be limited to the adjustments of designated balancing devices including; adjustment of balancing dampers, adjustment of inlet vane dampers, adjustment of air extractors, air splitters, or manual dampers, the adjustment of adjustable sheaves for fan speed, the adjustment of balancing valves, or similar devices. The existence of the T & B Agency shall not relieve the Contractor of his responsibility for the complete operation of the mechanical systems in conformance with the contract documents.

3.4 CORRECTION OF WORK

- A. The Contractor shall at no additional cost to the Owner rectify discrepancies between the actual installation and contract documents when in the opinion of the T & B Agency the discrepancy will significantly affect system balance and performance.

3.5 COORDINATION AND ASSISTANCE

- A. The Contractor shall assist the T & B Agency by providing all labor, equipment, tools and material required to operate all of the equipment and systems necessary for the testing and balancing of the systems and for the adjustment, calibration or repair of all electric or pneumatic or automated control devices and components. These services shall be available on each working day during the period of final testing and balancing. The Contractor shall assist the T & B Agency by arranging to have all ceilings, partitions, windows, and doors installed prior to the scheduled commencement of balancing within each specified area.
- B. The Contractor shall provide to the approved T & B Agency a complete set of plans and specifications and an approved copy of all heating, ventilating and air conditioning equipment shop drawings. The Contractor shall include the cost of all pulley, belt, and drive changes, as well as balancing dampers required to achieve proper system balance recommended by the T & B Agency.

3.6 AIR SYSTEMS

- A. The testing and balancing shall include, but is not limited to, the following requirements:
 - 1. Adjust fan speeds to deliver the required cfm and static pressure, and record rpm and full load amperes.
 - 2. Make pitot tube traverse of main supply ducts to verify design cfm. Seal duct access holes with rubber or metal snap-in plugs.
 - 3. For each supply air system, verify the quantity of outside air and return air when the system is operating in the maximum cooling and full heating modes.
 - 4. Test and adjust each diffuser, grille and register to within 10% of design requirements, and also adjust so as to minimize drafts in all areas.
 - 5. Observe all equipment and exposed ductwork for noise, movement or vibration under normal operating conditions and report excesses to the Architect/Engineer.
- B. After all air distribution devices have been balanced to distribute calculated design indicated air quantities and if temperature in any area (where such area does not have the particular zone temperature control thermostat located therein) of any zone is not maintained within 2 degrees plus or minus of the zone areas which does have the zone temperature control thermostat, then notify Architect/Engineer of such conditions and obtain approval to rebalance devices to obtain air quantities other than

those indicated so that air temperature in entire zone will be as even as possible regardless of calculated design air quantities. After obtaining approval to rebalance, perform such necessary rebalancing.

3.7 HYDRONIC AND STEAM SYSTEMS

- A. The testing and balancing shall include, but is not necessarily limited to, the following requirements as applicable to either or both the hydronic systems and steam systems:
1. Prior to testing and balancing of each system check all flow meters for proper installation, calibration and accuracy.
 2. Measure and adjust pump flow capacity to proper quantity.
 3. Adjust flow through chillers.
 4. Adjust flow through any heat exchangers.
 5. Balance system flows.
 6. Coordinate equipment operation and output performance with the manufacturer's representative. Record inlet and outlet temperatures.
 7. Mark or otherwise record settings of adjustable balancing devices which provide the design flow requirement.
 8. For each hydronic system record flow rate, pump inlet and outlet pressures and motor amperage for each pump for each increment of system flow rate provided by the pumping/piping configuration. Variable speed pumps shall operate as constant volume pumps at maximum speed for purposes of this record.

END OF SECTION 23 05 94

SECTION 23 07 00

INSULATION, HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide all work necessary to insulate all equipment, piping, ducts and other items related to the piping and duct systems.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division-23 and to all other applicable portions of the Drawings and Specifications.
- B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Piping systems.
 - 2. Duct systems.
 - 3. Heat generating equipment.
 - 4. Heat exchange equipment.
 - 5. Cooling equipment.

- C. Vessels, tanks, stacks, and other items which contain or convey fluids which are at such temperatures as to create condensation or surface temperatures which are hazardous or where heat loss or gain prohibits proper system operation.

1.4 SHOP DRAWINGS

- A. General: Refer to the Section entitled "General Mechanical Provisions". Shop drawings shall contain complete descriptive and engineering data, including flame spread and smoke developed ratings (ASTM E84 test method) on all materials and adhesives. Where finishes, covers, or jackets are specified, provide complete data on same. Shop drawings shall contain specified information on: densities, conductivities, conductances, or resistances as required to establish conformance with the specified values or materials.

- B. Industry Standards: Where compliance with an industry, society or association standard is specified or indicated, certification of such compliance shall be submitted with shop drawings.
- C. Commencement of Work: Submit shop drawings before any work is commenced.

1.5 STORAGE OF MATERIALS

- A. Do not store fiberglass insulation within the building until it has been "dried in". If no other dry space is available and this insulation must be installed or stored before the building is "dried in" and completely enclosed, provide polyethylene film cover for protection.

1.6 COMPLIANCE WITH CODES AND STANDARDS

- A. Applicable Codes: The total insulation system including insulation, sealant, finishes, etc., shall comply with or exceed all code requirements.
- B. NFPA: All materials and adhesives used shall conform to the requirements of NFPA 90A as to flame spread and smoke developed ratings.

1.7 DEFINITIONS AND TERMINOLOGY

- A. Terminology: Throughout this section, insulation products may be described as regards the location, surface or other point at which they are to be applied. Except in special cases (where a detailed indication or description will be given), the majority of conditions can be defined in whole or in part by use of (but not necessarily limited to) any or all of the following words:
 - 1. "Internal" or "External".
 - 2. "Interior" or "Exterior".
 - 3. "Concealed" or "Exposed".
 - 4. "Protected" or "Unprotected".
- B. Definitions: Wordage used to describe locations, surfaces or other points or conditions shall be defined as follows as related to this section. Where the ascertainment or determination of locations, surfaces and other conditions is obvious from the intent of use of the item (e.g., roof-mounted ductwork, underground piping, etc.) or from other information, then the following words may not be required. If any ambiguity should occur, provide bid based on the most severe condition; however, obtain clarification from Architect/Engineer prior to installation:
 - 1. "Internal" and "External": Relates to an item or its surface which is to be insulated or uninsulated. Does not relate to the confines of the building, structure

- or other entity in which the item is located. (Examples: internal/external surfaces of ductwork, pipe, air handling units or other such items.)
2. "Interior": Relates to the location of an item as to whether the item is within a heated, ventilated, air conditioned or otherwise controlled environment of the building, structure or other entity in which the item is located. "Interior" is always "Protected". (Examples(s): Interior ductwork, interior piping, interior air handling units.)
 3. "Exterior": Relates to the location of an item as to whether the item is outside (i.e., exterior to) a heated, ventilated, air conditioned or otherwise controlled environment of the building, structure, facility or other entity which the item serves or relates. "Exterior" generally means that the item is surrounded by the ambient outside environment. "Exterior" is considered "Unprotected" unless otherwise described. (Examples(s): exterior rooftop air handling units, exterior ductwork, exterior cooling tower.)
 4. "Concealed" and "Exposed": Relates to the visibility of an item. "Concealed" implies out-of-sight from normal view by an occupant, user or employee of the facility when such person is performing their normal function. "Exposed" implies that the item is readily visible by such a person when that person is performing a normal function. (Examples(s): "Concealed interior ductwork" would be out-of-sight in a ceiling plenum, whereas "exposed interior ductwork" would be readily visible in a mechanical equipment room or in a room which intentionally had no ceiling system.)
 5. "Protected" and "Unprotected": Relates to an exterior item which may or may not be sheltered from the outside elements but which exists in contiguous contact with the ambient environment without benefit of any direct heating, ventilating or air conditioning. (Example(s): Piping or ducts located in an open crawl space beneath a building would be "protected/concealed"; in an open parking garage such piping or ducts would be "protected/exposed". Piping or ducts on a rooftop would be "unprotected" and usually "exposed".)

PART 2 - PRODUCTS

2.1 GENERAL

- A. Materials: Materials listed are those used as basis of design; equivalent products of acceptable manufacturers will be accepted. Materials must be approved and recommended by the insulation product manufacturer for the particular application(s).
- B. Flame and Smoke Ratings: Application of insulation materials may require, in many cases, that the final insulation system comply with NFPA 90A with regard to maintaining a flame spread rating of 25 or less and a smoke developed/fuel contributed value of 50 or less. In such cases, verify that the materials comply with the indicated flame spread and smoke developed ratings.

- C. Applicability: Products and manufacturers listed may not all be applicable. Use only those products and manufacturers which are indicated as being applicable to a specific insulation condition.
- D. Acceptable Manufacturers: Manufacturers which are listed are those manufacturers who may make one or more of the insulation products required. Listing of a manufacturer does not necessarily mean the manufacturer is approved for all applicable insulation conditions. Each listed manufacturer must still comply with the specific requirements of each insulation condition to be acceptable for the particular application. Acceptable manufacturers of insulation-related products include (but are not necessarily limited to) the following: Armstrong; CertainTeed; Childers Products Co.; Knauf; Manville; Owens-Corning; Pittsburg Corning; Rubatex; Upjohn Co.; Duracote Corporation; Ferro Corporation; Dow Corning Corporation; Duro Dyne Corporation; Goodloe E. Moore, Inc.; 3M Co.; United McGill Corporation, Vimasco Corporation; Foster; Gustin-Bacon; Nomaco Inc.; Insulcoustic; Molded Acoustical Products; Lion Nokorode and other manufacturers as may be listed for a specific application.

2.2 BASIC MATERIALS

- A. Cellular Glass Insulation: Preformed or block type as indicated or as applicable. Fire, water and vermin retardant; closed cell glass composition; density of 8.5-pcf. Comply with the following: ASTM C 552, "Specification for Cellular Glass Thermal Insulation"; Military Specification MIL-I-24244B. Flame spread rating of "5" and a smoke developed rating of "0" as per ASTM E 84. Recommended temperature applications from -450°F to 1200°F when installed in accord with manufacturer's recommendations. Pittsburg-Corning Foamglas.
- B. Elastomeric Insulation: Preformed (tube), roll or sheet as indicated or as applicable. Nitrile, rubber based, closed cell structure. K factor of 0.28 at 75°F. In tube, roll or sheet form of 3/4-inch thickness or less, ASTM E 84 flame spread rating of "25" or less and smoke developed rating of "50" or less. Recommended temperature applications from -40°F to 220°F when installed in accord with manufacturer's recommendations. Do not install in return air plenums unless flame spread rating and smoke developed rating are within constraints of applicable codes. Manufacturers and/or series: Armstrong "Armaflex"; Manville "Aerotube"; "Rubatex"; Gustin-Bacon "Ultra-Foam".
- C. Fiberglass Insulation: Inorganic fibrous glass. Flame spread of "25" or less and smoke developed rating of "50" or less per ASTM E 84.
 - 1. Board: Rigid or semi-rigid form, faced or unfaced as indicated. Stiffness of 475 EI, 800 EI or 1400 EI as indicated.
 - 2. Blanket: Flexible form; faced, unfaced or coated as indicated.
 - 3. Preformed: Jacketed or unjacketed as indicated.

- D. Calcium Silicate Insulation: Preformed or block type as indicated or as applicable. Asbestos free. Rigid hydrous calcium silicate. K factor of 0.42 at 200°F. Density: 14-pcf. Flame spread rating of "0" and smoke developed rating of "0" as per ASTM E 84. Recommended temperature applications up to 1200 °F. Use where indicated only on equipment and surfaces which generate heat; do not use as a cold-surface insulation.

2.3 INSULATION PRODUCTS, BASIC

- A. Type PI-1: Pipe insulation, preformed cellular glass. Pittsburg-Corning "Foamglas" or equivalent.
- B. Type PI-2: Pipe insulation, preformed jacketed fiberglass. Jacketed with factory-applied kraft reinforced foil vapor barrier jacket. Jacket closure system of double pressure-sensitive adhesive on longitudinal joints; self-sealing butt strips at circumferential joints; provide positive vapor barrier seal. Thermal conductivity (K) of 0.24 at 100°F. Owens-Corning Fiberglas ASJ/SSL-II; Manville Micro-Lok with AP-T Plus jacket; CertainTeed 500 Snap-On; or equivalent.
- C. Type PI-3: Pipe insulation, preformed unjacketed fiberglass. Suitable for field-jacketing. Thermal conductivity (K) of 0.23 at 100°F. Owens-Corning Fiberglas No-Wrap, Manville Micro-Lok, or equivalent.
- D. Type PI-4: Pipe insulation, preformed segmental rigid calcium silicate. Thickness as indicated; provide single layer where nominal pipe size allows; provide "factory nested" double layer when nominal pipe size so requires for the thickness indicated. Owens-Corning Kaylo; Manville Thermo-12; or equivalent.
- E. Type PI-5: Pipe insulation, preformed elastomeric. Rubatex, Armaflex II or equivalent.
- F. Type I-1: Cellular glass block insulation. Field formed, fitted and finished as required for the application. Pittsburg-Corning Foamglas or equivalent.
- G. Type I-2: Calcium silicate block insulation. Field formed, fitted and finished as required for the application. Owens-Corning Kaylo; Manville Thermo-12; or equivalent.
- H. Type I-3: Elastomeric insulation. Field formed, fitted and finished as required for the application. Armaflex, Rubatex or equivalent.
- I. Type I-4: Fiberglass flexible blanket insulation. Unfinished, non-combustible, wool-like; composed of long glass fibers bonded with a thermosetting resin. Thermal conductivity (K) of 0.23 at 100°F. Applicable where indicated for boilers, vessels, breaching and stacks operating at up to 1000°F. Finished or held in place by wire

ties, metal lath, lagging or as indicated. Owens-Corning Thermal Insulating Wool TIW Type II or equivalent.

- J. Type DI-1: Duct insulation, fiberglass flexible blanket wrap. Composed of flexible blanket of glass fiber factory laminated to a reinforced foil kraft (FRK) vapor barrier with a minimum 2-inch taping and stapling flange on one edge. Suitable for operation at temperatures from 40°F to 250°F. Thermal conductivity of 0.31 at 75°F. Minimum density of three-quarter (3/4) pound per cubic foot. Provide in thickness of (2.2) inches unless otherwise specified as 2-1/2 or 3-inch thickness. Owens-Corning All Service Faced Duct Wrap; Manville R-Series Microlite; CertainTeed Standard Duct Wrap; or equivalent.
- K. Type DI-2: Duct insulation, fiberglass semi-rigid board. Composed of resin bonded glass fibers faced with a foil scrim-kraft (FSK) reinforced laminate of aluminum foil and kraft bonded to provide a metallic surface finish vapor barrier; alternate vapor barrier facing (if specifically indicated) is an all service jacket (ASJ) of high intensity white bleached, chemically treated kraft paper reinforced with fiberglass yarn mesh and laminated to aluminum foil with fire-retardant adhesive to impart a clean, white appearance. Conductivity (K) of not greater than 0.23 at 75°F. Provide in thickness of one (1) inch unless otherwise indicated. Provide with minimum density of 3-pcf unless 6-pcf is specifically indicated. CertainTeed Industrial Insulation Board Type IB-300 (or IB-600); Manville 800 Series Spin-Glas Type 814 (or 817); Owens-Corning 700 Series Industrial Insulation Board Type 703 (or Type 705); or equivalent.

2.4 INSULATION ADHESIVES, MASTICS, SEALANTS

- A. All Adhesives, Mastics, Sealants used indoors shall be of the low VOC type in compliance with the latest addition of LEED.
- B. Adhesive (Type A-E1): For joints and seams in elastomeric insulation (Type I-3) not requiring weather protection. Rubatex R-373 Insulation Adhesive; Armstrong 520 Adhesive or equivalent.
- C. Joint Sealant (Type JS-CG1): Non-hardening vapor barrier sealant specifically designed for use with cellular glass insulation (Types PI-1, I-1): Foster's 35-40 Foamseal Sealant, Pittsburg-Corning Pittseal 111 Sealant or equivalent.
- D. Adhesive (Type A-F1): For adhering fiberglass blanket and board insulations (Types DI-1, DI-2) to metal substrate such as ductwork. Insulcoustic I-C 201, Foster 85-20 or equivalent.

- E. Mastic, General Purpose (Type M-GP1): Non hardening vapor barrier general purpose mastic. For use where indicated or otherwise applicable. Foster GPM 35-00 or equivalent.

2.5 INSULATION FINISHES, JACKETS AND COVERS

- A. Finishing Coating (Type FC-E1): For weather protection of elastomeric insulations (Types I-3, PI-5). Rubatex 374 coating; Armstrong Armaflex Finish or equivalent.
- B. Finish Mastic (Type FM-CG1): For cellular glass insulations (Types PI-1, I-1). Waterproof, weather, acid and alkali resistant asphalt mastic coating for use in the range of -40°F to 200°F (installation must be done when in the 50°F to 120°F range). Pittsburg-Corning Pittcote 300 Vapor and Weather Barrier Finish or equivalent.
- C. Finish Fabric (Type FF-CG1): For cellular glass insulations (Types PI-1, I-1). 6 x 6 meshes per inch polyester fabric for reinforcing the finish mastic. Pittsburg-Corning PC Fabric 79 or equivalent.
- D. Finish Fabric, General Purpose (Type FF-GP1): Nylon membrane. For use generally with fiberglass duct insulations (Types DI-1, DI-2) at joints or seams or as may be indicated. Apply using Foster GPM 35-00 or equivalent.
- E. Jacket, Underground Pipe (Type JP-CG-1): For cellular glass pipe insulations (Type PI-1, I-1) where indicated. Prefabricated laminate containing a 20 x 10 mesh asphalt impregnated glass fabric and a 1-mil thick aluminum foil sandwiched between three layers of a bituminous mastic. External jacket surface coated with a protective plastic film and internal surface with a special release paper. Apply around cellular glass pipe insulation in a cigarette type wrap with the overlap heat sealed. Seal butt joints in the same manner using a 4-inch wide seal strip of the jacketing. Irregular surfaces of the pipe system shall have the jacket's plastic film burned away prior to application of a 20 x 10 asphalt impregnated mesh which shall be sandwiched between two glove coats of finish mastic (Type FM-CG1).
- F. Jacket, Pipe, PVC (Type JP-PVC): All purpose, UL-rated, UV-rated, white vinyl jacket, with or without self-sealing feature. Pittsburg-Corning "UNI-JAC" or equivalent.
- G. Jacket, Pipe, Aluminum (Type JP-A1): Aluminum jacketing, 0.016 inches thick, type 3003 alloy, H-14 temper, circumferentially corrugated, with a continuously laminated moisture barrier of one mil polyethylene film and a protective layer of 40 lb. virgin kraft paper. Childers Products Co. "Corolon"; General Aluminum Supply Co. (Gasco); Insulcoustic "Alcorjac" or equivalent.
- H. Pipe Fitting Covers, PVC (Type PFC-PVC): Insulated polyvinyl-chloride fitting covers in shapes as required; with fiberglass insulation insert. Suitable for temperature range of 0°F to 450°F. Flame spread rating of 25 or less and smoke

developed rating of 50 or less when kept below 150°F. Acid, alkali and chemical resistant. Suitable for painting if required. Manville Zeston 25/50 PVC Insulated Fitting Covers or equivalent.

- I. Pipe Fitting Covers, Aluminum (Type PFC-A1): Aluminum fitting covers, 0.020 inches minimum thickness, type 3003 alloy, H-14 temper prefabricated fitting covers with baked epoxy moisture barrier for pipe sizes through 24". Field fabricate fitting covers for pipe sizes larger than 24" using 0.020 inches thick aluminum roll jacketing with laminated polyethylene/kraft moisture barrier. Childers Products "Ell-Jacs", "Gore Ell-Jacs", "Tee-Jack", "End-Caps", and "Flange Jacs" or equivalent.

2.6 RELATED PRODUCTS

- A. Wire (Type W-1): Dead soft, 16-gauge, stainless steel.
- B. Straps (Type ST-1): Stainless steel T-304 (18-8) soft annealed with deburred edge with stainless steel wing seals. Childers Products "Febstraps" or equivalent.
- C. Tape (Type T-1): High tensile strength rope stock flat back paper pressure sensitive tape. Pittsburg-Corning "PC Tape No. 25" or equivalent.
- D. Screws (Type S-1): Aluminum pan head type "A" slotted #8 by 1/2-inch.

PART 3 - EXECUTION

3.1 GENERAL

- A. Field Forming, Fitting and Finishing: Where preformed insulation products are indicated as being acceptable for a particular application, provide field formed, fitted and finished insulation systems if such application is more practical (such as due to size, configuration or dimensions which may be outside of the availability ranges for size, dimension and/or thickness of preformed products).
- B. Pre-installation:
 - 1. Do not apply insulation adhesives, materials or finishes until the item to be insulated has been completely installed and tested and proved tight and suitable for insulation.
 - 2. Prepare surfaces to be clean and dry before attempting to apply insulation.
- C. Insulation Shields: Provide hanger or pipe support shields of 16 gage (minimum) galvanized steel over or embedded in the insulation. Shield shall extend halfway up the pipe insulation cover and at least 6" on each side of the hanger. Securely fasten shield with pipe straps at each end.

- D. Valves, Cocks and Specialties: Insulate as for the related piping system in which they are located unless otherwise indicated.
- E. Factory Pre-insulated Components: Where equipment and other system components are specified in other sections to have factory installed insulation, then no additional insulation is required as work of this section unless additional non-factory-installed insulation is specifically described. Examples of such equipment and components which may not require additional insulation include, but are not necessarily limited to, boiler vessels, chiller evaporators, air handling units, airside terminal units, and similar items.
- F. Minimum Thicknesses: Insulation thicknesses which are indicated are minimum thicknesses. Contractor may provide the same insulation material in greater thickness as an aid to installation and handling procedures or due to material availability and procurement considerations.
- G. Branch Runouts: Branch runouts are considered to be individual supply/return pipes to individual terminal heating or cooling units (duct mounted coils, airside terminal units with heating coils, fan coil units, humidifiers, and similar small equipment). The supply/return pipe to such units is not considered to be a branch runout if the length of the supply or return pipe exceeds 12'-0" in length to the coil/unit connection.
- H. Steam Supply Piping Systems and Steam Condensate Return Piping Systems:
 - 1. Supply Piping System: Shall be considered as the portion of the steam piping systems which conveys steam to a point of direct use at an equipment item which utilizes the steam for humidification or other useful purpose. Such piping conveys steam in or at its vapor phase condition.
 - 2. Condensate Return Piping System: Shall be considered as all portions of the steam piping system which are not part of the steam supply pipe system. Such piping generally conveys steam condensate, exhaust or vented steam, feedwater, blowdown and similar forms of piping on the low pressure (downstream) side of steam traps and relief valves.
- I. Steam System Classifications: Steam systems of the following classifications shall be considered to operate within the following temperature and pressure ranges. See performance data scheduled, specified or shown for applicable operating conditions.
 - 1. Low pressure: 0 to 15-psig; up to 250°F.
 - 2. Medium pressure: Between 15-psig and 60-psig; between 251°F and 305°F.
 - 3. High pressure: Over 60-psig; between 306°F and 450°F.
- J. Insulation for Plumbing Systems: See other sections describing insulation for plumbing systems.

3.2 INSULATION THICKNESS FOR PIPING SYSTEMS

A. General:

1. Basis: Insulation thicknesses for piping are given for insulation installed in the locations indicated. Thicknesses are based on the various conditions of temperature, usage and environment which are typically encountered.
2. Applicable Thicknesses: All thicknesses as applicable to all conditions may not be given in this section article. Where an insulation thickness for a particular application is specified to be of other thickness than may be listed in this section article, "INSULATION THICKNESSES FOR PIPING SYSTEMS", then provide the insulation in the thickness indicated in other portion of this section which specifically describes the particular insulation application and its required insulation thickness. Thicknesses for other than piping insulation are given in the specific description of the particular application or description of the particular material used.
3. Ambient Conditions: Unless otherwise indicated, ambient conditions for the purpose of describing insulation thicknesses are related to cold applications to prevent condensation or excessive heat gain (e.g., chilled water pipe, cold vessels) and are related to hot applications to prevent harm to personnel or to prevent objectionable heat loss to the environment (e.g., hot water pipe, hot vessels, hot stacks).

a. These conditions are generally:

Interior: 80°F and 80% RH.

Exterior: 90°F and 80% RH.

4. Thickness Requirements: Thicknesses are given below based on the following information:
 - a. General type of fluid or process involved (e.g., chilled water, hot water, steam, refrigerant).
 - b. General location and, if necessary, conditions related to temperature (either or both internal or external to the insulation barrier) and ambient environment of the insulated item.
 - c. Pipe size range.

- B. Refrigerant Piping Systems: Fluid generally considered to be between 40°F and 65°F. Thickness is for elastomeric unless other insulation material is indicated.

Location or Description Pipe Size (inches) Insulation Thickness

Interior	All Sizes	1"
Exterior	All Sizes	2"
Underground	All Sizes	2"

C. Chilled Water Piping Systems: Fluid generally considered to be between 40°F and 65°F. Thickness is for cellular glass unless other insulation material is indicated.

Location or Description Pipe Size (inches) Insulation Thickness

Interior	Up to 1	1-1/2"
Interior	1-1/4 to 4	2"
Interior	6 and up	2-1/2"
Exterior	Up to 4	2-1/2"
Exterior	6 and up	3"
Underground	All Sizes	2"

D. Hot Water Piping Systems, Low Temperature: Fluid generally considered to be 200°F or less. Thickness is for fiberglass insulation except where annotated by the letter "G" in which case the insulation thickness is for cellular glass unless other insulation material is indicated. An asterisk (*) indicates branch runouts.

Location or Description Pipe Size (inches) Insulation Thickness

Interior*	Up to 2	1/2"
Interior	Up to 2	1"
Interior	2-1/2 and up	1-1/2"
Exterior, Protected	Up to 2	1-1/2"
Exterior, Protected	2-1/2 and up	2"
Exterior, Unprotected	Up to 2	1-1/2"G
Exterior, Unprotected	2-1/2 and up	2" G
Underground	Up to 4	2"G
Underground	5 to 14	2-1/2"G
Underground	16 and up	3"G

- E. Steam Supply Piping Systems, Medium and Low Pressure: Fluid generally between 200°F and 305°F. Thickness is for fiberglass insulation except where annotated by the letter "G" in which case the insulation thickness is for cellular glass unless other insulation material is indicated. An asterisk (*) indicates branch runouts.

<u>Location or Description</u>	<u>Pipe Size (inches)</u>	<u>Insulation Thickness</u>
Interior*	Up to 2	1-1/2"
-----	-----	-----
Interior; and Exterior, Protected	Up to 1	2"
-----	-----	-----
Interior; and Exterior, Protected	1-1/4 to 4	2-1/2"
-----	-----	-----
Interior; and Exterior, Protected	5 and up	3"
-----	-----	-----
Exterior, Unprotected	Up to 4	2"G
Exterior, Unprotected	5 and up	2-1/2"G
-----	-----	-----
Underground	Up to 4	2"G
Underground	5 and up	2-1/2"G
-----	-----	-----

- F. Steam Supply Piping System, High Pressure: Fluid between 306°F and 450°F. Thickness is for fiberglass insulation except where annotated by the letter "G" in which case the insulation thickness is for cellular glass unless other insulation material is indicated.

<u>Location or Description</u>	<u>Pipe Size (inches)</u>	<u>Insulation Thickness</u>
Interior; and Exterior, Protected	Up to 2	2-1/2"
-----	-----	-----
Interior; and Exterior, Protected	2-1/2 to 4	3"
-----	-----	-----
Interior; and Exterior, Protected	5 and up	3-1/2"
-----	-----	-----
Underground	Up to 4	2"G
Underground	5 to 8	2-1/2"G
Underground	10 and up	3"G
-----	-----	-----

- G. Steam Condensate Return Piping System (including all related piping for steam vent, steam blowdown, and feedwater). Thickness is for fiberglass insulation except where annotated by the letter "G" in which case the insulation thickness is for cellular glass unless other insulation material is indicated. An asterisk (*) indicates branch runouts.

<u>Location or Description</u>	<u>Pipe Size (inches)</u>	<u>Insulation Thickness</u>
Interior*	Up to 2	1"
Interior; and Exterior, Protected	Up to 1	1-1/2"
Interior; and Exterior, Protected	1-1/4 and up	2"
Exterior, Unprotected	Up to 4	2"G
Exterior, Unprotected	5 and up	2-1/2"G
Underground	Up to 4	2"G
Underground	5 and up	2-1/2"G

3.3 CHILLED WATER PIPING SYSTEMS

- A. Interior, Concealed (e.g., ceiling plenums): Insulate with prefabricated, cellular glass pipe insulation (PI-1, I-1). Butter joints with joint sealant (JS-CG1) and secure each section with not less than two wires (W-1). Finish with a layer of fabric (FF-CG1) applied between two glove coats of mastic (FM-CG1). Mastic and fabric shall be applied in strict accordance with the manufacturer's recommendations.
- B. Interior, Exposed (e.g., central mechanical rooms, air handling unit rooms): Insulate with prefabricated, cellular glass pipe insulation (PI-1, I-1). Butter joints with joint sealant (JS-CG1) and secure each section with not less than two wires (W-1). Finish with jacketing (JP-A1). Secure jacketing with straps. Finish elbows and fittings with mastic (FM-CG1), reinforced with fabric (FF-CG1); or finish with fitting covers (PFC-A1). Finish materials shall be applied in strict accordance with the manufacturer's recommendations.
- C. Interior, Exposed, Special Locations: Same as for "Interior, Concealed" with the additional requirement that the final coat of mastic for the insulation finish shall be especially gloved and finished smooth to accept painting of color(s) required in other divisions as specially selected by the Architect/Engineer. These special locations consist of exposed piping in the following normally occupied areas of the building:
1. Gymnasium.

2. Natatorium.

- D. Exterior, Protected: Same insulation system as for "Interior, Exposed" except thickness as required.
- E. Exterior, Unprotected: Same insulation system as for "Exterior, Protected" except thickness as required.
- F. Underground: Insulate with cellular glass pipe insulation (PI-1, I-1). Butter joints with joint sealant (JS-CG1) and secure each section with not less than two wires (W-1). Finish with underground jacket (JP-CG1) having 2-inch minimum overlap of the longitudinal seams. Heat seal longitudinal seams with a propane torch. Cover butt joints with a 4-inch wide strip of jacket with the edges heat sealed around the circumference. Precut the jacket to fit the contour or irregular surfaces such as 90° bends, 45° bends, fittings, etc. to which it is to be applied; in addition to heat sealing the jacket on these irregular surfaces, burn away the polyester film and glove a coat of mastic (FM-CG1) on the surface; while this coat is still tacky, embed a 10 x 10 asphalt impregnated fabric (FF-CG1) into the mastic. After this application has dried for not less than one hour, apply another coating of mastic. Caution: Keep mastic away from sparks and open flame and keep container closed when not in use.
- G. Underground Expansion Joints, Expansion Elbows and Expansion Loops: Provide oversized insulation telescoped over the adjacent pipe insulation to provide close fit and adequate annular space to allow all movement expected to be encountered through maximum temperature ranges (including idle) of the conveyed fluid. Provide 1-1/2 pcf density fiberglass pipe insulation of thickness equal to the cellular glass insulation beneath the oversized insulation to completely fill the annular space void and yet allow freedom of pipe movement. Comply with insulation manufacturer's recommendations for these conditions or with details on drawings, as applicable.

3.4 HOT WATER PIPING SYSTEMS

- A. Interior, Concealed: Insulate with glass fiber insulation (PI-2) with all purpose jacket. Elbows, joints, valves, unions and all like items shall be insulated using closely mitered insulation and wrapped with glass fabric and mastic or these items may be insulated and jacketed using pipe fitting covers (PFC-PVC). Install in strict accordance with the manufacturer's recommendations.
- B. Interior, Exposed: As specified for "Interior, Concealed", except finish with aluminum jacketing (JP-A1) and fitting covers (PFC-A1). Secure fitting covers with screws (S-1) and secure jacketing with straps (ST-1). Finish materials shall be applied in strict accordance with the manufacturer's recommendations.
- C. Interior, Exposed, Special Locations: Same as for "Interior, Concealed" with the additional requirement that the final coat of mastic for the insulation finish shall be especially gloved and finished smooth to accept painting of color(s) required in other

divisions as specially selected by the Architect/Engineer. These special locations consist of exposed piping in the following normally occupied areas of the building.

1. Gymnasium.
 2. Natatorium.
- D. Exterior, Protected: Same insulation system as for "Interior, Exposed" except thickness as specified.
- E. Exterior, Unprotected: None applicable.
- F. Underground: Same insulation system as for "Chilled Water Piping Systems" in this location except thickness as specified.
- G. Underground Expansion Joints, Expansion Elbows and Expansion Loops: Same as for "Chilled Water Piping Systems" in this location except thickness as specified.

3.5 STEAM SUPPLY PIPING SYSTEMS, LOW AND MEDIUM PRESSURE

- A. Interior, Concealed: Same insulation system as for "Hot Water Piping Systems" in this location except thickness as specified.
- B. Interior, Exposed: Same insulation system as for "Hot Water Piping Systems" in this location except thickness as specified.
- C. Exterior, Protected: Same insulation system as for "Interior, Exposed" except thickness as specified.
- D. Exterior, Unprotected: Same insulation system as for "Chilled Water Piping systems" in this location except thickness as specified.
- E. Underground: Same insulation system as for "Chilled Water Piping systems" in this location except thickness as indicated.
- F. Underground Expansion Joints, Expansion Elbows and Expansion Loops: Same insulation system as for "Chilled Water Piping Systems" in this location except thickness as specified.

3.6 STEAM SUPPLY PIPING SYSTEMS, HIGH PRESSURE

- A. Interior, Concealed: Same insulation system as for "Hot Water Piping Systems" in this location except thickness as specified.

- B. Interior, Exposed: Same insulation system as for "Hot Water Piping Systems" in this location except thickness as specified.
- C. Exterior, Protected: Same insulation system as for "Interior, Exposed" except thickness as specified.
- D. Exterior, Unprotected: None applicable.

3.7 DUCT SYSTEMS

A. General:

1. Locations and extent of both internal and external insulation for duct systems are described in section entitled "Ductwork" and/or by the "Duct Type and Location Schedule" on the Drawings.
 2. Internal Insulation: Ductwork which is required to be insulated internally (acoustically/thermally lined) shall be insulated as work of the section entitled "Ductwork".
 3. External Insulation: Ductwork which is required to be insulated externally shall be insulated as work of this section.
 4. Factory Insulation: Ductwork which is factory manufactured with internal or external insulation is not to be additionally insulated as work of this section unless specifically stated. Such factory insulated ductwork generally consists of flexible externally insulated ductwork and double walled acoustically thermally lined ductwork.
- B. Interior, Concealed (e.g., ceiling plenums): Where external insulation is required, insulate externally with 2.2 inch thick fiberglass blanket wrap (Type DI-1). Adhere duct insulation using adhesive (Type A-F1) applied in accordance with the manufacturer's recommendations. Where duct width exceeds twenty-four inches (24"), the insulation shall be additionally secured to the bottom of the duct using mechanical fasteners spaced one foot (1') on center. Insulation shall be applied with edges tightly butted, and all joints and breaks in the vapor barrier sealed using glass fabric and mastic applied in conformance with manufacturer's recommendations.
- C. Interior, Exposed, (e.g., air handling unit rooms): Where external insulation is required, insulate with 1-inch thick semi-rigid fiberglass board (Type DI-2). Adhere to ductwork with adhesive (Type A-F1). Finish joints and seams with finish fabric (Type FF-GP1).

3.8 DUCT SYSTEMS EQUIPMENT

- A. General: Insulate as follows unless detailed to a greater extent on the Drawings.
- B. Fire damper and Fire/Smoke Damper External Surfaces:

1. Externally Insulated Duct Locations: Extend duct insulation up face of fire damper to damper sleeve. Seal insulation edges with 4-inch minimum width duct tape.
 2. Internally Insulated Duct Locations: Provide additional external insulation from a point on the duct 12 inches from the fire damper to the fire damper and on the face of the fire damper to the fire damper sleeve. Seal insulation edges with 4-inch minimum width duct tape.
- C. Air Distribution Devices: Insulate the backs of all ceiling diffusers and other air outlet devices installed in other than return air plenums as specified for interior concealed ducts.

3.9 COLD EQUIPMENT AND RELATED COMPONENTS

- A. Pump Volutes for Chilled Water Systems: Insulate with elastomeric sheet insulation (Type 1-3) out to and including pump flanges. Provide cutouts or removable sections as required to provide access to grease fittings and similar items and to allow adequate clearance for shaft. Secure the insulation with adhesive (Type A-E1). Insulation thickness shall be one and one-half (1-1/2) inches.
- B. Expansion Tanks(s), Air Separator(s) and Chemical Pot Type Feeder(s) for Chilled Water Systems: Insulate with elastomeric sheet insulation (Type 1-3). Secure the insulation with adhesive (Type A-E1) applied to a clean surface and finish with a layer of membrane (Type FF-GP1) applied between two glove coats of mastic (Type M-GP1). Insulation thickness shall be one and one-half (1-1/2) inch.
- C. Condensate Drain Piping From Cooling Equipment:
1. Interior, and Exterior, Protected: Insulate with preformed elastomeric pipe insulation (Type PI-5) secured with adhesive (Type A-E1) and finished with white finish coating (FCC-E1). Thickness 3/4-inch. Provide 25/50 flame/smoke rating.
 2. Exterior, Unprotected: None applicable.
- D. Cold Surfaces at Chillers and Evaporators: Factory insulated. No insulation required as work of this section.
- E. Flexible Pipe Connectors for Vibration Isolation: Insulate with elastomeric insulation (Type 1-3). Secure the insulation with adhesive (Type A-E1) applied to a clean surface and finish with white finish coating (FC-E1). Insulation thickness shall be one and one-half inches (1-1/2").

3.10 HOT EQUIPMENT AND RELATED COMPONENTS

- A. Heat Exchangers, Shell and Tube: Insulate with 2-1/2-inch thick calcium silicate insulation (Type -2). Wire insulation securely to vessel and then cover with wire mesh. Apply a 1/2-inch thick finish coat of insulating finish cement over the wire mesh. Trowel external surface to a smooth finish.

END OF SECTION 23 07 00

SECTION 23 08 00

COMMISSIONING OF HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. Section includes commissioning process requirements for HVAC&R systems, assemblies, and equipment.
- B. Related Sections:
 - 1. Division 01 Section "General Commissioning Requirements" for general commissioning process requirements.

1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. CxA: Commissioning Authority.
- C. HVAC&R: Heating, Ventilating, Air Conditioning, and Refrigeration.
- D. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 ALLOWANCES

- A. Labor, instrumentation, tools, and equipment costs for technicians for the performance of commissioning testing are covered by the "Schedule of Allowances" Article in Division 01 Section "Allowances."

1.5 UNIT PRICES

- A. Commissioning testing allowance may be adjusted up or down by the "List of Unit Prices" Article in Division 01 Section "Unit Prices" when actual man-hours are computed at the end of commissioning testing.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Perform commissioning tests at the direction of the CxA.
- B. Attend construction phase controls coordination meeting.
- C. Attend testing, adjusting, and balancing review and coordination meeting.
- D. Participate in HVAC&R systems, assemblies, equipment, and component maintenance orientation and inspection as directed by the CxA.
- E. Provide information requested by the CxA for final commissioning documentation.
- F. Provide measuring instruments and logging devices to record test data, and provide data acquisition equipment to record data for the complete range of testing for the required test period.

1.7 CxA'S RESPONSIBILITIES

- A. Provide Project-specific construction checklists and commissioning process test procedures for actual HVAC&R systems, assemblies, equipment, and components to be furnished and installed as part of the construction contract.
- B. Direct commissioning testing.
- C. Verify testing, adjusting, and balancing of Work are complete.
- D. Provide test data, inspection reports, and certificates in Systems Manual.

1.8 COMMISSIONING DOCUMENTATION

- A. Provide the following information to the CxA for inclusion in the commissioning plan:
 - 1. Plan for delivery and review of submittals, systems manuals, and other documents and reports.
 - 2. Identification of installed systems, assemblies, equipment, and components including design changes that occurred during the construction phase.
 - 3. Process and schedule for completing construction checklists and manufacturer's prestart and startup checklists for HVAC&R systems, assemblies, equipment, and components to be verified and tested.

4. Certificate of completion certifying that installation, prestart checks, and startup procedures have been completed.
5. Certificate of readiness certifying that HVAC&R systems, subsystems, equipment, and associated controls are ready for testing.
6. Test and inspection reports and certificates.
7. Corrective action documents.
8. Verification of testing, adjusting, and balancing reports.

1.9 SUBMITTALS

- A. Certificates of readiness.
- B. Certificates of completion of installation, prestart, and startup activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 TESTING PREPARATION

- A. Certify that HVAC&R systems, subsystems, and equipment have been installed, calibrated, and started and are operating according to the Contract Documents.
- B. Certify that HVAC&R instrumentation and control systems have been completed and calibrated, that they are operating according to the Contract Documents, and that pretest set points have been recorded.
- C. Certify that testing, adjusting, and balancing procedures have been completed and that testing, adjusting, and balancing reports have been submitted, discrepancies corrected, and corrective work approved.
- D. Set systems, subsystems, and equipment into operating mode to be tested (e.g., normal shutdown, normal auto position, normal manual position, unoccupied cycle, emergency power, and alarm conditions).
- E. Inspect and verify the position of each device and interlock identified on checklists.
- F. Check safety cutouts, alarms, and interlocks with smoke control and life-safety systems during each mode of operation.
- G. Testing Instrumentation: Install measuring instruments and logging devices to record test data as directed by the CxA.

3.2 Testing AND BALANCING VERIFICATION

- A. Prior to performance of testing and balancing Work, provide copies of reports, sample forms, checklists, and certificates to the CxA.
- B. Notify the CxA at least 10 days in advance of testing and balancing Work, and provide access for the CxA to witness testing and balancing Work.
- C. Provide technicians, instrumentation, and tools to verify testing and balancing of HVAC&R systems at the direction of the CxA.
 - 1. The CxA will notify testing and balancing Contractor 10 days in advance of the date of field verification. Notice will not include data points to be verified.
 - 2. The testing and balancing Contractor shall use the same instruments (by model and serial number) that were used when original data were collected.
 - 3. Failure of an item includes, other than sound, a deviation of more than 10 percent. Failure of more than 10 percent of selected items shall result in rejection of final testing, adjusting, and balancing report. For sound pressure readings, a deviation of 3 dB shall result in rejection of final testing. Variations in background noise must be considered.
 - 4. Remedy the deficiency and notify the CxA so verification of failed portions can be performed.

3.3 GENERAL TESTING REQUIREMENTS

- A. Provide technicians, instrumentation, and tools to perform commissioning test at the direction of the CxA.
- B. Scope of HVAC&R testing shall include entire HVAC&R installation, from central equipment for heat generation and refrigeration through distribution systems to each conditioned space. Testing shall include measuring capacities and effectiveness of operational and control functions.
- C. Test all operating modes, interlocks, control responses, and responses to abnormal or emergency conditions, and verify proper response of building automation system controllers and sensors.
- D. The CxA along with the HVAC&R Contractor, testing and balancing Contractor, and HVAC&R Instrumentation and Control Contractor shall prepare detailed testing plans, procedures, and checklists for HVAC&R systems, subsystems, and equipment.
- E. Tests will be performed using design conditions whenever possible.
- F. Simulated conditions may need to be imposed using an artificial load when it is not practical to test under design conditions. Before simulating conditions, calibrate testing instruments. Provide equipment to simulate loads. Set simulated conditions as directed

by the CxA and document simulated conditions and methods of simulation. After tests, return settings to normal operating conditions.

- G. The CxA may direct that set points be altered when simulating conditions is not practical.
- H. The CxA may direct that sensor values be altered with a signal generator when design or simulating conditions and altering set points are not practical.
- I. If tests cannot be completed because of a deficiency outside the scope of the HVAC&R system, document the deficiency and report it to the Owner. After deficiencies are resolved, reschedule tests.
- J. If the testing plan indicates specific seasonal testing, complete appropriate initial performance tests and documentation and schedule seasonal tests.

3.4 HVAC&R SYSTEMS, SUBSYSTEMS, AND EQUIPMENT TESTING PROCEDURES

- A. Boiler Testing and Acceptance Procedures: Testing requirements are specified in Division 23 boiler Sections. Provide submittals, test data, inspector record, and boiler certification to the CxA.
- B. HVAC&R Instrumentation and Control System Testing: Field testing plans and testing requirements are specified in Division 23 Sections "Instrumentation and Control for HVAC" and "Sequence of Operations for HVAC Controls." Assist the CxA with preparation of testing plans.
- C. Pipe system cleaning, flushing, hydrostatic tests, and chemical treatment requirements are specified in Division 23 piping Sections. HVAC&R Contractor shall prepare a pipe system cleaning, flushing, and hydrostatic testing plan. Provide cleaning, flushing, testing, and treating plan and final reports to the CxA. Plan shall include the following:
 - 1. Sequence of testing and testing procedures for each section of pipe to be tested, identified by pipe zone or sector identification marker. Markers shall be keyed to Drawings for each pipe sector, showing the physical location of each designated pipe test section. Drawings keyed to pipe zones or sectors shall be formatted to allow each section of piping to be physically located and identified when referred to in pipe system cleaning, flushing, hydrostatic testing, and chemical treatment plan.
 - 2. Description of equipment for flushing operations.
 - 3. Minimum flushing water velocity.
 - 4. Tracking checklist for managing and ensuring that all pipe sections have been cleaned, flushed, hydrostatically tested, and chemically treated.
- D. Refrigeration System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of chillers, cooling towers, refrigerant compressors and

condensers, heat pumps, and other refrigeration systems. The CxA shall determine the sequence of testing and testing procedures for each equipment item and pipe section to be tested.

- E. HVAC&R Distribution System Testing: Provide technicians, instrumentation, tools, and equipment to test performance of air, steam, and hydronic distribution systems; special exhaust; and other distribution systems, including HVAC&R terminal equipment and unitary equipment.
- F. Vibration and Sound Tests: Provide technicians, instrumentation, tools, and equipment to test performance of vibration isolation and seismic controls.

END OF SECTION 23 0 800

SECTION 233100

DUCTWORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide complete duct systems as indicated. Systems shall include, but not be limited to, the following: outside air, exhaust air, and air conditioning supply and return air duct systems as shown on drawings. Drawing scales prohibit the indication of all offsets, fittings, and like items; however, these items shall be installed as required for the actual project conditions at no change in contract price.
- B. Items Included: This section generally includes, but is not limited to, the following major items:
 - 1. Low pressure sheet metal ductwork.
 - 2. Acoustical thermal duct liner.
 - 3. Low pressure fiberglass ductwork.
 - 4. High pressure sheet metal ductwork, round and flat oval.
 - 5. High pressure sheet metal ductwork, rectangular.
 - 6. Low pressure flexible ducts.
 - 7. High pressure flexible ducts.
 - 8. Other special duct systems.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions" for related requirements. Refer to other sections of Division 23 and to other applicable portions of the Drawings and Specifications.
- B. This section is directly related in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Sections describing air handling equipment and fans.
 - 2. Air distribution devices.
 - 3. Terminal units.
 - 4. Duct system accessories.
 - 5. Insulation.

- C. Coordinate shop drawings, ordering, delivery, and placement of all items affecting the duct systems including, but not limited to, the following items: air handling units, exhaust fans, supply fans, sound attenuators, duct mounted coils, access panels, air distribution devices, fire dampers, outside air louvers, hoods, filters, roof curbs, structural framing, roof construction, roofing, and the work of all trades to insure an orderly and timely progression of the work. Refer to the requirements of Section entitled "General Mechanical Provisions".
- D. Refer to other sections which may describe additional sound attenuation measures which may relate to this section.

1.4 SHOP DRAWINGS

- A. Refer to Section entitled "General Mechanical Provisions". Include complete data as applicable to this project on: all prefabricated duct and fittings; duct liner including mechanical fasteners and adhesives; duct sealing materials; duct joining and seaming methods; and all other items. If required by Architect, prepare and submit for approval completely detailed shop drawings of supply and return ductwork from any or each air handling unit through its transitions, bends and elbows until such ducts are extended beyond the air handling unit equipment area and/or congested areas; these shop drawings will not be required unless specifically called for elsewhere or unless significant deviation from the Drawings is necessitated by the equipment provided.

1.5 OTHER REQUIREMENTS

- A. Provide all ductwork and components thereof in accord with manufacturer's recommendations. All ductwork dimensions indicated are nominal free clearance internal dimensions which do not include insulation thickness.

1.6 DEFINITIONS

- A. "SMACNA" means "Sheet Metal and Air Conditioning Contractors National Association, Inc."
- B. Low Pressure Ductwork: Any and all ductwork conveying air or other gases at velocities less than 2500 fpm and static pressure less than 2.0 inches wg. This ductwork may also be referred to in these specifications as "Low Velocity Ductwork". SMACNA "HVAC Duct Construction Standards, Metal and Flexible", Second Edition, 1995, shall govern construction of this ductwork unless otherwise specified.
 - 1. Where and if fiberglass ductwork is specified, it shall be considered only for low pressure classification use and shall be constructed in accord with SMACNA "Fibrous Glass Duct Construction Standards", Fifth Edition, 1977.

C. High Pressure Ductwork: Any and all ductwork conveying air or other gases at velocities equal to or greater than 2500 fpm or static pressure equal to or greater than 2.0 inches wg. This ductwork may also be referred to in these specifications as "High Velocity Ductwork" or "Medium Pressure Ductwork", but shall be considered, in either terminology, to fall within pressure/velocity class (PV/C designation) 3 to 10. SMACNA "HVAC Duct Construction Standards, Metal and Flexible", Second Edition, 1995, shall govern construction of this ductwork unless otherwise specified.

1.7 PRESSURE/VELOCITY CLASSIFICATIONS

A. Pressure and velocity classifications (hereinafter called "P/VC") for ducts are defined as follows:

<u>P/VC</u> <u>Desig.</u>	<u>SMACNA Static</u> <u>Pressure Class</u>	<u>Static</u> <u>Pressure</u> <u>Rating</u>	<u>Positive</u> <u>or</u> <u>Negative</u> <u>Pressure</u>	<u>SMACNA Maximum</u> <u>Seal</u> <u>Class</u>	<u>Maximum</u> <u>Velocity</u> <u>(fpm)</u>
10	High	10"	+	A	2000 up
6	Medium	6"	+	A	2000 up
4	Medium	4"	+	A	4000 dn
3	Medium	3"	+ or -	B	4000 dn
2	Low	2"	+ or -	C	2500 dn
1	Low	1"	+ or -	C	2500 dn
½	Low	1/2"	+ or -	C	2000 dn

B. See Part 3, EXECUTION, of this section for duct sealing requirements.

PART 2 - PRODUCTS

2.1 GENERAL

A. Materials shall comply with current SMACNA standards.

B. ASTM: Unless otherwise specified, ASTM material specifications applicable are:

<u>Material</u>	<u>Type</u>	<u>ASTM Number</u>
Galvanized steel	G90	A525
Stainless steel	304,316	A240
Cold rolled steel	20-28 ga.	A366
Cold rolled steel	18 ga.	A619
Aluminum	3003 H-14	B609

C. Special Materials, Gauges and Construction:

1. Special Materials: Where special duct material other than galvanized steel is required, such duct material (e.g., fiberglass, stainless steel, plastic such as polyvinylchloride, etc.) shall be specifically indicated.
2. Gauges: Gauges indicated in this section are for galvanized steel. Where greater or lesser gauges are specifically indicated for a sheet metal material other than galvanized steel, provide the indicated gauge. Comply with the SMACNA construction standard covering the required material if no gauge is given.
3. Construction: Comply with indicated special requirements (i.e., such as welding, soldering, etc.) where application requires.

2.2 LOW PRESSURE SHEET METAL DUCTWORK

A. Material: Prime quality forty-eight inch wide resquare tight coat galvanized steel conforming to the requirements of ASTM A-525 and/or A-527 as applicable to the intended use.

B. Construction:

1. Construct to comply with the pressure/velocity classification(s) indicated.
2. Use rectangular or round as indicated on drawings.
3. Reinforcing, Cross Breaking, Seams, Joints: Be in accord with latest SMACNA construction standard for low pressure sheet metal duct.
4. Gauge: As required by SMACNA for the dimensions and pressure/velocity classification involved.

C. Insulation:

1. Rectangular rigid sheet metal ductwork: shall be internally lined with acoustical thermal duct liner if so designated.
2. Round rigid sheet metal ductwork: Where low pressure round ductwork is designated to have internal acoustical/thermal liner, provide factory fabricated double wall ductwork as specified for high pressure round acoustically lined sound attenuating duct (i.e., factory fabricated double wall duct with perforated inner wall).

2.3 ACOUSTICAL THERMAL DUCT LINER

A. Line ductwork where indicated. Dimensions indicated are net inside dimensions. Liner shall be one inch thick, three pound density fiberglass duct liner with the surface in contact with moving air stream stabilized with black pigmented neoprene. Duct liner shall comply with requirements of NFPA 90A as to flame spread and smoke developed ratings. Duct liner shall be factory treated with antimicrobial/antibacterial treatment to prevent formation & growth of bacteria.

- B. Acceptable Manufacturers: Johns-Manville, Microtex; PPG Industries, Testrafine; or Certain-Teed/Saint Gobain, Coated Ultralite.
- C. Attachment: Attach to the interior of sheet metal ducts using a full coverage coat of Foster's 85-20 adhesive and mechanical fasteners applied as follows:
 - 1. Horizontal Ducts: Install mechanical fasteners on underside of the tops of ducts over twelve inches in width and on the insides of ducts over sixteen inches in height.
 - 2. Vertical Ducts: Install mechanical fasteners on all duct surfaces exceeding twelve inches.
 - 3. Fastener Spacing: Install fasteners within two inches of the leading edge of each duct section and within three inches of the leading edge of cross joints in insulation within any given duct section. Pins shall thereafter be spaced at not more than fifteen inches on centers. Pins shall be installed in strict accordance with manufacturer's instructions.
- D. Edge Stabilization: All exposed edges and the leading edge of all cross joints of liner shall be coated with Foster's 30-36.

2.4 HIGH PRESSURE DUCTWORK, ROUND AND FLAT-OVAL

A. General:

- 1. Comply with current SMACNA standards.
- 2. Factory fabricated portions shall be made by United McGill, Semco or equal.

B. Straight Conduit: Galvanized steel unless otherwise indicated for a specific application.

- 1. Seam construction: Spiral lock-seam (SMACNA Type RL-1) allowed for all pressure/velocity classifications. Longitudinal grooved seam (SMACNA Type RL-5) allowed only up to pressure/velocity classification P/VC-3.

C. Fittings:

- 1. Material: Same as connecting duct system.
- 2. Configuration: Standard design as manufactured by United McGill, Semco or equal.
- 3. Elbows:
 - a. General: All mitered elbows must be vanned.
 - b. Round: 5-inch diameter and larger shall be five-section construction; less than 5-inches diameter shall be die-formed.
 - c. Flat-oval: Five-section construction.

d. Hard turn oval elbows shall have vanes as follows:

<u>Equivalent diameters</u>	<u>Number of Vanes</u>
10" through 14"	3
15" through 19"	4
20" through 60"	5
Over 60"	12" spacing

4. Vanes: Be minimum 20 gauge and limited to 24 inches of unsupported length. The leading edge of all vanes in duct exceeding 20 inch size will be hemmed with a 1/2 inch fold back.
5. Divided Flow Fittings: All divided flow configurations are to be furnished as separate fittings. Tap covers welded into spiral duct sections are not acceptable. All tees, crosses and laterals up to an including 12" diameter tap size, will have a minimum 3/8" radius rounded entrance into the tap, produced by machining, press forming, or hand grinding to a smooth entrance. The entrance will be free of projections, weld buildups, burrs or irregularities. All fittings will have continuous welds along all seams.
6. Tees and Crosses: All tees and crosses shall be the spun conical type with branch entrances through 12" size, to be rounded laminar flow as noted above.
7. Connections: Connections of conduit to fittings shall be made with a synthetic rubber sealing compound conforming to NFPA 90A as to flame spread and smoke developed ratings and mechanically fastened with drive or twist screws, and all joints tested in accordance with test procedure described hereinafter. Raychem TDB duct sealing bands may be used in lieu of the sealing compound. Connection between conduit and terminals shall be made with a maximum of 48" of flexible duct. Runout connections shall be assembled in same manner as conduit and fittings.

D. Gauge: Minimum gauge as follows (gauges are for round and flat-oval duct with spiral lock-seam construction unless otherwise indicated):

1. Round duct (galvanized steel):

<u>Diameter (Inches)</u>	<u>Gauge</u>	<u>Alternate Gauge(2)</u>
3 thru 8	26	24
9 thru 14	26	24
15 thru 26	24	22
27 thru 36	22	20
37 thru 50	20	20
51 thru 60	18	18
61 thru 84	18(1)	16

(1) Must be 16 ga. when static pressure is negative.

(2) Alternate gauges are allowable for longitudinal grooved seam (SMACNA Seam Type RL-1) and only for pressure/velocity class up to P/VC-3.

2. Flat-oval duct (galvanized steel):

Major Dimension (Inches)	Gauge
0 thru 24	24
25 thru 36	22
37 thru 48	22
49 thru 60	20
61 thru 70	20
71 and up	18

E. Fittings:

1. Round duct: Same as duct unless otherwise recommended by manufacturer.
2. Flat-oval duct:

Major Dimension (Inches)	Gauge
0 to 24	20
25 to 36	20
36 to 48	18
49 to 60	18
61 to 70	16
71 and up	16

F. Acoustically Lined Sound Attenuating Round and Flat Oval Duct and Fittings: General construction is specified in paragraphs above. Flame spread and smoke developed ratings shall comply with NFPA 90A. Double walled with zinc coated solid sheet steel outer wall and zinc coated perforated sheet steel inner wall. One inch thick annular space between inner and outer walls uniformly packed with fiberglass insulation with effective thermal conductivity of 0.27 BTUH per sq. ft. (F⁰ per inch) separated from air stream using mylar film. Equal to United Acousti-K27.

2.5 HIGH PRESSURE DUCTWORK, RECTANGULAR

A. General:

1. Airtight and structurally stable at maximum system operating pressure.
2. Any welding shall be continuous and corrosion resistant.
3. Galvanized sheet steel unless otherwise indicated for a specific application.

4. Reinforced and supported to neither cause nor convey any objectionable vibrations.
 5. Be in accordance with latest SMACNA construction standard for high pressure ductwork.
- B. Turning Vanes: Adequate rigidity and strength to be completely flutterproof. Airfoil, permanently fixed type constructed of galvanized steel or aluminum with sound attenuating fiberglass inner liner with open protective metal facing. Quantity in each elbow in accordance with manufacturer's recommendations. Airsan Acoustiturn as made by Air Filter Corporation, 4554 W. Woolworth Ave., Milwaukee, Wisconsin 53218 or equal.

2.6 HIGH PRESSURE DUCT RELIEF AND ACCESS DOORS

- A. Provide suitable size for access to heaters, dampers and other equipment installed in duct, and at other points indicated on drawings. Size shall be as listed by paragraph above and compatible with duct size but not smaller than 8"x12". Doors shall be 24 US gauge galvanized steel hinged to a 24 gauge galvanized mounting frame and for insulated duct shall be double panel construction with 1/2 inch rigid insulation material between metal panels. Doors shall be United Sheet Metal Type AR or an approved equal.

2.7 LOW PRESSURE FLEXIBLE DUCTS

A. General:

1. The inclusion of flexible ducts in this specification shall not be construed as approval of use on the project unless specifically shown on the Drawings.
 2. Where used, provide in factory finished lengths not in excess of lengths required to make kink-free connections with minimum air pressure drop.
- B. Insulated flexible ducts: Flexible duct shall be factory-fabricated preinsulated type with seamless vapor barrier. Duct shall bear UL 181 Class 1 Air Duct label and shall comply with NFPA 90A and 90B. Fiberglass insulation nominal 1" thickness with thermal conductance of 0.23 BTU/hr-ft²-°F maximum at 75°F mean temperature. Flexible duct shall have an operating range of minus 0.5" w.g. to plus 2" w.g. Core shall be continuous and consist of aluminized mylar laminated to corrosion resistant steel wire helix. Vapor barrier perm rating shall be 0.17 maximum per ASTM E96-A. Maximum working velocity shall be 4000 FPM. Flexible duct shall be Genflex SLR-25, Clevaflex Type KQ, Wire Mold type WG, Flexmaster Type 5B, or approved equal.
- C. Un-insulated flexible ducts, steel: Flexible ductwork shall be constructed of all metal one ply hot-dipped galvanized steel, closely corrugated for strength and flexibility, with seams interlocked, folded flat, and knurled to insure tightness. Duct shall be

listed as #UL181 "Flexible Air Duct", Class 1, and NFPA 90A. Products shall be Flexmaster Type NI-TL, Clevaform Type GS or approved equal.

D. Round branch take-off fittings for flexible duct:

1. Round duct branch take-off fitting shall be made of galvanized sheet metal designed for twist-in installation and to assure minimum air loss at the take-off. The fittings shall be of the conical converging type to reduce the pressure drop through the fittings. Provide a raised bead on the throat of the fitting to assure a tight positive connection. Products shall be Flexmaster Model CB-DE-BO3 or approved equal.
2. Provide each fitting with the following:
 - a. Lockable quadrant damper.
 - b. 45-degree extractor scoop.
 - c. Insulation guard where used with internally lined ductwork.
3. Provide these "spin-in" type fittings at all connections between rigid sheet metal duct and flexible duct at the upstream end of the flexible duct.

2.8 HIGH PRESSURE FLEXIBLE DUCTS

- A. Meet all requirements for low pressure flexible ducts except be recommended by manufacturer for high pressure application.

2.9 FLEXIBLE STAINLESS STEEL EXHAUST DUCTS

- A. Flexible ducts shall be factory fabricated uninsulated all metal type. Ducts shall be spiral flexible lockformed from type 302 stainless steel strips of 0.18" to 0.20" minimum thickness. Ends of individual duct lengths shall be plain for connection to ductwork collars and for securing to collars with stainless steel band clamps. Flexible duct lengths shall suit the usage and purpose requirements of the devices served by the flexible ducts. Flexible ducts shall have an operating range of minus 3.0" w.g. to plus 3.0" w.g. Maximum working velocity shall be 4000 FPM. Minimum allowable inside bend radius shall be no greater than four and one-half duct diameters. Flexible ducts shall be Universal Metal Hose Company "U-120", Flexmaster Type SS-NI-TL, or approved equivalent.

2.10 RIGID STAINLESS STEEL EXHAUST DUCTS

- A. Food Service Equipment Exhaust Ducts: Exhaust ducts which are intended to remove air laden with grease vapor and/or water vapor from cooking ranges, fryers, ovens and similar cooking equipment shall be as follows:

1. Construct ductwork and vertical exhaust duct stackheads of stainless steel ANSI type 304, mill finish, 16 gauge minimum.
2. Exposed locations shall have No. 4 polished finish.

B. Exhaust Ducts for Laboratory Fume Hoods and Ethylene Oxide Sterilizers:

1. Construct ductwork and vertical exhaust duct stackheads of stainless steel ANSI type 302, mill finish.
2. Ductwork in exposed locations shall have No. 4 polished finish.

2.11 OTHER SPECIAL DUCT SYSTEMS

A. Perchloric Acid Fume Hood Exhaust Ducts and Wash-Down Systems:

1. Perchloric acid fume hood exhaust ductwork shall be type 316 stainless steel, flanged and gasketed. Ductwork in exposed locations shall have No. 4 polished finish.
2. Provide two washdown systems for each perchloric acid fume hood system. One washdown system shall serve the hood, and the other system shall serve the exhaust ductwork and fan system.
3. Washdown systems shall include type 316 stainless steel full-jet spray nozzles with stainless steel piping to the centerline of each duct with exterior duct couplings and all interconnecting piping, including water supply and drain piping. The washdown systems shall provide complete coverage including fume hoods, ductwork, elbows, fans and stacks. All controls, valves and appurtenances shall be provided for proper operation of the systems.
4. All perchloric acid fume hood exhaust ductwork, including exhaust fans and stacks, shall be fabricated and installed by the fume hood manufacturer. All perchloric acid fume hood exhaust washdown and drain systems shall be designed, fabricated, and installed by the fume hood manufacturer.

PART 3 - EXECUTION

3.1 GENERAL

- A. All duct systems shall be free of noise, chatter, vibration and pulsation under all conditions of operation. Remove, replace or reinforce as directed by the Architect/Engineer if necessary to correct such conditions.
- B. If field conditions are determined to exist which would limit the guarantee of air delivery or system performance, due notice in writing shall be submitted to the Architect/Engineer of such conditions prior to starting fabrication.

- C. Properly support and align ductwork. Ducts to be free of sag and bulge. Hang ductwork below concrete floors or roof deck with hangers set prior to pouring concrete, or from self drilling screw anchors. GUN POWDER SET ANCHORS ARE NOT PERMITTED.
- D. Where it is necessary that ducts be divided due to pipes or other obstructions which must pass through these ducts, the Contractor shall, at locations as noted or directed, provide air-stream deflectors in the duct and the duct shall be increased in size to maintain equivalent area around deflectors. Such changes shall be in accord with standard SMACNA details and shall be shown on Contractor's As-Built Drawings.
- E. Interior of ductwork visible through registers, grilles, or diffusers shall be painted flat black.
- F. Do not route ductwork through transformer vaults and electrical equipment spaces and enclosures.
- G. Construct all ductwork and accessories in accord with the latest indicated editions of applicable SMACNA construction standards. Sheet Metal and Air Conditioning Contractors' National Association.
- H. Streamline all ductwork to the full extent practical and equip with proper and adequate devices to assure proper balance and quiet draftless distribution of indicated air quantities.
- I. Protect all ductwork and system accessories from damage during construction until Architect/Engineer's final acceptance of project.
- J. Prior to ductwork fabrication, verify if all ductwork as dimensioned and generally shown will satisfactorily fit allocated spaces. Take precautions to avoid space interferences with beams, columns, joists, pipes, lights, conduit, other ducts, equipment, etc. Notify Architect/Engineer if any spatial conflicts exist, and then obtain Architect/Engineer's approval of necessary routing. Make any such necessary revisions which are minor at no additional cost.
- K. Carefully correlate all duct connections to air handling units and fans to provide proper connections, elbows and bends which minimize noise and pressure drop.
- L. Provide all curved elbows with radius ratios of not less than 1.5 unless otherwise shown or approved by Architect/Engineer. Provide all mitered elbows with turning vanes.
- M. Properly suspend all ductwork so that no objectionable conditions result (such as vibration, sagging, etc.).

- N. Coordinate any and all dimensions at interfaces of dissimilar type of ductwork and at interfaces of ductwork with equipment so that proper overlaps, interfaces, etc., of insulation and continuity of vapor barriers are maintained.
- O. If necessary where ducts interface and have different types of insulation, provide transitions so that internal free-clear dimensions of duct remain unchanged.
- P. Install horizontal low pressure ductwork at a level which maximizes length of any vertical, rectangular or round rigid duct connections to rectangular diffuser necks; however, such vertical duct connections are not required to be over 24 inches in length.
- Q. Make connections from any low pressure ductwork to terminal units (fan terminal units, variable volume boxes, etc.) with appropriate lengths of flexible duct unless other type of connection is indicated.
- R. Install all flexible round duct without kinks or similar obstructions so that pressure drop is minimized. Cut and remove excess lengths as necessary.
- S. Install horizontal rigid ductwork as high as practical above suspended ceilings so that movable light fixtures may be relocated without interference to meet any future partition relocation requirements.
- T. Insulated Duct: Where ducts will be insulated, make provision for neat insulation finish around damper operating quadrants, splitter adjusting clamps, access doors, and similar operating devices. A metal collar equivalent in depth to insulation thickness and of suitable size to which insulation may be finished shall be mounted on duct.

3.2 LOW PRESSURE SHEET METAL DUCTS

- A. If width or height of rectangular duct exceeds 12 inches, cross break or roll a cross bead in panels to increase stiffness; otherwise, use two gages heavier steel.
- B. Provide corner closures. Longitudinal seams and transverse joints shall be flat and smooth inside. Make slip joints in direction of air flow. See governing SMACNA manual for transition requirements.
- C. Fabricate offsets, turns and elbows with centerline radius equal to 1-1/2 times diameter when possible. No mitered offsets will be allowed. Provide double thickness turning vanes to assist in smooth flow of air in square elbows or elbows with centerline radius less than duct width or diameter.

3.3 HIGH PRESSURE DUCTWORK

A. In addition to other requirements, this ductwork shall be as follows:

1. Any welds shall be continuous and corrosion resistant.
2. Reinforced and supported to cause and/or to convey no objectionable vibrations.
3. All seams and joints permanently sealed and joined in strict accordance with the manufacturer's recommendations.

B. Conical Tees: Make all branch duct take-offs and all connections to flexible duct supplying air to terminal units with conical tees.

3.4 LOW PRESSURE FLEXIBLE DUCTS

A. Flexible ducts shall not be used unless specifically indicated on drawings.

B. If flexible duct is indicated for use on this project, it must comply with the following requirements.

1. The extent of the use of flexible ductwork shall be limited to that shown on the drawings.
2. Flexible duct installation shall be per SMACNA Flexible Duct Installation Standards, and manufacturers latest printed instructions, whichever is stricter. In addition the following shall apply:
 - a. Flexible duct between rigid duct and diffusers shall be a MAXIMUM of 8 feet in length and shall be fully extended with a maximum equivalent of (2) 90 degree bends (no bend shall be made with centerline radius of less than one duct diameter). No additional flexible duct shall be provided for future terminal device relocation unless otherwise specified.
 - b. Flexible duct shall be supported at ends and at each 90 degree bend. Maximum permissible sag is 1/2 inch per foot of spacing between supports.
 - c. Hanger or saddle material in contact with the flexible duct shall be of sufficient width to prevent any restriction of the internal diameter of the duct when the weight of the supported section rests on the hanger or saddle material. In no case will the material contacting the flexible duct be less than 1 inch wide. Narrower hanger material may be used in conjunction with a sheet metal saddle which meets the foregoing specifications. This saddle must be formed to cover one-half the circumference of the outside diameter of the flexible duct and must be rolled to fit neatly around the lower half of the duct's outer circumference.
 - d. Factory installed suspension systems integral to the flexible duct are an acceptable alternative hanging method when manufacturers recommended procedures are followed.

- e. Hangers shall be adequately attached to the building structure (not pipe, conduit, etc.).
 - f. To prevent tearing of vapor barrier, do not support entire weight of flexible duct on any one hanger during installation. Avoid contact of flexible duct with sharp edges of hanger material. Damage to vapor barrier may be repaired with approved tape. If internal core is penetrated, replace flexible duct or treat as a connection.
3. Terminal devices connected by flexible duct shall be supported independently of the flexible duct.

3.5 HIGH PRESSURE FLEXIBLE DUCTS

- A. Meet all the requirements for low pressure flexible ducts.

3.6 FLEXIBLE STAINLESS STEEL EXHAUST DUCTS

- A. Flexible stainless steel ducts shall not be used unless specifically indicated on drawings.
- B. If flexible stainless steel duct is indicated for use on this project, it must comply with the following requirements.
1. The extent of the use of flexible ductwork shall be limited to that shown on the drawings.
 2. Flexible duct installation shall be per SMACNA Flexible Duct Installation Standards, and manufacturers latest printed instructions, whichever is stricter. In addition the following shall apply:
 - a. Flexible duct between rigid duct and terminal devices shall be fully extended with a maximum equivalent of (2) 90 degree bends (no bend shall be made with centerline radius of less than one duct diameter).
 - b. Flexible duct shall be supported at ends and at each 90 degree bend. Maximum permissible sag is 1/2 inch per foot of spacing between supports.
 - c. Hanger or saddle material in contact with the flexible duct shall be of sufficient width to prevent any restriction of the internal diameter of the duct when the weight of the supported section rests on the hanger or saddle material. In no case will the material contacting the flexible duct be less than 1 inch wide. Narrower hanger material may be used in conjunction with a sheet metal saddle which meets the foregoing specifications. This saddle must be formed to cover one-half the circumference of the outside diameter of the flexible duct and must be rolled to fit neatly around the lower half of the duct's outer circumference.
 - d. Factory installed suspension systems integral to the flexible duct are an acceptable alternative hanging method when manufacturers recommended procedures are followed.

- e. Hangers shall be adequately attached to the building structure (not pipe, conduit, etc.).
 - f. Provide collars on rigid duct at flexible duct connection points. Connect flexible ducts to rigid ducts and to terminal devices and secure with stainless steel band clamps, or otherwise in accordance with flexible duct manufacturer's instructions.
 - g. Do not support entire weight of flexible duct on any one hanger during installation. Avoid contact of flexible duct with sharp edges of hanger material. If duct is penetrated, replace flexible duct or treat as a connection.
3. Terminal devices connected by flexible duct shall be supported independently of the flexible duct.

3.7 RIGID STAINLESS STEEL DUCT

- A. In addition to SMACNA recommendations and other requirements, rigid stainless steel duct systems shall comply with the following:
 1. All joints and seams shall be made with continuous welds. Ductwork shall be liquid tight and gas tight.
 2. Hangers and supports in finished areas shall be of same material as ductwork.
 3. Joints in laboratory hood exhaust duct may be flanged and gasketed at the Contractor's option.
 4. Food Service Equipment Exhaust Ductwork:
 - a. Kitchen exhaust ductwork of stainless steel shall be installed in accordance with NFPA 96 Standard for removal of smoke and grease laden vapors from commercial cooking equipment.
 - b. Install horizontal stainless steel kitchen exhaust ductwork with a minimum slope of 1-inch per foot.
 - c. Provide access panels of suitable size at 3'-0" centers minimum and at each change of direction for cleaning purposes.
 - d. Changes in Shape and Direction: Construct all changes in shape or direction in such a manner as to prevent the formation of any traps or pockets which might collect grease.
 - e. Cleanout Openings: Provide an opening in each exhaust duct at each change in direction of duct for the purposes of inspection and cleaning. Openings shall be at the sides and large enough to permit cleaning. In horizontal sections the lower edge of the opening shall be not less than one and one-half inches from bottom of the duct. Covers shall be constructed of the same material and thickness as the duct and shall be grease tight when in place.
 - f. Standards: Comply with latest SMACNA construction standard which covers this type of duct system.

3.8 POLY-VINYL-STEEL DUCTS

A. In addition to the requirements for low pressure sheet metal ducts and other requirements specified herein elsewhere in this section, poly-vinyl-steel duct systems shall comply with the following:

1. All ducts and fittings shall be constructed in accordance with manufacturer's recommendations and specifications.
2. All exposed raw edges shall be covered completely with poly-vinyl-steel sealant.
3. Apply aerosol poly-vinyl-steel coating compound to any scratched surfaces.
4. All sheet metal screws and fasteners shall be stainless steel.

3.9 OTHER SPECIAL DUCT SYSTEMS

A. Roof Mounted Exterior Ductwork:

1. Support all roof-mounted exterior ductwork with angle iron bracing firmly secured to roof construction and in such a manner to maintain watertight integrity of specified roofing system. All ductwork roof penetrations and ductwork support roof penetrations shall also be provided in such a manner to maintain watertight integrity of specified roofing system.
2. All roof-mounted exterior ductwork shall be completely and permanently weatherproof including connections at air conditioning units, roof penetration points and all other points.
3. Submit shop drawings completely describing all supporting systems for this external ductwork.

B. Perchloric Acid Fume Hood Exhaust Ductwork and Wash-Down System:

1. The fume hood manufacturer shall fabricate and install all perchloric acid fume hood exhaust ductwork, including exhaust fans and stacks. The ductwork shall be routed as shown on the drawings, shall be fabricated and installed by the mechanical contractor.
2. The fume hood manufacturer shall design, fabricate and install all perchloric acid fume hood exhaust washdown and drain systems. The respective washdown water supply and drain piping systems shall be connected to domestic water supply and drain connections provided at the locations shown on the plumbing drawings.

3.10 MISCELLANEOUS DUCT SYSTEM COMPONENTS

A. Spin-In Take-Off Fittings: Install around duct branch takeoff fittings according to manufacturer's installation instruction. Additionally seal fitting to rectangular duct with a thin bead of mastic sealant.

3.11 HANGERS AND SUPPORTS

- A. General: Comply with latest applicable SMACNA construction standard. Where sprayed fireproofing occurs, install hangers before application of such treatment and withhold installation of ducts until after application.
- B. Supports: Vertical risers and other duct runs where the method of support specified above is not applicable shall be supported by substantial angle brackets designed to meet field conditions and installed to allow for duct expansion.
- C. Fasteners: Secure hangers to steel beams or metal deck with beam clamps or drop through connections from the metal or concrete deck.

3.12 CHANGES IN SHAPE OR DIMENSION

- A. Where duct size or shape is changed to effect a change in area, the following shall apply:
 - 1. Where the area at the end of the transformation results in an increase in area over that at the beginning, the slope of the transformation shall not exceed one inch in seven inches.
 - 2. Where the area at the end of the transformation results in a decrease in area from that at the beginning, the slope of the transformation may be one inch in four inches, but one inch in seven inches is preferable, space permitting.
 - 3. The angle of transformation at connections to heating coils or other equipment shall not exceed thirty degrees from a line parallel to the air flow on the entering side of the equipment, nor fifteen degrees on the leaving side. The angle of approach may be increased to suit limited space conditions when the transformation is provided with vanes approved by the Architect/Engineer.

3.13 CHANGES IN DIRECTION

- A. Changes in direction shall be basically as indicated on the drawings and the following shall apply:
 - 1. Supply duct turns of ninety degrees in low pressure duct shall be made with mitered elbows fitted with closely spaced turning vanes designed for maintaining a constant velocity through the elbow.
 - 2. Return and exhaust duct turns of ninety degrees in low pressure duct shall be made with mitered elbows, as specified hereinbefore for supply ducts, unless radius elbows are indicated in which case they shall be constructed with a turning radius one and one-half (1-1/2) times the width (with width considered as the dimension in the plane of the turn) as measured to the duct centerline.

3. Tees in low pressure duct shall conform to the design requirements specified hereinbefore for elbows.
4. Branch take-offs in low pressure supply duct shall be made with extractors or splitter dampers, as indicated, in square take-offs.
5. In high pressure duct, branch take-offs and connections to flexible duct supplying air to terminal units shall be made with conical taps.

3.14 IMPROPER MATERIALS OR CONFIGURATION

- A. If ductwork materials or ductwork configurations are installed which do not meet these specifications, Contractor shall remove such ductwork and replace with materials or configurations which are acceptable. Any delay in job progress will be the responsibility of the Contractor.

3.15 OTHER REQUIREMENTS

- A. Insulated Duct: Where ducts will be insulated, make provision for neat insulation finish around damper operating quadrants, splitter adjusting clamps, access doors, and similar operating devices. A metal collar equivalent in depth to insulation thickness and of suitable size to which insulation may be finished shall be mounted on duct.
- B. Control Devices: Properly install all control related devices which are part of the duct systems. See Section(s) describing control systems.

3.16 SEALING OF DUCTS

- A. Duct seal classes are as follows:
 1. Seal class "A": Seal all transverse joints, longitudinal seams and duct wall penetrations. Use for P/VC-4 (4" w.g.) and greater unless otherwise indicated.
 2. Seal class "B": Seal all transverse joints and longitudinal seams. Use for P/VC-3 (3" w.g.) unless otherwise indicated.
 3. Seal class "C": Seal all transverse joints. Use for P/VC-2 (2" w.g.) and lower unless otherwise indicated.
- B. Where sealing is required it shall mean the following:
 1. The use of adhesives, gaskets, tape systems or combinations thereof to close openings in the surface of the ductwork and field-erected plenums and casings through which air leakage would occur; or
 2. The use of continuous welds;
 3. The prudent selection and application of sealing methods by fabricators and installers, giving due consideration to the designated pressure class, pressure mode (positive or negative), chemical compatibility of the closure system, potential movement of mating parts, workmanship, amount and type of handling;

cleanliness of surfaces, product shelf life, curing time and manufacturer-identified exposure limitations;

4. That these provisions are applicable to duct connections to equipment and to apparatus but are not for equipment and apparatus;
5. That where distinctions between seams and joints are made herein, a seam is defined as joining of two longitudinally (in the direction of air-flow) oriented edges of duct surface material occurring between two joints. Helical (spiral) lock seams are exempt from sealant requirements. All other duct surface connections made on the perimeter are deemed to be joints. Joints are inclusive of but not limited to girth joints; branch and sub-branch intersections; so-called duct collar tap-ins; fitting subsections; louver and air terminal connections to ducts; access door and access panel frames and jambs; duct, plenum and casing abutments to building structures; that sealing requirements herein do not contain provisions to:
 - a. Resist chemical attack.
 - b. Be dielectrically isolated.
 - c. Be waterproof, weatherproof or ultraviolet ray resistant.
 - d. Withstand temperatures higher than 120°F or lower than 40°F.
 - e. Contain atomic radiation or serve in other safety-related construction.
 - f. Be electrically grounded.
 - g. Maintain leakage integrity at pressures in excess of the duct classification herein.
 - h. Be underground below the water table.
 - i. Be submerged in liquid.
 - j. Withstand continuous vibration visible to the naked eye.
 - k. Be totally leak-free within an encapsulating vapor barrier.
 - l. Create closure in portions of the building structure used as ducts, e.g., ceiling plenums, shafts, pressurized compartments.
6. The requirements to seal apply to both positive pressure and negative pressure of operation.
7. Externally insulated ducts located outside of buildings shall be sealed prior to being insulated as though they were inside. If metal surfaces of ducts located on the exterior of buildings are exposed to weather, they shall receive exterior duct sealant. An exterior duct sealant is defined as a sealant that is marketed specifically as forming a positive air and water tight seal, bonding well to the metal involved, remaining flexible with metal movement and having a service temperature range of -30°F to 175°F. If exposed to direct sunlight it shall also be ultraviolet ray and ozone resistant or shall, after curing, be painted with a compatible coating that provides such resistance. The term sealant herein is not limited to materials of adhesive or mastic nature but is inclusive of tapes and combinations of open weave fabric strips and mastics.

C. Materials and applications for sealing ducts:

1. General:

- a. Complete product data on all materials used for sealing ducts must be submitted for approval prior to any duct fabrication.
 - b. All sealants must be specifically recommended by their manufacturer for the purpose of sealing ducts.
2. Liquid Sealant:
- a. Use only for slip type joints where sealant is to fill small space between overlapping pieces of metal. Do not use where metal clearances exceed 1/32-inch.
 - b. Sealant must be specifically manufactured for the purpose of sealing ducts.
3. Mastics:
- a. Use in lieu of liquid sealant at Contractor's option.
 - b. Use as a fillet, in grooves and between flanges.
 - c. Do not use oil base caulking or glazing compounds.
4. Gaskets:
- a. Use soft elastomer butyl or neoprene rubber or extruded forms of sealants in flanged joints in addition to mastic.
5. Tape:
- a. Tape is not allowed on sheet metal ducts.
6. Combination of mastic and embedded fabric:
- a. Use mastic/mesh/mastic as a sealant where pressure/velocity classification equals and exceeds P/VC-3 and where any spaces between metal surfaces at transverse joints or longitudinal seams or duct wall penetrations exceeds 1/16-inch.
 - b. Apply glove coat of mastic, then embed a continuous or overlapping strip of not less than 4-inch wide 10 x 10 fiberglass cloth into the mastic, then apply a final glove coat of mastic over the glass cloth.
7. Surface preparation:
- a. Surfaces to receive sealant should be adequately clean (free from oil, dust, dirt, rust, moisture, ice crystals and other substances that inhibit or prevent bonding). Use solvent and/or apply a face primer if necessary to obtain adequately clean surface for adhesion.

3.17 LEAKAGE TESTING

A. General:

1. Test the following duct systems:
 - a. All ducts which are (1) under positive or negative pressure and (2) which are directly connected to air moving device (air handling unit, exhaust fan, supply fan or similar air moving equipment) and (3) which convey 1000-cfm or greater through their largest portion.
 - b. All ducts which are (1) under positive or negative pressure and (2) which are part of a supply, return, outside and/or exhaust air system and (3) which are equal to or greater than 25 feet in length and (4) which may or may not be directly connected to an air moving device.
2. Portions of duct to be tested shall consist of all portions from the largest cross sectional area to the air distribution device connection or to the smallest inlet or outlet point, whichever is applicable.
3. Duct systems shall be constructed so that leakage does not exceed 5.00% of the air quantity handled by the respective fan.

B. Allowable Leakage:

1. Leakage shall be measured during leakage test at a test pressure which is equal to the pressure/velocity classification of the duct system (e.g., a P/VC-2 duct shall be tested at 2.0 in. w.g.s.p., a P/VC-1/2 duct at 0.5 in. w.g.s.p., etc.).

C. Test Procedure:

1. Test at time of duct installation and prior to installation of any field applied insulation and prior to any concealment in chases or similar enclosures.
2. Duct openings (both entry openings and outlet openings) shall be capped or sealed by taping or banding a flexible plastic sheet over each opening prior to pressurizing duct. The plastic sheet shall be of adequate strength and thickness to withstand the test pressures. Use other method of sealing duct openings providing objective of test is obtained and if method of sealing is approved by Architect/Engineer.
3. Use a fan having a minimum capacity of 300-cfm or 5% of the particular duct system design capacity, whichever is greater and which is capable of producing a duct test pressure of 150% of the duct test pressure.
4. Test fan shall be connected to a flow measuring assembly consisting of straightening vanes and an orifice plate mounted in a straight tube with appropriately located pressure taps. Orifice assembly shall be accurately calibrated with its own calibration curve. Pressures shall be measured with U-tube manometers and corresponding flow rates obtained from the orifice performance curve.

5. Connect test fan and orifice flow measuring assembly to the duct to be tested with a section of flexible duct.
6. Test for audible leaks as follows:
 - a. Close off and seal all openings in the duct section to be tested. Connect the test apparatus to the duct by means of a section of flexible duct.
 - b. Start the blower with its control damper closed (some small blowers popularly used for testing ducts may damage the duct because they can develop pressures up to 25 inches (W.G.).
 - c. Gradually open the inlet damper until the duct pressure reaches 50% in excess of designed duct operating pressure.
 - d. Survey all joints for audible leaks. Mark each leak and repair after shutting down blower. Do not apply a retest until sealing has been repaired if and where necessary.
7. After all audible leaks have been sealed, the leakage should be measured with the orifice section of the test apparatus as follows:
 - a. Start blower and open damper until pressure in duct reaches 25% in excess of designed duct operating pressure.
 - b. Total allowable leakage shall not exceed five (5) percent of the total system design air flow rate. When partial sections (such as supply section, return section, etc.) of the duct system are tested, the summation of the leakage for all sections shall not exceed the total allowable leakage.
8. Correct any duct leaks which are detected either audibly or by touch regardless of whether leakage through duct system is less than allowable test leakage.

3.18 DEFINITIONS OF DUCT TYPES

A. Refer to the "Duct Type and Location Schedule" on the Drawings for:

1. The type of ductwork and where it is to be installed.
2. The pressure/velocity class at each location.
3. Indication of whether the ductwork is to be insulated externally or internally lined or not insulated.

END OF SECTION 23 31 00

SECTION 23 33 00

DUCT SYSTEM ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide all necessary duct system accessories to assure proper balance, quiet and draftless distribution and conveyance, and minimization of turbulence, noise and pressure drop for all supply return, exhaust and ventilation air quantities indicated.
- B. Items Included: This section generally includes, but is not limited to, the following items as may be applicable to this project:
 - 1. Flexible duct connections.
 - 2. Splitters.
 - 3. Turning vanes.
 - 4. Extractors.
 - 5. Manual volume dampers.
 - 6. Access doors.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.
- B. This section directly relates in particular to sections (which may or may not be included in this division) which describe the following:
 - 1. Ductwork.
 - 2. Air distribution devices.
 - 3. All types of air handling equipment.

1.4 COORDINATION

- A. Coordinate all items affecting the duct systems including but not limited to the following items: air handling units, exhaust fans, supply fans, sound attenuators, duct mounted coils, access panels air distribution devices, fire dampers, outside air

DUCT SYSTEM ACCESSORIES

louvers, hoods, filters, roof curbs, structural framing, roof construction, roofing, and the work of all trades to insure an orderly and timely progression of the work.

1.5 SHOP DRAWINGS

- A. Include complete data on: access doors; flexible connectors; manual volume dampers including operating hardware; extractors; turning vanes; automatic shutters and all other items.
- B. See section entitled, "General Mechanical Provisions".

1.6 OTHER REQUIREMENTS

- A. Provide all components in accordance with manufacturer's recommendations.
- B. All ductwork dimensions indicated which may affect items of this section are nominal free clearance internal dimensions which do not include insulation thickness.

1.7 DEFINITIONS

- A. "SMACNA" means "Sheet Metal and Air Conditioning Contractors National Association, Inc.".

PART 2 - PRODUCTS

2.1 GENERAL

- A. Be recommended by the manufacturer for the application.
- B. Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:

1. Ventfabrics
2. Barber-Colman
3. Tuttle & Bailey
4. Dura-Dyne
5. Airsan
6. Titus
7. Anemostat
8. Young
9. Metalaire
10. United McGill

- C. Products which are specified may not necessarily all be required on the projects; provide those products which are applicable.

2.2 FLEXIBLE DUCT CONNECTIONS

- A. Provided where air handlers, fans and blowers connect to their ductwork.
- B. At least 4 inches long.
- C. Connected on each side to metal (either metal ductwork, air handling apparatus, or heavy gauge steel sleeves).
- D. For use in high and/or low pressure duct systems.
- E. Ventfabrics, Inc., "Ventglas Metaledge", or equivalent.

2.3 SPLITTERS

- A. Provide for adjustment of air volume to their respective branches, where indicated. Constructed of at least the same gauge galvanized steel as the duct wherein they are used, and in no instance be less than twenty-two (22) US gauge. Use in low pressure duct systems only. Be adequately sized to close off air to applicable branches. Rigidly attached to pivot rod and operating linkage. Install on raised insulated base when used in internally insulated ductwork. Splitter blades; formed in two thicknesses of metal so that entering edge presents rounded nose to air flow; length no less than one and one half times the width of the smaller branch served or twelve inches, whichever is larger. Hardware used for the construction, assembly, and operation of splitter dampers shall be as follows:
 - 1. Operators for exposed splitters and those located above "lay-in" or accessible ceiling shall be Ventlok #690 splitter damper assembly.
 - 2. Operators for concealed splitters shall be Ventlok #691 with #680 miter and #677 concealed regulator.

2.4 LOW PRESSURE METAL TURNING VANES

- A. Provide in all elbows, bends and tees of all low velocity supply air ducts whether or not shown in detail; provide in all elbows, bends and tees of all other low velocity ducts where portions of such ducts convey air at greater than 700 fpm average velocity. Adequate rigidity and strength to be completely flutterproof; properly designed; permanently fixed type. Aluminum, or steel with acid/solvent chemical corrosion resistant coating, or galvanized steel. Air foil type in all mitered elbows, mitered bends and tees. Air foil type must be manufactured by Titus, Tuttle & Bailey, Anemostat, Waterloo, Metalaire, Barber-Colman or other approved manufacturer. Be Barber-Colman "Airturns", Tuttle and Bailey "Ducturns", or Dura-Dyne "VR" with 24 gauge rails and hollow vanes, or equivalent.

2.5 HIGH PRESSURE TURNING VANES

- A. None required for this project.

2.6 EXTRACTORS

- A. Provide at rectangular branch duct take-offs.
- B. Use in low pressure duct systems only.
- C. Properly designed to deflect, proportion and direct the indicated air quantities to the branch duct and/or to the registers, grilles or other outlets without causing objectionable noise or pressure drop.
- D. Multivaned and adjustable.
- E. Aluminum, or steel with acid/solvent chemical corrosion resistant coating, or galvanized steel.
- F. Provided with devices for adjusting and securing the position of these deflectors; these devices shall allow adjustment of the deflectors from outside the completed ductwork without necessity for puncturing or otherwise penetrating ductwork and/or its vapor barrier.
- G. Made by Titus, Tuttle and Bailey, Metalaire, Anemostat, Waterloo, Barber-Colman, or equivalent.
- H. Be similar to Titus Model AG-45 or AG-225 Volume Extractor, Tuttle & Bailey Type VCL or VLK Vectrol, Waterloo Type DTM or DT2M Extractor, Anemostat "DTB" or "DTA" or Young Regulator "890" or 890A", or equivalent.

2.7 MANUAL VOLUME DAMPERS

- A. These dampers are to be other than those specified as being integral with each register, diffuser and other air outlet or inlet.
- B. Provided where indicated in the complete air distribution system(s) (including ductwork, return air plenums, etc.) to allow complete balancing of the air supply, return, ventilation and exhaust system(s).
- C. Opposed blade type.
- D. 8" maximum blade width.

- E. Made of galvanized steel, steel with acid/solvent chemical resistant coating, or steel with a sprayed or dipped aluminum rust resistant finish; flutterproof.
- F. Provided so that all damper adjustment can be made form outside the completed ductwork without necessity for puncturing or otherwise penetrating the ductwork and/or its vapor barrier.
- G. Fully adjustable and with locking device.
- H. Manufactured by Titus, Tuttle & Bailey, Anemostat, Waterloo, Metalaire, Greenheck or equivalent.
- I. Provided at a point in the ductwork which is a sufficient distance upstream from an outlet (or downstream from an inlet) to attenuate objectionable noise due to damper throttling and to preclude adverse effects on the distribution device.
- J. Based upon location of the duct in which the damper is to be installed, provide the following types:
 - 1. Dampers in ducts which are exposed or located above "lay-in" or "accessible ceilings": Young Regulator Company Model 817 or equivalent.
 - 2. Dampers in ducts concealed above plaster ceilings or behind dry wall construction: Young Regulator Company Model 817A or equivalent.
- K. Use in low pressure duct system only.

2.8 LOW PRESSURE DUCT ACCESS DOORS

- A. Provided for: each manual and motorized damper; fire damper; smoke damper; electric duct heater; and where access is otherwise necessary.
- B. Factory prefabricated double wall insulated type of 24 US gauge galvanized steel (of same or thicker gauge than ductwork panel in which installed, whichever is greater).
- C. Minimum size shall be as large as is compatible with duct size but in no case less than the following (provide larger sizes if necessary to permit proper access operation):

<u>Max. Duct Dimensions</u>	<u>Access Door Size</u>
11" and less	10" x 12"
12" through 16"	12" x 16"
17" and over	16" x 24"

- D. Doors shall be provided with and operated adjustable tension catches and shall be completely gasketed around their perimeters. Doors shall be Ventlok "Access

Doors". Install in accordance with manufacturers recommendations using Ventlok #360 sealant or equivalent.

2.9 TEST OPENINGS

- A. Furnish and install gasketed capped test openings for test equipment (pitot tubes, etc.) on the entering and leaving sides of air handling unit and other air handling equipment and heating coils. Test openings shall be Ventlok #699-2 or equivalent.

2.10 PREFABRICATED DUCT CONNECTIONS

- A. At Contractor's option, prefabricated duct connections as manufactured by Ductmate (or approved equal system) may be used in locations and applications for which the duct connection system is recommended. Use of these connections must meet or exceed specified duct construction quality as related to structural rigidity, pressure, accessibility and other such requirements.

PART 3 - EXECUTION

3.1 GENERAL

- A. Construct and install all accessories in accordance with the latest indicated editions of applicable SMACNA construction standards.
- B. Provide all mitered elbows with turning vanes.
- C. Install all duct system accessories in accordance with manufacturer's recommendations.
- D. All accessories installed in poly-vinyl-steel ductwork shall have acid/solvent chemical corrosion resistant coating.
- E. All manual damper arms shall be tagged with fluorescent colored strip.

END OF SECTION 23 33 00

SECTION 23 37 13

AIR DISTRIBUTION DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-01 Specification sections, apply to work of this section.

1.2 SCOPE

- A. Provide all air distribution devices as indicated on the drawings and as specified herein for a complete and operable system.

1.3 RELATION TO OTHER WORK

- A. Refer to the section, "General Mechanical Provisions", for related requirements. Refer to other sections of Division 23 and to all other applicable portions of the Drawings and Specifications.
- B. Coordinate with work of the ceiling, drywall and plastering trades as required to insure an orderly progression of work and a first class finished system with respect to placement, alignment, finish, general fit and absence of conflict with lighting systems and fire protection systems.

Insulate air distribution devices to prevent condensation formation.

1.4 DESIGN CONDITIONS

- A. Acoustical: Noise produced at each diffuser, register, grille or other air distribution device shall not exceed a noise criteria level of NC 35 based on sound pressure levels in db re 0.002 microbars unless otherwise indicated. Coordinate air distribution devices, sound attenuation measures and equipment actually provided to insure that this design constraint is not exceeded by the system installed.

Exceptions: Any particular rooms or areas which are normally occupied by other than maintenance staff or service staff and which may be noted on the drawings as requiring lower NC criteria.

- B. Pressure Drop: Pressure drop across any air distribution device shall not exceed 0.15 in wg static pressure unless otherwise indicated.

AIR DISTRIBUTION DEVICES

1.5 SHOP DRAWINGS

A. Refer to the requirements of Section entitled "General Mechanical Provisions".

1.6 MANUFACTURER

A. Products listed in this Section or on the plans are based on a specific manufacturer to establish the desired style, quality and type. Equivalent products, complying with the requirements of this Section and the installation requirements of the plans, by the following manufacturers are acceptable:

1. Titus
2. Metalaire
3. Price
4. Krueger
5. Carnes

B. Manufacturers must be members of the Air Distribution Council unless otherwise indicated.

1.7 OTHER REQUIREMENTS

A. All aluminum is to be extruded unless otherwise indicated.

B. Appearance: Each air distribution device which has a portion thereof (frame, core, etc.) exposed to view in the finished area shall have a factory applied finish which matches and is compatible with the color of the surrounding surface on which the device is installed. Colors must be approved by Architect prior to device fabrication.

C. All louvers, dampers and/or shutters shall be rated by their manufacturer in accord with AMCA Standard 500-74.

D. Integral Components: All dampers, blank-off baffles and other companion devices which form an integral part of air distribution device shall be factory made items produced by the manufacturer of air distribution device.

E. Louvers: Louvers may be specified in another division but for reference may also be indicated on mechanical drawings.

F. Door Grilles: Door grilles may be specified in another division but for reference may also be indicated on mechanical drawings.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Provide the following air distribution devices as applicable to this project. Refer to air distribution device schedule as shown on drawings.

2.2 OTHER REQUIREMENTS

- A. All devices must each comply with the applicable portions of the Air Diffusion Council (ADC) Equipment Test Code 1062R4 "Certification, Rating and Test Manual", the Air Movement and Control Association, Inc. (AMCA) Standard 500 "Test Method for Louvers, Dampers and Shutters" and the "National Fire Protection Association" (NFPA) Standard 90A "Installation of Air Conditioning and Ventilating Systems".
- B. Provide ceiling and/or linear diffusers with border styles that are compatible with adjacent ceiling systems, and that are specifically manufactured to fit into ceiling module with accurate fit and adequate support. Refer to general construction drawings and specifications for types of ceiling systems which will contain each type of diffuser.
- C. Diffusers, grilles and registers installed in fire rated ceiling, or floor/ceiling assemblies shall be constructed of steel.
- D. Mounting Screws: Where grilles, diffusers or registers are specified which require mounting screws visible from the face of the device these screws shall be furnished with the air distribution equipment and be finished at the factory to match the finish on the grille, diffuser or register in which they are to be used.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install neatly where indicated in accord with manufacturer's recommendations and in accord with SMACNA recommendations and as otherwise indicated.
- B. Properly test, balance and adjust to produce quiet, draftless operation to best degree possible.

3.2 INSTALLATION

- A. Rectangular Diffusers: Where diffusers are the lay-in type, they shall be supported by the inverted T-bar suspension system but all ducts connected thereto shall be supported independently of the ceiling as specified under Section entitled

"Ductwork". Surface mounted diffusers shall be supported by the duct runouts or drops where sheet metal ducts are indicated and by separate hangers where flex runouts are indicated. All rectangular ceiling diffusers shall be installed with their lines parallel and perpendicular to the building line and properly aligned with the ceiling.

- B. Sidewall Grilles and Registers: Mount securely to the duct system flanges using finish screws and in accordance with accepted good practice.
- C. Ceiling mounted Exhaust and Return Registers/Grilles: Mount as specified hereinbefore for surface mounted ceiling diffusers except use finished screws provided and secure to duct and finished ceiling (or finished ceiling for nonducted returns) in accordance with the manufacturer's instructions. Where required to provide adequate support for nonducted registers or grilles, provide appropriate mounting frame for incorporation into the ceiling system.
- D. Install all outlets and inlets as recommended by the manufacturer; in accordance with recognized industry practices; to insure that products serve intended functions.
- E. Locate ceiling air outlets and inlets as indicated on the drawings. Unless otherwise indicated, locate units in center of acoustical ceiling modules. Install square and parallel with partitions, ceiling grid members, etc.
- F. Spare Parts: Furnish to Owner, with receipt, 3 operating keys for each type of outlet and inlet that require them.
- G. Do not install blank-offs under continuous linear diffuser distribution plenums. Distribution plenums shall cover only active portion of the diffuser.

3.3 PROTECTION OF WORK UNTIL FINAL ACCEPTANCE

- A. Coordinate the installation of the air distribution equipment with related work and finishing of adjacent surfaces to prevent damage to the devices or adjacent finishes. Protect the finish of all air distribution equipment until final acceptance. Replace or repair to the Architect's satisfaction any damaged equipment.

END OF SECTION 23 37 13

SECTION 260500 - COMMON WORK RESULTS FOR ELECTRICAL

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Except as modified in this section, General Conditions, Supplementary Conditions, applicable provisions of Division 1, General Requirements, and other provisions and requirements of the Contract Documents apply to work of Division 16.
- B. Each section included in Division 16 is incomplete without the provisions stated herein.

1.2 PRODUCTS SUPPLIED BUT NOT INSTALLED UNDER THIS SECTION

- A. Access doors.

1.3 REFERENCES

- A. ASTM D 698 - Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/cu. ft. (600kN-m/cu. m.)).
- B. ASTM E 814 - Fire Tests of Through-Penetration Fire Stops.
- C. IEEE C2 - National Electrical Safety Code.
- D. NFPA 70 - National Electrical Code.
- E. UL 1479 - Fire Tests of Through-Penetration Firestops.

1.4 DEFINITIONS

- A. Provide: Where the word "provide" is used, the word is understood to mean "the Contractor shall furnish and install" the equipment, tests, inspections, etc. referenced.
- B. Related Work: The sections referenced under RELATED SECTIONS shall be understood to include provisions, which directly affect the work being specified in the section where RELATED SECTIONS occurs.
- C. Concealed: Where the word "concealed" is used in conjunction with raceways, equipment, and the like, the word shall be understood to mean hidden from sight as in chases, furred spaces, or suspended ceilings.
- D. Exposed: Where the word "exposed" is used, the word shall be understood to mean open to view.

1.5 SUBMITTALS

- A. Access Doors: Indicate detailed dimension.

1.6 REGULATORY REQUIREMENTS

- A. Perform work in accordance with the National Electrical Code and all editions, revisions, amendments, or supplements of applicable statutes, ordinances, codes, or regulations of Federal, State, and Local Authorities having jurisdiction in effect on the date bids are received.
- B. Where approval standards have been established by OSHA, UL, ASME, AGA, AMCA, ANSI, ARI, NFPA, State Fire Insurance Regulatory Body, and FM, follow these standards whether or not indicated on the Drawings and Specifications. Include cost of work required to comply with requirements of these authorities in the original proposal. Comply with IEEE C2 where applicable.
- C. Requirements in reference specifications and standards are minimum for equipment, material, and work. In instances where capacities, size, or other scheduled features of equipment, devices, or materials exceed these minimums, meet scheduled or specified capacities.
- D. Resolve code interpretations discovered in Contract Documents with A/E prior to Contract award. After Contract award, make corrections or additions necessary for compliance with applicable codes.
- E. Arrange with local and state authorities and utility companies for permits, fees, and service connections, verifying locations and arrangement, and pay charges including inspections.

1.7 CONTRACT DRAWINGS

- A. Drawings are generally diagrammatic and are intended to encompass a system that will not interfere with the structural and architectural design of the building. Coordinate work to avoid interferences between conduit, equipment, architectural, and structural work. Provide a complete operational fire alarm system. Provide all necessary interfaces with the electrical BAS and HVAC systems. Route conduit raceways and install equipment to avoid conflicts with other trades and to enhance maintainability of system.
- B. Coordinate with architectural features, trim and millwork, and install equipment in cabinets or other special areas as directed by A/E.
- C. Drawings are based on equipment specified. Make adjustments, modifications, or changes required, due to use of other equipment at no additional cost to the Owner.

1.8 PROJECT/SITE CONDITIONS

- A. Site Visitation: Visit the site of the proposed construction to become thoroughly familiar with details of work and working conditions, verify dimensions in the field, and advise A/E of discrepancies before performing work.

- B. Space Requirements
 1. Consider space limitations imposed by contiguous work in selection and location of equipment and material. Do not provide equipment or material, which is not suitable in this respect.
 2. Make changes in equipment location of up to 5 feet, to allow for field conditions prior to actual installation, and as directed by A/E.
 3. Conceal conduit in finished areas. Conduit may be exposed in mechanical rooms, electrical rooms and where specifically allowed on Drawings. Route conduit through the building without interfering with other equipment or construction. Where existing construction prohibits the installation of conduit concealed provide wire mold metallic raceway and boxes.
 4. Provide maximum possible clear height underneath conduit. Install conduit as high as possible.
 5. Install equipment requiring service so that it is easily accessible.
 6. Compare the equipment sizes with the space allotted for installation before installation and make written notice of possible conflict. Disassemble large equipment to permit installation through normal room openings when required. Should written notice not be made in a timely manner, make adjustments and modifications necessary without additional compensation.
 7. Timely place equipment too large to fit through finished openings, and stairways.

- C. Site Obstructions:
 1. Drawings indicate certain information pertaining to surface and subsurface obstructions, which has been taken from available drawings. Such information is not guaranteed as to accuracy of location or completeness of information.
 2. Verify with A/E, utility companies, municipalities, and other interested parties that available information has been provided before cutting or trenching operations are begun. Verify locations given.
 3. Alter routing of new work should obstruction be encountered, whether or not shown on Drawings. Reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.
 4. Assume total responsibility for and repair damage to existing utilities or construction, whether or not such existing facilities are shown. Repair the lines, if damaged.

- D. Cutting and Patching:
 - 1. Submit written request to A/E in advance of cutting or alterations.
 - 2. Execute cutting and demolition by methods which will prevent damages to other work and will provide proper surfaces to receive installation of repairs.
 - 3. Restore work which has been cut or removed; install new products complying with specified products, functions, tolerances and finishes as specified.
 - 4. Escutcheon Plates
 - a. Heavy chrome-plated or nickel-plated escutcheon plates for penetrations of finished surface.
 - b. Product: B&C No. 10 with concealed hinges.
 - 5. Fit work airtight to conduit, sleeves, and other penetrations through surfaces. For fire-rated penetrations, provide assemblies in accordance with UL 1479 and ASTM E 814 utilizing products and materials equal to rating of surfaces penetrated.

1.9 MATERIALS AND WORKMANSHIP

- A. Provide new materials and equipment of a domestic manufacturer by those regularly engaged in the production and manufacture of specified materials and equipment. Where UL or other agency has established standards for materials, provide materials which are listed and labeled accordingly. The commercially standard items of equipment and the specific names mentioned herein are intended to identify standards of quality and performance necessary for the proper functioning of the work.
- B. Install materials and equipment to present a neat appearance when completed and in accordance with the approved recommendations of the manufacturer and in accordance with Contract Documents.
- C. Provide labor, materials, apparatus, and appliances essential to the complete functioning of the systems described or indicated herein, or which may be reasonably implied as essential whether mentioned in the Contract Documents or not.
- D. Make written request to A/E for supplementary instructions in cases of doubt as to Work intended or in event of need for explanation thereof.
- E. Performance and material requirements scheduled or specified are minimum standards acceptable. The right to judge the quality of equipment that deviates from the Contract Documents remains solely with A/E.

1.10 DELIVERY, STORAGE AND HANDLING

- A. Follow the manufacturer's directions completely in the delivery, storage, and handling of equipment and materials.
- B. Store equipment in a clean, dry place, protected from other construction. While stored, maintain factory wrappings or tightly cover and protect equipment against dirt, water, construction debris, chemical, physical or weather damage, traffic and theft.
- C. Adequately brace and package equipment to prevent breakage and distortion while in transit.

1.11 EXCAVATION

- A. Trenching:
 - 1. Perform excavation of every description and of whatever substance encountered to depths indicated or specified. Pile materials suitable for backfilling a sufficient distance from banks of trenches to prevent slides or cave-ins. Comply with OSHA requirements for excavation, trenching, and shoring. Keep surface drainage of adjoining areas unobstructed. Waste excavated materials not required or satisfactory for backfill. Remove water by pumping or other approved methods, discharge at a safe distance from the excavation.
 - 2. Provide trenches of necessary width for proper laying of conduit and comply with latest publication of OSHA 2226 Excavating and Trenching Operations. Coordinate trench excavation with pipe installation to avoid open trenches for prolonged periods. Accurately grade to bottoms of trenches to provide uniform bearing and support for each section of conduit on undisturbed soil or the required thickness of bedding material at every point along its entire length.
 - 3. Provide minimum 12 inches between outer surfaces and embankment or shoring which may be used, when excavating for manholes, pull boxes, and similar structures. Remove unstable soil that is incapable of supporting the structure in the bottom of the excavation to the depth necessary to obtain design bearing.
 - 4. Material to be excavated is "unclassified." No adjustment in the contract price will be made on account of the presence or absence of rock, shale, masonry, or other materials.
 - 5. Protect existing utility lines that are indicated or the locations of which are made known prior to excavating and trenching and that are to be retained. Protect utility lines constructed during excavating and trenching operations, from damage during excavating, trenching and backfilling; if damaged, repair lines as directed by utilities, Owner, and A/E. Issue notices when utility lines that are to be removed are encountered within the area of operations in ample time for the necessary measures to be taken to prevent interruption of the service.

6. Provide trenches for utilities of a depth that will provide the following minimum depths of cover from existing grade or from indicated finish grades, whichever is lower:
 - a. 3-Foot Minimum Cover: Raceways for primary voltage conductors.
 - b. 2-Foot Minimum Cover: Raceways for secondary conductors.

- B. Backfilling:
 1. Backfill trenches after conduit, fittings, and joints have been tested and approved.
 2. Backfill trenches with sand to provide 6 inches sand below conduit and 12 inches sand cover. Backfill remainder of trenches with satisfactory materials consisting of earth, loam, sandy clay, sand, and gravel, or soft shale, free from large clods of earth and stones not over 1-1/2 inch in size, and deposit in 9 inch maximum layers, loose depth as indicated or specified. Provide 6" wide red warning tape 6" below grade. Take care not to damage utility lines. Deposit the remainder of backfill materials in the trench in 1 foot maximum layers, and compact by mechanical means. Re-open trenches and excavation pits improperly backfilled or where settlement occurs to the depth required to obtain the specified compaction, then refill and compact with the surface restored to the required grade and compaction.
 3. Where trenches cross streets, driveways, building slabs, or other pavements, backfill trench utility line with sand backfill material in 6 inch layers. Moisten each layer and compact to 95 percent of the maximum soil density as determined by ASTM D 698. Accomplish backfilling in such a manner as to permit the rolling and compaction of the filled trench with the adjoining material to provide the required bearing value so that paving of the area can proceed immediately after backfilling is complete.
 4. Restore surface/ slab/ drive to original "new" condition.

1.12 PAINTING

- A. Properly prepare surfaces to receive paint. Prime prepared surfaces and finish with two coats of exterior oil base paint. Verify primer and paint are rated for application.

- B. Repair damage to factory painted finishes.

- C. Remove splattered and incidental paint from electrical equipment.

1.13 PILOT INSTALLATION

- A. Provide a pilot installation of items of equipment, which are concealed and require service, such as disconnect switches above ceiling, and transformers above ceiling. Have pilot installation approved before further installation work is performed for the particular items of equipment.

1.14 ACCESS DOORS

- A. Provide hinged access doors in walls, floors and ceilings to permit access to equipment requiring service or adjustment.
- B. Provide hinged access doors and frames as follows:
 - 1. Drywall Construction:
 - a. Provide with concealed spring hinges and flush screwdriver operated cam locks in sufficient number of the size of the panel. Factory prime paint surfaces not galvanized.
 - b. Product: Milcor, "Style DW".
 - 2. Visible Masonry and Ceramic Tile: Milcor, "Style M".
 - 3. Gypsum and Cement Plaster: Milcor, "Style K".
 - 4. Acoustic Plaster:
 - a. Reinforce panel as required to prevent sagging. Provide continuous steel piano type hinge for the length of the panel, and sleeved and grommeted screwdriver operated cam locks in sufficient number for the size of the panel. Factory prime paint surfaces not galvanized.
 - b. Product: Milcor, "Style AP".
 - 5. Acoustic Tile: Milcor, "Style AT".
 - 6. Inmate Accessible Areas: Security access doors in all hard ceilings as specified by the Architect.
- C. Provide continuous concealed hinges and cam locks.
- D. Provide UL listed 1-1/2 hour Label "B" access doors with automatic self-closing latching mechanism where required.
- E. Provide removable ceiling access tile section immediately adjacent to each mechanical or electrical device located in the ceiling plenum above removable tile ceiling.
- F. Coordinate approval and location of doors with A/E.

1.15 NOISE AND VIBRATION

- A. Provide the entire operating system and its component items of equipment free of objectionable vibration or noises. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, ballasts, or other parts of the work, rectify such condition at no additional compensation.

1.16 OPERATING INSTRUCTIONS

- A. Provide services of authorized representatives of manufacturer to ensure that the equipment is installed according to the manufacturer's recommendations, is operating properly, and to instruct Owner's operating personnel during start-up and operating tests of complete electrical system. Notify A/E seven days prior to beginning equipment start-up.
- B. Certify in writing that these services have been performed.

- C. Perform tests as specified in Section 26 08 00.

1.17 SERVICE

- A. Inspect, clean, and service light fixtures; replace fluorescent or HID lamps if utilized for construction lighting immediately prior to final acceptance of project. All new light shall be LED type.
- B. Clean and polish fixtures, equipment, and materials thoroughly, and return to "as new" condition.
- C. Remove excess material and debris. Place fire alarm systems in complete working order before request for final review. Broom clean areas.

1.18 ARC FLASH HAZARD

- A. Perform calculations to determine the ARC flash hazard at switchboards, panelboards, motor control centers, starters and industrial control panels.
- B. Install ARC flash hazard labels at each piece of equipment in accordance with NFPA 70, Article 110.16.

1.19 PROJECT RECORD DOCUMENTS

- A. Maintain a set of Contract Documents at the job site for the purpose of recording final size, location, and interrelation of work under this Division. Mark this set of drawings as the job progresses to indicate "as-built" location of equipment, including concealed conduit and equipment.
- B. Obtain mylar Drawings from A/E, at Contractor's expense, and record as-built conditions.
- C. Clearly and accurately delineate the work by dimensions on the record drawings as installed, with equipment locations identified by at least two dimensions to permanent structures.
- D. Final record drawings shall be marked "AS-BUILT," and signed and dated by Contractor.
- E. Provide certified "AS-BUILT" drawings at the conclusion of project.

1.20 FINAL REVIEW

- A. Obtain necessary Certificates of Occupancy from local authorities.
- B. Submit final approved operation and maintenance manuals including approved submittals, test reports, and "AS-BUILT" drawings prior to requesting final payment. Delivery of operation and maintenance manuals is a condition of final acceptance.

1.21 GUARANTEE

- A. Guarantee materials, parts and labor for Work for one year from the date of issuance of occupancy permit. During that period make good faults or imperfections that may arise due to defects or omissions in materials or workmanship with no additional compensation and as directed by A/E.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

Not used.

END OF SECTION 260500

SECTION 260503 - EQUIPMENT WIRING CONNECTIONS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install splicing and terminating devices.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Burndy Corp.
- B. Dossert Manufacturing Corp.
- C. Ideal Industries, Inc.
- D. Ilsco Corp.
- E. Minnesota Mining and Manufacturing Co.
- F. Thomas & Betts Co., Inc.

2.2 MATERIALS

- A. Cable and wire connections for splicing or terminating shall be made with compression deforming type connectors. Connectors for cable sizes 250 kcmil and larger shall be the long barrel type for double indentation. Soldered connections will not be permitted. Twist-on insulated connectors may be used which are resistant to vibration and are used in the proper sizes.
- B. Provide terminal connectors with hole sizes and spacing in accordance with NEMA standards. Provide terminal connectors with two holes in tongue for use on conductor sizes 250 kcmil and larger. Terminal connectors will not be required for connections to the circuit breakers in the lighting and/or receptacle panels.
- C. Provide connections made with non-insulated connectors insulated with three layers of plastic tape, each layer being half lapped. Provide No. 33+ plastic tape.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide electrical connections to equipment furnished under other contracts and furnish wiring, conduit, outlet boxes, and safety switches, as required. Verify locations, horsepower, and voltages of equipment prior to installation of feeders. If apparent conflict arises in power wiring, advise A/E immediately for clarification.
- B. Provide switches as required by national or local codes.
- C. If the motor is integral to the equipment, isolate the entire piece of equipment with a short section of flexible metal conduit to prevent vibration and/or noise amplification to be transferred to the building structure.
- D. If the motor is adjustable, install an additional length of flexible metal conduit at the motor.
- E. Major equipment furnished under mechanical and other sections of specifications may require different rough-in requirements than those indicated on Drawings. Secure detailed drawings from source furnishing equipment to determine actual rough-in locations, conduit and conductor requirements to assure proper installation.
- F. Before connecting any piece of equipment, verify the name plate data corresponds with information shown on Drawings. Discrepancies shall be called to attention of A/E.
- G. Change any feeders installed incorrectly as a result of not verifying equipment requirements, of equipment provided by others, prior to feeder installation.

END OF SECTION 260503

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install wire and cable, including:
 - 1. Building wire.
 - 2. Cable.
 - 3. Wiring connections and terminations.

1.2 REFERENCES

- A. NEMA WC 3 - Rubber-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.
- B. NEMA WC 5 - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Wire and Cable
 - 1. Carol.
 - 2. Southwire.
 - 3. Triangle PWC, Inc.
- B. Connectors
 - 1. Burndy.
 - 2. T & B.
 - 3. 3M.
- C. Power Distribution Blocks
 - 1. IlSCO.
 - 2. Square D.

2.2 BUILDING WIRE

- A. Thermoplastic-Insulated Building Wire: NEMA WC 5.
- B. Rubber-Insulated Building Wire: NEMA WC 3.
- C. Feeders and Branch Circuits Larger Than #6 AWG: Copper, stranded conductor, 600 volt insulation, THW, THHN/THWN, XHHW, RHW.

- D. Feeders and Branch Circuits #6 AWG and Smaller: Copper conductor, 600 volt insulation, THW, THHN/THWN; smaller than #10 AWG, solid conductor.
- E. Control Circuits: Copper, stranded conductor 600 volt insulation, THW, THHN/THWN.
- F. Plenum Rated Cable: Provide plenum rated cable where cable is installed exposed in plenums.
- G. Wiring type BX will not be acceptable for use on this project.

2.3 WIRING CONNECTIONS AND SPLICES

- A. Connect and splice wire #8 AWG and smaller with self-insulating, wire nut connectors.
- B. Terminate and splice all #6 AWG and larger copper conductors, except for load side lugs on Class I and II switchboards, panelboards, motor control centers, fusible switches, circuit breakers, transformers and individual motor controllers with high conductivity, wrought copper, color-keyed compression connector similar to T & B Series 54100 for terminal connection; Series 54500 for two-way copper-to-copper splices; and Series 54700 for tapping and pigtail copper conductors.
- C. Motor Connections: 3M Series 5300-5304.
- D. Water Chilling Unit Motor Connection: Provide Anderson Model VHCL compression connector sized to accommodate the wire size indicated on the drawings, and have holes sized to fit the stud. Field modification to the compression lug or the motor stud will not be permitted.
- E. Set screw type connectors are only acceptable on the load side lugs of Class I and II switchboards, panelboards, circuit breakers, fusible switches and on individual motor controllers.
- F. Where three or more conductors larger than #8 AWG are installed in wiring gutter, utilize a screw-type power distribution block. Utilize split-bolt mechanical connector, filled and taped for smooth joint, only where specifically requested by Contractor and approved by A/E.

PART 3 - EXECUTION

3.1 GENERAL WIRING METHODS

- A. Use no wire smaller than No. 12 AWG for power and lighting circuits, and no smaller than No. 14 AWG for control wiring. Provide minimum of No. 12 AWG for all switch legs. Provide neutral conductor of the same size as the phase conductors to which it is associated.
- B. Use No. 10 AWG conductor minimum for 20 ampere, 120 volt branch circuits longer than 100 feet, and for 20 ampere, 277 volt branch circuits longer than 200 feet.

- C. Provide homerun conductors of continuous length without joint or splice from overcurrent device to first outlet.
- D. Provide main service and feeder conductors of continuous length without joint or splice for their entire length.
- E. Install wiring in conduit, unless indicated otherwise. Install cable in ceiling plenums with dedicated drop wires and J-hooks.
- F. Neatly train and lace wiring inside boxes, panelboards, switchgear, motor control centers, wiring gutters, and other equipment using Thomas & Betts "Ty-Wraps."
- G. Provide equal conductor lengths for all parallel circuits.
- H. Provide individual neutral for branch circuits.
- I. Drawings indicate proposed circuiting only, and do not indicate every conductor unless intent is unclear and further clarification is required. Provide the necessary travelers for all three-way and four-way switches.
- J. Tag each circuit in an outlet box where two or more circuits run to a single outlet as a guide for the fixture hanger in making connections.

3.2 WIRING INSTALLATION IN RACEWAYS

- A. Pull all conductors into a raceway at the same time. Use UL listed wire pulling lubricant. Do not exceed manufacturer's recommended tension.
- B. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Completely and thoroughly swab raceway system before installing conductors.
- D. Remove and discard conductors cut too short or installed in wrong raceway. Do not install conductors, which have been removed from a raceway.
- E. Do not install conductors in conduit, which contains wires already in place.

3.3 WIRING CONNECTIONS AND TERMINATIONS

- A. Make taps and splices in accessible junction or outlet boxes only.
- B. Thoroughly clean wires before installing lugs and connectors.
- C. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

- D. Provide joints in branch circuits only where such circuits divide. Where circuits divide, provide one through circuit to which the branch is spliced from the circuit. Do not leave joints in branch circuits for fixture hanger to make. Make all taps and splices with approved type compression connector.
- E. Terminate spare conductors with electrical tape.
- F. Identify and label all conductor terminations as specified in electrical identification.
- G. Properly terminate indicated conductors in equipment furnished and provide properly sized lugs.

3.4 COLOR CODING

- A. Color code all distribution systems as follows:
 - 1. 120/208V System

Phase	Color
A	Black
B	Red
C	Blue
N	White
G	Green

- 2. 277/480V System

Phase	Color
A	Brown
B	Purple
C	Yellow
N	Gray/White
G	Green

- 3. For areas where local authority color coding differs from that specified, contact A/E for instructions.

- B. Provide color coding throughout the full length of all wire No. 10 and smaller. Identification by permanent paint bands or tags at the outlets will be acceptable for wire sizes larger than No. 10. Provide the same color and shade of color throughout the project.

3.5 FIELD QUALITY CONTROL

- A. Inspect wire and cable for physical damage and proper connection.
- B. Torque test conductor connections and terminations to manufacturers recommended values.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section includes grounding electrodes and conductors; equipment grounding conductors; bonding methods and materials; including:
 - 1. Power system grounding.
 - 2. Communication system grounding.
 - 3. Electrical equipment and raceway grounding and bonding.
 - 4. Structural steel grounding.
 - 5. Miscellaneous system grounding.

1.2 REFERENCES

- A. NECA - Standard of Installation.
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems.
- C. NFPA 70 - National Electrical Code.
- D. NFPA 99 - Health Care Facilities.

1.3 SYSTEM DESCRIPTION

- A. Grounding systems use the following elements as grounding electrodes:
 - 1. Metal frame of the building.
 - 2. Rod electrode.
 - 3. Metal cold water pipe at building entry.
 - 4. Reinforcing steel in foundation.
- B. Grounding System Resistance: 3 ohms.

1.4 SUBMITTALS

- A. Product Data: Submit grounding electrodes and connections; for fastening components; and nameplates, labels, and markers.
- B. Test Reports: Indicate overall resistance to ground and resistance of each electrode.
- C. Manufacturer's Installation Instructions: Submit for active electrodes.
- D. Project Record Documents: Record actual locations of components and grounding electrodes.
- E. Provide installation pictures for coordination and records.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Rod Electrodes: Copper-encased steel, 3/4-inch (19 mm) diameter, minimum length 8 feet.
- B. Mechanical Connectors:
 - 1. Manufacturers:
 - a. Burndy.
 - b. O.Z. Gedney.
 - 2. Heavy-duty, bolt-type, copper alloy or bronze for grounding and bonding applications, in configurations required for particular installation.
- C. Exothermic Connections:
 - 1. Type for underground and structural steel; Cadweld.
 - 2. Exothermic materials, accessories, and tools for preparing and making permanent field connections between grounding system components.
- D. Wire:
 - 1. Stranded, copper cable.
 - 2. Foundation Electrodes: 2/0 AWG.
 - 3. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.
- E. Grounding Well Components:
 - 1. Well Pipe: 8 inch NPS by 24-inch long concrete pipe with belled end.
 - 2. Well Cover: Cast iron with legend "GROUND" embossed on cover.

PART 3 - EXECUTION

3.1 GROUNDING AND BONDING INSTALLATION

- A. Install rod electrodes as indicated. Install additional rod electrodes as required to achieve specified resistance to ground.
- B. Provide grounding well pipe with cover at each rod location. Install well pipe top flush with finished grade.
- C. Provide bonding to meet Regulatory Requirements.
- D. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.
- E. Interface with lightning protection system installed under Section 26 41 13.13.
- F. Locate and install anchors, fasteners, and supports in accordance with NECA "Standard of Installation".

- G. Do not fasten supports to pipes, ducts, mechanical equipment, or conduit.
- H. Do not use spring steel clips and clamps.
- I. Do not use powder-actuated anchors.
- J. Do not drill or cut structural members.
- K. Do not use compression or mechanical connectors underground.

3.2 ELECTRIC SERVICE GROUND

- A. Ground the electrical service system neutral at service entrance equipment to grounding electrodes.
- B. Bond together system neutrals, service equipment enclosures, and equipment grounding conductor at service entrance.
- C. Connect the electric service grounding electrode conductors to the incoming metal water pipe system (when available, using a suitable ground clamp) and to supplemental electrodes such as ground rods or ground loop.
- D. Provide grounding and bonding at the power company's metering equipment.
- E. Provide test wells for access to the ground grid and removable connections for testing the system.

3.3 GROUND LOOP

- A. Provide an electrically continuous ground system consisting of minimum of #4/0 copper main ground loop and ground rod stations with the bare copper conductors connected to the ground rod stations. Verify that the resistance to ground between any point on the system does not exceed 3 ohms. *Required for buildings 60' and above.*
- B. Install the ground conductors in contact with the earth below the frost line or a minimum of 30 inches, whichever is deeper.

3.4 EQUIPMENT GROUND

- A. Provide a complete ground system for the building consisting of copper cable, ground rods and exothermic connections to serve the service entrance, building structural steel, metallic enclosures and conduit systems.
- B. Provide a separate, insulated equipment grounding conductor from the main service ground to each main switchboard and in all feeders and branch circuits. Terminate each end on a grounding lug, bus, or bushing. Do not use conduit as grounding conductor.

- C. Provide OZ Type "BJ" bonding jumper at all expansion joints, points of electrical discontinuity or connections in conduit where firm mechanical bond is not possible, such as flexible connections, insulating couplings, etc.
- D. Ground each lighting and power panelboard by connecting the grounding conductor to the grounding stud.
- E. Ground each secondary dry-type transformer to the ground bus of the primary side panelboard. Provide a bonding jumper between the ground stud and the neutral. Ground transformer ground stud to ground loop if a ground loop is installed or the nearest structural steel member.
- F. Bond every item of equipment served by the electrical system to the building equipment ground system. This includes switchboards, panelboards, disconnect switches, receptacles, controls, fans, air handling units, pumps, and flexible duct connections.
- G. Ground each light pole.

3.5 ISOLATED GROUND

- A. Isolated Grounding Systems: Use insulated equipment grounding conductor and connect only to separate grounding electrode as shown.

3.6 COMMUNICATIONS GROUND

- A. Provide communications system grounding conductor at point of service entrance and connect to ground loop.
- B. Use minimum No. 6 AWG copper conductor for communications service grounding conductor. Leave 10-foot slack conductor at terminal board.

3.7 FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Grounding and Bonding: Perform inspections and tests listed in NETA ATS, Section 7.13.

END OF SECTION 260526

SECTION 260529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install supporting devices, including:
 - 1. Conduit and equipment supports.
 - 2. Fastening hardware.

1.2 COORDINATION

- A. Coordinate size, shape and location of concrete pads with section on cast-in-place concrete.
- B. Coordinate size, shape and requirements for utility company equipment with local utility company.

1.3 QUALITY ASSURANCE

- A. Provide support systems adequate for weight of equipment and conduit, including wiring, which they carry.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. B-Line.
- B. Kindorf.
- C. Unistrut.

2.2 MATERIAL

- A. Support Channel: Galvanized steel.
- B. Hardware: Galvanized steel.
- C. Provide epoxy or PVC coated materials for corrosive environments.
- D. Spring steel clips.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using expansion anchors, beam clamps or bolts.
- B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; sheet metal screws in sheet metal studs and wood screws in wood construction.
- C. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.
- D. Do not use powder-actuated anchors on new concrete structure.
- E. Do not drill structural steel members.
- F. Fabricate supports from structural steel or steel channel, rigidly welded or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.
- G. Provide concrete pads and equipment bases for all outdoor equipment on grade, floor mounted equipment, areas with floors below grade, penthouse equipment rooms and where shown on Drawings.
- H. Install surface-mounted cabinets and panelboards with minimum of four anchors.
- I. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.
- J. Do not support conduit from ceiling wire supports.
- K. Do not support conduits by individual hanger wires.
- L. Where multiple runs of conduit can be run grouped together, run conduit in racks supported from the building structure. Provide for future use of rack by properly planning routing of conduits in and through restricted areas such as through walls and around mechanical and electrical equipment.
- M. Use spring steel clips only with EMT for individual branch circuits and device boxes in drywall construction.

END OF SECTION 260529

SECTION 260533.13 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install wall and ceiling outlet boxes, floor boxes, and pull and junction boxes.
- B. Furnish and install raceway systems including telephone, data, cable TV, and security.

1.2 REFERENCES

- A. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- C. NFPA 70 - National Electrical Code.

PART 2 - PRODUCTS

2.1 OUTLET BOXES

- A. Provide galvanized or cadmium-plated pressed steel outlet boxes suitable for the conditions of each outlet. Provide multi-gang outlets of single box design; sectional boxes will not be acceptable.
- B. Provide deep type cast metal outlet boxes located in damp locations exposed to weather or exposed areas subject to damage, or where surface mounted below 8' above finished floor, complete with gasketed cover and threaded hubs.
- C. Provide outlet boxes of sufficient volume to accommodate the number of conductors entering the box in accordance with the requirements of NFPA 70, and not less than 4 inches square and 1-1/2 inch deep unless shallower boxes are required by structural conditions and are specifically approved by A/E.
- D. Provide non-metallic type outlet boxes only in corrosive areas.
- E. Provide 4-inch octagonal ceiling outlet boxes.

2.2 FLOOR BOXES

- A. Provide fully adjustable, cast iron, or formed steel floor boxes for installation in cast-in-place concrete floors.

2.3 PULL AND JUNCTION BOXES

- A. Provide galvanized sheet metal boxes conforming to NEMA OS 1. Provide hinged enclosures for any box larger than 12 inches in any dimension. Hinged covers must open at least 90 degrees.
- B. Provide cast metal boxes for outdoor and wet locations conforming to NEMA 250; Type 4 and Type 6, flat-flanged, surface-mounted junction box, UL listed as watertight with cover and ground flange, neoprene gasket, and stainless steel cover screws.
- C. Provide precast concrete or fiberglass handholes for underground installations. Where fiberglass handholes are provided, provide die-molded type with pre-cut 6"x6" cable entrance at center bottom of each side and fiberglass weatherproof cover with non-skid finish.
- D. Provide pre-cast reinforced concrete type pull/splice boxes with flush cover as manufactured by Brooks Products, for underground circuits. Size boxes as indicated.
- E. Provide separate pull boxes and junction boxes for electric power, control, and communication systems.
- F. Duct Bank Pull Boxes
 - 1. Provide pull boxes constructed of cast-in-place concrete with steel reinforcing bars; precast concrete with steel reinforcing bars; or fiberglass.
 - 2. Design and test manufactured pull boxes to temperatures of minus 50 degrees F. Provide pull boxes with material compressive strength no less than 11,000 psi.
 - 3. Provide covers with a minimum coefficient of friction of .5 and which are full vehicular traffic H-20 rated. Provide factory engraved "logo" on cover to indicate "electrical" or "telephone". Provide lockable covers with two penta-head bolts and pull slot(s) for easy removal.

2.4 BACKBOARDS

- A. Backboards: 3/4-inch, fire-retardant, exterior grade plywood.
 - 1. Provide minimum of two 4-foot by 8-foot sheet of plywood for each telephone location shown unless otherwise noted.
 - 2. Provide minimum of two 4-foot by 4-foot sheet of plywood for each data, cable TV, or security location shown unless otherwise noted.

2.5 CONDUIT

MANUFACTURERS

- A. Rigid Metal Conduit, Intermediate Metal Conduit, Electrical Tubing and Fittings.
 - 1. Allied Tube and Conduit Corporation
 - 2. Triangle PWC, Inc.
 - 3. Wheatland Tube Co.
- B. Flexible Conduit and Fittings
 - 1. Anamet, Inc.
 - 2. Electri-Flex Co.
 - 3. Triangle PWC, Inc.

- C. Nonmetallic Conduit and Fittings
 - 1. Can-Tex Industries.
 - 2. Carlon
 - 3. Certain-Teed.

MATERIALS

- D. Rigid Metal Conduit and Fittings
- B. Intermediate Metal Conduit (IMC) and Fittings
- C. Electrical Metallic Tubing (EMT) and Fittings
- D. Flexible Metal Conduits and Fittings
- E. Liquidtight Flexible Conduit and Fittings
- F. Nonmetallic Conduit and Fittings

2.6 WIREWAYS

MANUFACTURERS

- A. BLine
- B. General Electric
- C. Hoffman
- D. Keystone
- E. Square D

MATERIALS

- A. General Purpose Wireway: Square D Square Duct, Series LD.
- B. Oiltight, Dust Tight Wireway: Square D Type JIC, Series LL.
- C. Raintight Wireway: Square D lay in raintight, Series LDR.
- D. Raintight Troughs: Square D, Series RD.
- E. Wireway End Closures, Supports and Associated Fittings: Square D of best forms and dimensions for applications.

Part 3 - EXECUTION

3.1 COORDINATION OF BOX LOCATIONS

- A. Provide electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections, and code compliance.
- B. Electrical box locations shown on Drawings are approximate unless dimensioned. Verify with A/E the location of floor boxes and outlets in offices and work areas prior to rough-in.

- C. Locate and install boxes to allow access. Provide access doors where installation is inaccessible. Coordinate locations and sizes of required access doors with those specified in Division 25 - Mechanical.
- D. Locate and install to maintain headroom and to present a neat appearance.

3.2 OUTLET BOX INSTALLATION

- A. Do not install boxes back-to-back in walls. Provide minimum 6 inch separation, except provide minimum 24-inch separation in acoustic-rated walls.
- B. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat openings for boxes.
- C. Provide knockout closures for unused openings. Provide blank plates for all junction boxes.
- D. Securely fasten boxes to the building structure using an approved bracket (i.e., "H" bracket), independent of the conduit, except for splice boxes that are connected to two metal conduits, both supported within 12 inches of box.
- E. Provide access to all boxes.
- F. Use multiple-gang boxes where more than one device are mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- G. Install boxes in walls without damaging wall insulation.
- H. Coordinate with A/E for mounting heights and locations of outlets mounted above counters, benches, and backsplashes.
- I. Set boxes installed in concealed locations flush with the finish surfaces, and provide with the proper type extension rings and/or covers where required.
- J. Position outlets to locate luminaires as shown on reflected ceiling plans.
- K. In inaccessible ceiling areas, do not install junction boxes which are accessible only through luminaire ceiling opening.
- L. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use adjustable steel channel fasteners for flush ceiling outlet boxes.
- M. Align wall-mounted outlet boxes for switches, thermostats, and similar devices. Install all grouped device locations neat and symmetrical. Coordinate with A/E before rough-in.
- N. Label junction boxes as to circuits located within and panelboards serving those circuits.

3.3 FLOOR BOX INSTALLATION

- A. Set boxes level and flush with finish flooring material.
- B. Seal as recommended by manufacturer.

3.4 PULL AND JUNCTION BOX INSTALLATION

- A. Locate pull boxes and junction boxes above accessible ceilings or in unfinished areas.
- B. Support pull and junction boxes independent of conduit.
- C. Provide pull boxes in feeder circuits as required but at least every 150 feet in straight runs.
- D. Identify all junction boxes by circuit number on cover with legible permanent ink marker.
- E. Duct Bank Pull Boxes
 - 1. Where installed outside, set pull boxes level with above finish grade.
 - 2. Rate all pull boxes for H-20 heavy traffic. Concrete encase pull boxes.
 - 3. Stack pull boxes or provide extensions as required for routing of conduits as indicated on Drawings.
- F. Provide weatherproof pull boxes or junction boxes where installed outdoors with watertight gasketed covers fastened by means of corrosion resistant screws.

END OF SECTION 260533.13

SECTION 260533.16 - EMPTY RACEWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install raceway systems including telephone, data, cable TV, and security.

1.2 SYSTEM DESCRIPTION

- A. Provide conduit and terminal boards required to form a system of raceways for pulling of cable at a later date.

PART 2 - PRODUCTS

2.1 EQUIPMENT

- A. Backboards: 3/4-inch, fire-retardant, exterior grade plywood.
 - 1. Provide minimum of two 4-foot by 8-foot sheet of plywood for each telephone location shown unless otherwise noted.
 - 2. Provide minimum of two 4-foot by 4-foot sheet of plywood for each data, cable TV, or security location shown unless otherwise noted.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide underground system service as shown on drawings. Verify exact system requirements for each vendor or utility.
- B. Provide pull boxes in conduit runs spaced not greater than 100 feet apart. Install no more than two right angle bends between junction boxes for all empty raceway systems.
- C. Place label on pull and junction boxes indicating system type.
- D. Conduit
 - 1. Provide minimum 3/4-inch conduit from each telephone outlet to ceiling plenum.
 - 2. Provide minimum 1" inch conduit from each data outlet to ceiling plenum.
 - 3. Provide minimum 1-1/4"-inch conduit from each cable TV outlet to ceiling plenum.
 - 4. Provide minimum 3/4-inch conduit from each security device outlet to ceiling plenum.
 - 5. Provide No. 12 AWG insulated conductor or suitable steel pull wire or nylon cord in all conduits which are for future use or do not call for wire or cable to be installed.
 - 6. Refer to contract documents to verify quantity and size of cables to determine actual conduit size.

- E. Provide two coats of light gray paint for each backboard.
- F. Provide bushing on all conduit or raceway entrances.

END OF SECTION 260533.16

SECTION 260533.19 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install raceway systems, including:
 - 1. Rigid metal conduit and fittings.
 - 2. Intermediate metal conduit and fittings.
 - 3. Electrical metallic tubing and fittings.
 - 4. Flexible metal conduit and fittings.
 - 5. Liquid-tight flexible metal conduit and fittings.
 - 6. Nonmetallic conduit and fittings.

1.2 REFERENCES

- A. ANSI C80.1 - Rigid Steel Conduit, Zinc-Coated.
- B. ANSI C80.3 - Electrical Metallic Tubing, Zinc-Coated.
- C. NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies.
- D. NEMA RN 1 - PVC Externally-Coated Galvanized Rigid Steel Conduit and Electrical Metallic Tubing.
- E. NEMA TC 2 - Electrical Plastic Tubing (EPT) and Conduit (EPC-40 and EPC-80).
- F. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Rigid Metal Conduit, Intermediate Metal Conduit, Electrical Metallic Tubing and Fittings
 - 1. Allied Tube and Conduit Corporation.
 - 2. Triangle PWC, Inc.
 - 3. Wheatland Tube Co.
- B. Flexible Conduit and Fittings
 - 1. Anamet, Inc.
 - 2. Electri-Flex Co.
 - 3. Triangle PWC, Inc.
- C. Nonmetallic Conduit and Fittings
 - 1. Can-Tex Industries.
 - 2. Carlon.
 - 3. Certain-Teed.

2.2 MATERIALS

- A. Rigid Metal Conduit and Fittings
 1. Rigid Steel Conduit: ANSI C80.1; hot-dip galvanized.
 2. PVC Externally Coated Conduit: NEMA RN 1; rigid steel conduit with external PVC coating and internal galvanized surface.
 3. Fittings and Conduit Bodies: NEMA FB 1; threaded type, material to match conduit.
- B. Intermediate Metal Conduit (IMC) and Fittings
 1. Conduit: Hot-dipped galvanized steel.
 2. Fittings and Conduit Bodies: NEMA FB 1; use fittings and conduit bodies specified above for rigid steel conduit.
- C. Electrical Metallic Tubing (EMT) and Fittings
 1. EMT: ANSI C80.3; hot-dipped galvanized tubing.
 2. Fittings and Conduit Bodies: NEMA FB 1; steel set screw type.
- D. Flexible Metal Conduit and Fittings
 1. Conduit: Galvanized steel strips, spirally wound.
 2. Fittings and Conduit Bodies: NEMA FB 1.
- E. Liquid-tight Flexible Conduit and Fittings
 1. Conduit: Flexible metal conduit with PVC jacket and integral grounding conductor.
 2. Fittings and Conduit Bodies: NEMA FB 1; liquid-tight, zinc coated steel.
- F. Nonmetallic Conduit and Fittings
 1. Conduit: NEMA TC 2; Schedule 40 PVC.
 2. Fittings and Conduit Bodies: NEMA TC 3.

PART 3 - EXECUTION

3.1 CONDUIT SIZING, ARRANGEMENT AND SUPPORT

- A. Minimum size of conduit is 1/2-inch. Minimum size of homerun and feeder conduits is 3/4-inch. Indicated sizes are minimum based on THW copper wire and larger sizes may be used for convenience of wire pulling.
- B. Arrange conduit to maintain headroom and present a neat appearance.
- C. Conceal conduit in ceiling of all finished areas and in walls of all areas of the building. In unfinished areas without ceilings, conduit may be run exposed overhead. Install all conduit, including conduit above accessible ceiling, parallel or perpendicular to walls and adjacent piping. Neatly route conduit in a common rack where possible.
- D. Maintain minimum 6 inch clearance between conduit and piping. Maintain 12 inch clearance between conduit and heat sources such as flues, steam pipes, and heating appliances.

- E. Arrange conduit supports to prevent distortion of alignment by wire pulling operations. Fasten conduit securely to building structure using clamps, hangers and threaded rod.
- F. Refer to Section 26 05 29 for support of conduit.

3.2 GENERAL CONDUIT INSTALLATION

- A. Cut conduit square using a saw or pipecutter; de-burr cut ends before joining.
- B. Bring conduit to the shoulder of fittings and couplings and fasten securely.
- C. Install no more than the equivalent of three 90-degree bends between boxes.
- D. Use conduit bodies to make sharp changes in direction, as around beams.
- E. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point. Seal conduit which crosses a boundary between areas of extreme temperature difference.
- F. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture.
- G. Drawings indicate intended circuiting and are not intended to be scaled for exact conduit location.
- H. Install conduit such that it does not interfere with fire-proofing of steel.
- I. Do not install conduit in floor slab of ground floor of building.
- J. Provide a minimum of three(3)-4” conduits sleeves from the first floor data room to the second floor. Provide a minimum of two(2)-3” conduit from the war room data room to the second floor main data room.

3.3 NONMETALLIC CONDUIT INSTALLATION

- A. Wipe nonmetallic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.

3.4 METALLIC CONDUIT INSTALLATION

- A. Make joints mechanically tight and all conduit electrically continuous.
- B. Use conduit hubs for fastening conduit to sheet metal boxes in damp or wet locations. Use sealing locknuts and other approved techniques for moisture proofing raceway in wet areas.
- C. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2 inch size.
- D. Install expansion joints where conduit crosses building expansion joints and at 150 foot intervals in straight runs.

- E. Provide fire-stop compound at all penetrations of floor slabs or fire walls such that fire rating integrity of barrier is not lessened.

3.5 UNDERGROUND DUCT BANK INSTALLATION

- A. Install top of duct bank minimum 24 inches below finished grade, unless indicated otherwise.
- B. Slope duct banks that extend beyond the building outside walls, downward 4 inches per 100 feet from point of origin inside of building to manholes or junction boxes outside the building.
- C. Terminate conduit in end bell at manhole entries.
- D. Stagger conduit joints.
- E. Use suitable separators and chairs installed 5 feet on centers. Band conduit together with suitable banding devices. Securely anchor conduit to prevent movement during concrete placement.
- F. Provide minimum 3 inches red concrete cover at top and bottom and 3 inches concrete at sides of duct bank.
- G. Provide two No. 5 steel reinforcing bars at each corner and at 12 inches on center on top and sides of all duct banks and at 6 inches on center on the bottom. Provide No. 3 steel reinforcing stirrups at 5 feet on center. Provide 3" minimum clear spacing between ducts.

3.6 CONDUIT INSTALLATION SCHEDULE

- A. Exterior
 - 1. Exposed
 - a. Rigid metal conduit.
 - b. PVC coated rigid metal conduit at all concrete slab penetrations.
 - c. Liquid-tight flexible metal conduit for connection to vibrating equipment including motors, transformers and control devices.
 - 2. Underground
 - a. Rigid nonmetallic conduit for all branch circuits.
 - b. Rigid nonmetallic conduit for all feeders with concrete encasement as specified.
 - c. PVC coated rigid metal factory elbows for all bends and for concrete slab penetrations.
- B. Interior
 - 1. Exposed
 - a. Rigid metal conduit in areas subject to moisture, corrosive agents, physical abuse or in unconditioned spaces.
 - b. Electrical metallic tubing in areas not subject to moisture, corrosive agents or physical abuse.

2. Concealed
 - a. Rigid metal conduit in areas subject to moisture or corrosive agents.
 - b. Electrical metallic tubing in areas not subject to moisture or corrosive agents.
 3. Connections to Equipment:
 - a. Liquid-tight flexible metal conduit in areas subject to moisture, high humidity, or corrosive agents.
 - b. Flexible metal conduit in dry, noncorrosive areas.
- C. Electrical nonmetallic tubing, flexible polyethylene or PVC tubing will not be acceptable for use on this project.
- D. BX cable will not be acceptable for use on this project.

END OF SECTION 260533.19

SECTION 260533.22 - WIREWAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 REFERENCES

- A. NFPA 70 - National Electrical Code.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D.
- B. General Electric.
- C. Hoffman.
- D. Keystone.
- E. B-Line.

2.2 MATERIALS

- A. General Purpose Wireway: Square D Square Duct, Series LD.
- B. Oiltight, Dust-Tight Wireway: Square D Type JIC, Series LL.
- C. Raintight Wireway: Square D lay-in raintight, Series LDR.
- D. Raintight Troughs: Square D, Series RD.
- E. Wireway End Closures, Supports and Associated Fittings: Square D, of best forms and dimensions for applications.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide systems of wireway of sufficient size where shown, on equipment racks, and at other locations with two or more starters, disconnect switches, and cabinets mounted in close proximity.
- B. Size wireway cross-sectional area and length based upon conductor fill and equipment served as required by NFPA 70 and local codes.

- C. Provide minimum 14 gauge construction and minimum 6" in any direction.
- D. Install types based on environmental conditions to which exposed.
- E. Provide covers for wiring gutters of the same construction as the wiring gutter. Secure cover with captive type screws located in accordance with manufacturer's recommendation. Hinged covers will not be acceptable.
- F. Provide weather tight raceways and sealed connections for all connections exposed to the elements.

3.2 PAINTING

- A. In finished spaces where wireway is visible, provide prime coat after wireway installation is complete.

END OF SECTION 260533.22

SECTION 26 05 36 - CABLE TRAYS FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Section includes cable tray.

1.2 REFERENCES

- A. NEMA VE 1 - Metallic Cable Tray Systems.
- B. NEMA VE 2 - Metallic Cable Tray Installation Guidelines.

1.3 SUBMITTALS

- A. Shop Drawings: Indicate tray type, dimensions, support points, and finishes. Provide layout of proposed cable tray routing.
- B. Product Data: Submit fittings and accessories.
- C. Manufacturer's Installation Instructions: Submit application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.
- D. Project Record Documents: Record actual routing of cable tray and locations of supports.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this Section with minimum three years documented experience.

1.5 PRE-INSTALLATION MEETING

- A. Convene minimum one week prior to commencing Work of this Section.

PART 2 - PRODUCTS

2.1 METAL LADDER-TYPE CABLE TRAY

- A. Manufacturers:
 - 1. Chatsworth Products, Inc.
 - 2. B-Line.
 - 3. PW.
 - 4. Thomas & Betts.

- B. Product Description: NEMA VE 1, Class 20C ladder type tray.
- C. Material: Steel, Stainless Steel (Mesh).
- D. Inside Width: Minimum 24".
- E. Inside Depth: Minimum 4 inches (152 mm).
- F. Straight Section Rung Spacing: 6 inches (152 mm) on center.
- G. Inside Radius of Fittings: 36 inches (914 mm).
- H. Provide manufacturer's standard clamps, hangers, brackets, splice plates, reducer plates, blind ends, barrier strips, connectors, and grounding straps.
- I. Covers: None.

2.2 WARNING SIGNS

- A. Engraved Nameplates: 1/2-inch (13-mm) black letters on yellow laminated plastic nameplate, engraved with the following wording:

WARNING! DO NOT USE CABLE TRAY AS WALKWAY, LADDER,
OR SUPPORT. USE ONLY AS MECHANICAL SUPPORT FOR
CABLES AND TUBING!

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install metal cable tray in accordance with NEMA VE 2.
- B. Install fiberglass cable tray in accordance with NEMA FG 1.
- C. Support trays and fasten to structure and finishes in accordance with Section 16050. Provide supports at each connection point, at the end of each run, and at other points to maintain spacing between supports of 20 foot (609 m) maximum.
- D. Contractor shall provide and install the necessary quantity and size of CADDY Fastener "CableCAT" hangers and support hardware necessary for routing all station cable bundles outside of cable tray systems.
- E. There shall be at a minimum one "CableCAT" hanger every 4 to 5 feet.
- F. Cable dressings will be required every two(2) to three(3) feet. Cables will be secured with Velcro type wrap. Plastic tie/wire wraps are not permitted.

- G. Use expansion connectors where required.
- H. Provide fire-stopping to sustain ratings when passing cable tray through fire-rated elements.
- I. Ground and bond metal cable tray under provisions of Section 26 05 26.
 - 1. Provide continuity between tray components.
 - 2. Use anti-oxidant compound to prepare aluminum contact surfaces before assembly.
 - 3. Connections to tray may be made using mechanical, compression or exothermic connectors.
 - 4. Cable tray to be bonded in accordance with Article 318, NFPA 70.
- J. Install warning signs at 50 feet (1,500 m) centers along cable tray, located to be visible.
- K. Provide curve and tee fittings for bends and transitions from manufacturer. Cable tray is not allowed to be cut and re-attached.

END OF SECTION 260536

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install items for identification of electrical products installed under Division 26.

1.2 SUBMITTALS

- A. Submit product data.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. W.H. Brady Co.
- B. Carlton Industries, Inc.
- C. Seton Nameplate Co.

2.2 MATERIALS

- A. Nameplates: Provide engraved three-layer laminated plastic nameplates with white letters on a black background. Provide red for emergency devices.
- B. Wire and Cable Markers: Provide vinyl markers with split sleeve or tubing type, except in manholes provide stainless steel with plastic ties.
- C. Underground Warning Tape
 - 1. Manufactured polyethylene material and unaffected by acids and alkalis.
 - 2. 3.5 mils thick and 6 inches wide.
 - 3. Tensile strength of 1,750 psi lengthwise.
 - 4. Printing on tape shall include an identification note BURIED ELECTRIC LINE, and a caution note CAUTION. Repeat identification and caution notes over full length of tape. Provide with black letters on a red background conforming to APWA recommendations.
- D. Panelboard Directories: Provide a typed circuit directory for each panelboard. In the final "As-Built" condition. Mount circuit directory in a permanent, clear Lexan card holder located on inside of door on panelboard.
- E. Conduit Markers: Flexible vinyl film with pressure sensitive adhesive backing and printed markings.
 - 1. Electrical conduit markers shall include three identifying titles on an orange background except as noted.

- a. Typical.
 - 1) Type Example - AC 60 Hertz
 - 2) Load Example – Lighting, Power, Communications, etc.
 - 3) Voltage Example - 480 VAC/3 Phase
 - b. As Noted:
 - 1) If more than one type of power is available in a conduit, then it shall be marked with the title Electrical on orange background.
 - 2) Limit switch controls, air conditioning controls and diffuser controls shall be marked with the title Control on an orange background.
2. Conduit that contains protective or communication systems shall have the exact content and title on blue background and installed and located as specified for conduit.

F. Conduit Markers and Letter Size

1. Dimensions:

Outside Diameter of Conduit in Inches	Width of Color Band in Inches	Height of Letter & Numerals in Inches
1/2 to 1-1/4	8	1/2
1-1/2 to 2	8	3/4
2-1/4 to 3-1/4	10	1
3-1/2 & Larger	12	1-1/4

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Degrease and clean surfaces to receive nameplates.
- B. Install nameplates parallel to equipment lines.
- C. Secure nameplates to equipment fronts using stainless steel or brass screws. Secure nameplate to inside face of recessed panelboard doors in finished locations.
- D. Provide adhesive labels for all outlet wall plates indicating the circuit serving the device. Provide red lettering for all outlet devices served by emergency circuits.
- E. Embossed tape will not be accepted.
- F. Provide underground tape at all electrical installations.

3.2 WIRE AND CABLE LABELING

- A. Provide wire markers on each conductor in splice boxes, pull boxes, and at first load connection on homerun. Identify with branch circuit or feeder number for power and lighting circuits, and with control wire number as indicated on equipment manufacturer's shop drawings for control wiring.
- B. Identify branch circuit or feeder number for power and lighting circuits on cover of pull and junction boxes with indelible marker.

3.3 EQUIPMENT LABELING

- A. Provide nameplates to identify all electrical distribution and control equipment.
- B. Engraved, Laminated Plastic Nameplates: 1/4-inch letters, equipment designation; 1/8-inch letters, source circuit number. Provide for:
 - 1. Meters.
 - 2. Panelboards.
 - 3. Switchboards including each individual device or piece of equipment within a switchboard.
 - 4. Motor control center including each individual device with a motor control center.
 - 5. Enclosed switches, starters, circuit breakers and contactors. Provide neatly typed label inside each motor starter enclosure door identifying motor served, nameplate horsepower, full load amperes, design letter, service factor, and voltage/phase rating. Provide phenolic nameplate on cover exterior to indicate motor served.
 - 6. Transformers if identified on Drawings.
- C. Identify all junction boxes by circuit number with legible permanent ink marker.

3.4 BOX COLOR CODING

- A. Boxes and covers for fire alarm wiring shall be painted red.
- B. Boxes and covers for emergency system wiring shall be painted yellow.

3.5 CONDUIT MARKERS

- A. Location of Identifying Markers: At each end of conduit run and at intermediate points 50' on center maximum.

END OF SECTION 260553-3

SECTION 260573 - OVERCURRENT PROTECTIVE DEVICE COORDINATION STUDY

PART 1- GENERAL

1.1 RELATED DOCUMENTS

- A. Contract Documents, General Requirements for Building Construction and Related Work, apply to work specified in this section.

1.2 SCOPE

- A. Scope: This Section covers the furnishing of an electrical short circuit and overcurrent protective device coordination study and an arc flash hazard analysis for the building electrical system required under this construction contract.

1.3 SUBMITTALS

- A. Conform to the requirements of Section 01 33 31, "Submittal Procedures for Electrical".
 - 1. In addition to the requirements of Section 01 33 31, the short circuit and protection coordination studies shall be bound in 8-1/2-inch by 11-inch hard cover bound volumes with drawings and diagrams folded to fit the 8-1/2 by 11-inch format and securely retained in pockets or compartments of the rigid binder.
 - 2. Six (6) copies of the study shall be submitted.
 - 3. The study shall include the complete low voltage distribution system.
- B. Provide, for each section of the study, an identification and description of the industry testing standards on which the study is based.

1.4 STUDY REQUIREMENTS

- A. The fault study shall include the utility power company's available fault current of 85,900 amps, RMS symmetrical or as indicated on drawings.
- B. Provide calculations, impedance diagrams, conclusions and recommendations as part of the general content of the study.
- C. Provide short circuit tabulations, which include the system impedances, X/R ratio, asymmetry factor, KVA, symmetrical and asymmetrical fault currents.
- D. Provide each study with the following items as a minimum.
 - 1. Provide coordination plots which graphically indicate the coordination proposed for the several systems. Provide plots centered on full scale log-log forms.

2. Provide coordination plots with complete titles, representative one-line diagrams and legends, associated power company's system characteristics, significant motor starting characteristics, complete parameters for power, complete operating bands for switchboard circuit breaker trip devices, fuses, if applicable, and the associated system load protective devices.
 3. Provide coordination plots which define the types of protective devices selected, together with the proposed coil taps, time dial settings and pick-up settings required.
 4. The long time region of the coordination plots shall indicate a complete tap scale for each relay and full load current transformer parameters and designate the pick-ups required for low voltage circuit breakers.
 5. The short time region shall indicate the low voltage circuit breaker, short time and instantaneous trip devices, fuse manufacturing tolerance bands, when applicable, and significant symmetrical and asymmetrical fault currents.
 6. The study shall include coordination down to and including a 20 ampere, 277 volt lighting circuit breaker.
- E. Coordinate each item of equipment as follows:
1. Separate low voltage power circuit breakers from each other by a 16 percent current margin for coordination and protection in the event of secondary line-to-line faults.
 2. The protective device characteristics or operating band shall be suitably terminated to reflect the actual symmetrical and asymmetrical fault currents sensed by the device.
 3. Prepare the study with a network analyzer, computer or by written calculations. Include complete fault calculations as specified above for each proposed and ultimate source combination.
 4. Source combinations include proposed and future, large motors, or generators.
- F. The system studies shall be prepared by the manufacturer of the, switchgear or equipment for the incoming service to the building.
- G. The drawings and specifications indicate the general requirements for the motors, motor starter equipment, and low voltage equipment. Determine additional specific characteristics of equipment furnished in accordance with the results of the short circuit and protective device coordination study.
1. Submit any equipment design discrepancies and the proposed corrective modifications, if required, with the short circuit and protective device coordination study. Identify any variations clearly on the subsequent shop drawings.
 2. Provide the necessary equipment, overcurrent devices, field settings, adjustments and minor modifications for conformance with the approved short circuit and protective device coordination study, without additional expense.
 3. Do not submit equipment shop drawings until the short circuit and protective device coordination study has been approved.

- H. Prepare a tabulation of the arc flash hazard values at equipment required by NFPA 70, Article 110-16.

PART 2- PRODUCTS

Not Used.

PART 3- EXECUTION

Not Used.

END OF SECTION 260573

SECTION 260800 - COMMISSIONING OF ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Test electrical systems and equipment.
- B. These tests are required to determine that the equipment involved may be safely energized and operated.
- C. Perform tests by and under the supervision of fully experienced and qualified personnel. Advise each respective manufacturer's representative of tests on their equipment.
- D. Record all test data.
- E. Each section of Division ~~46~~ 26 that has products or systems listed herein incorporate this section by reference and is incomplete without the required tests stated herein.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Submit test report forms for review a minimum of 90 days prior to requesting a final review by A/E.
- B. Furnish six individually bound copies of test data. Neatly type and arrange data. Include with the data the date tested, personnel present, weather conditions, nameplate record of test instrument and list all measurements taken, both prior to and after any corrections are made to the system. Record all failures and corrective action taken to remedy incorrect situation.
- C. A/E will retain one copy. Remaining copies will be returned to Contractor for inclusion in the operation and maintenance manuals.

PART 2 - PRODUCTS

Not used.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Furnish proposed test procedures, recording forms, list of personnel and test equipment for A/E review.
- B. Follow recommended procedures for testing as published by test equipment manufacturer.

3.2 WIRE AND CABLE

- A. Test insulation resistance of each main feeder and service after the installation is complete but before the connection is made to its source and point of termination.
- B. Test insulation resistance using Biddle Megger or equivalent test instrument at a voltage not less than 1,000 volts DC. Measure resistance from phase-to-phase and phase-to-ground. In circuits where insulation test value is lower than 1 megohm, remove and replace conductor and retest.
- C. Visually inspect connections of every branch circuit for tightness.
- D. Insure that grounding conductor is electrically continuous.
- E. Test branch circuits against grounds, shorts or other faults.
- F. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- G. Measure ground resistance from system neutral connection at service entrance to convenient ground reference point using suitable ground testing equipment.
- H. Test the system for stray currents, ground shorts, etc. If stray currents, shorts, etc., are detected, eliminate or correct as required.

3.3 WIRING DEVICES

- A. Operate switches at least twice.
- B. Test every convenience outlet with plug-in device for proper phasing and grounding.
- C. Demonstrate operation of lighting circuits and lighting control systems.

3.4 ELECTRICAL SWITCHGEAR

- A. Before Energization:
 - 1. Visually inspect connections for tightness and correctness.
 - 2. Verify proper fusing.

- B. After Energization:
 - 1. Verify proper voltage with system operating at load conditions.
 - 2. Verify proper operation.
 - 3. Operate every circuit breaker, switch and contactor.
 - 4. Modify tap settings on transformers as required.
 - 5. Measure line amperes with system operating at load conditions.
 - 6. Modify circuit breaker and relay settings as required.
 - 7. Megger meter centers for opens, shorts and grounds.
 - 8. Thermographic Tests:
 - a. With system operating at load conditions, perform thermographic test on switchgear, bus duct, control centers, distribution panelboards, lighting panelboards and equipment feeders using an infrared temperature scanning unit. Provide thermograph tests performed by General Electric Instrumentation Division.
 - b. Tighten or correct connections with higher temperatures than acceptable. After corrections have been made, perform thermograph test to confirm that problems have been corrected.

- C. Operate all equipment and control systems through intended sequence. Record all data pertaining to system operation.
 - 1. Contactors.
 - 2. Starters.
 - 3. Electrically operated circuit breakers.
 - 4. Measure noise level 3 feet from mechanical room where variable frequency drive starters are installed.
 - 5. Perform motor control center mechanical operator tests in accordance with manufacturer's instructions.
 - 6. Exercise each starter through entire operating sequence. Demonstrate that protective features such as phase failure, under-voltage and phase reversal are properly operating.
 - 7. Rotating Equipment:
 - a. Verify proper voltage and phasing.
 - b. Modify phasing as required for proper rotation.
 - c. Measure line amperes (starting and running) and rpm.
 - d. Demonstrate running of motors and operation of controls and interlocks.

3.5 GROUND FAULT

- A. Factory test switchboards at the manufacturer's factory prior to shipment as specified herein:
 - 1. Furnish a ground fault protection system test for circuit testing and verification of the tripping of the ground fault relays at the factory location. Pass predetermined values of current through the relay sensors and measure the relay tripping time for each phase and the neutral sensor (if one is required). Compare the measured time-current relationships to the tri-characteristic curves for each relay. If the relay trips outside the range of values indicated on the curve, replace or recalibrate the relays. Include a polarity verification of the interconnection of the ground sensor circuits as a part of the test.
 - 2. Have the proper voltages applied to their circuits and satisfactory operation demonstrated for additional auxiliary, pilot, control relays, electrically operated breakers, shunt-trip operated breakers, switches, etc.
 - 3. Furnish in accordance with NFPA 70 Section 230-95(c), test results certified by the switchboard manufacturer. One reviewed copy to be available at the job site for review by the authorities having jurisdiction.
 - 4. Upon completion of the factory ground fault protection system tests, the current and time adjustment on each relay are to be set on their minimum values.

- B. After construction work is complete and prior to energizing switchboards, field test ground fault protection system; provide reset to manufacturer's recommended setting for both current and time by General Electric Engineering and Service.
 - 1. The test procedure is to be similar to that specified for the factory test.
 - 2. Notify A/E in writing at least two weeks prior to the day of the field test. A/E may witness the field test if he so desires.
 - 3. Furnish all field test results certified by the testing company listed hereinbefore.

3.6 SECONDARY GROUNDING

- A. Test service entrance ground resistance.
- B. Provide additional made-electrodes if resistance is more than 3 ohms.
- C. Test grounding system resistance within building at a minimum of ten locations.

3.7 SOUND SYSTEM

- A. Test the system to determine that it is free from grounds, open and short circuits.
- B. Verify output volume meets Owner's requirements.

3.8 SOUND/CLOCK PROGRAM SYSTEM

- A. Test the system to determine that it is free from grounds, open and short circuits.
- B. Verify output volume meets Owner's requirements.
- C. Verify slave clocks respond to master controls.

3.9 FIRE ALARM SYSTEM

- A. Test system in accordance with manufacturer's recommendations in presence of manufacturer's and Owner's representatives:
 - 1. Operate initiating devices.
 - 2. Assure indicating devices operation.
 - 3. Assure system functions.
 - 4. Assure system interfaces with other systems.
- B. Test the system to determine that it is free from grounds, open and short circuits.

3.10 LIGHTING CONTROLS

- A. Test system in accordance with manufacturer's recommendations in presence of manufacturer's and Owner's representatives:
 - 1. Operate all occupant and switching devices.
 - 2. Assure all ceiling, wall, and corner mounted sensor all functioning properly.
 - 3. Assure system functions.
 - 4. Assure system interfaces with other systems.
 - 5. Perform test on daylight dimmers to ensure proper functions.
 - 6. Ensure Data Modeling (if installed) is functioning properly.

END OF SECTION 260800

SECTION 260923 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

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.

2. SUMMARY

a. Section Includes:

- 1. Time switches.
- 2. Photoelectric switches.
- 3. Standalone daylight-harvesting switching controls.
- 4. Indoor occupancy sensors.
- 5. Outdoor motion sensors.
- 6. Lighting contactors.
- 7. Emergency shunt relays.

b. Related Requirements:

- 1. Division 26 Section "Wiring Devices" for wall-box dimmers, wall-switch occupancy sensors, and manual light switches.

3. ACTION SUBMITTALS

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

- b. Shop Drawings: Show installation details for occupancy and light-level sensors.

- 1. Interconnection diagrams showing field-installed wiring.
- 2. Include diagrams for power, signal, and control wiring.
- 3. Shop drawings to reflect the overall coverages and sensor locations for all occupancy and daylight controls.

4. INFORMATIONAL SUBMITTALS

- a. Field quality-control reports.

5. CLOSEOUT SUBMITTALS

- a. Operation and Maintenance Data: For each type of lighting control device to include in emergency, operation, and maintenance manuals.

PART 2 - PRODUCTS

1. TIME SWITCHES

- a. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Intermatic, Inc.
 - 2. Invensys Controls.
 - 3. Leviton
- b. Electronic Time Switches: Solid state, programmable, with alphanumeric display; complying with UL 917.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Contact Configuration: SPST.
 - 3. Contact Rating: 30-A inductive or resistive, 240-V ac
 - 4. Programs: 2 on-off set points on a 24-hour schedule and an annual holiday schedule that overrides the weekly operation on holidays.
 - 5. Circuitry: Allow connection of a photoelectric relay as substitute for on-off function of a program on selected channels.
 - 6. Astronomic Time: All Selected channels.
 - 7. Automatic daylight savings time changeover.
 - 8. Battery Backup: Not less than seven days reserve, to maintain schedules and time clock.
- c. Electromechanical-Dial Time Switches: Comply with UL 917.
 - 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 - 2. Contact Configuration: SPST.
 - 3. Contact Rating: 30-A inductive or resistive, 240-V ac
 - 4. Circuitry: Allows connection of a photoelectric relay as a substitute for the on-off function of a program.
 - 5. Astronomic time dial.
 - 6. Eight-Day Program: Uniquely programmable for each weekday and holidays.
 - 7. Skip-a-day mode.
 - 8. Wound-spring reserve carryover mechanism to keep time during power failures, minimum of 16 hours.

2. OUTDOOR PHOTOELECTRIC SWITCHES

- a. Manufacturers: Subject to compliance with requirements, provide products by the following:

Hubbell Building Automations

1. Invensys Controls.
2. Leviton
3. Lutron
4. Sensor Switch

- b. Basis-of-Design Product: Subject to compliance with requirements, provide Intelligent Lighting Controls INC. or comparable product by one of the following:

1. Cooper Industries, Inc.
2. Intermatic, Inc.
3. NSi Industries LLC; TORK Products.
4. Tyco Electronics; ALR Brand.
5. Sensor Switch
6. Wattstopper

- c. Description: Solid state, with SPST dry contacts rated for 1800-VA to operate connected relay, contactor coils, or microprocessor input; complying with UL 773A.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of the photocell to prevent fixed light sources from causing turn-off.
3. Time Delay: Fifteen second minimum, to prevent false operation.
4. Surge Protection: Metal-oxide varistor.
5. Mounting: Twist lock complies with NEMA C136.10, with base-and-stem mounting or stem-and-swivel mounting accessories as required to direct sensor to the north sky exposure.

- d. Description: Solid state, with SPST dry contacts rated for 1800 VA, to operate connected load, complying with UL 773.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Light-Level Monitoring Range: 1.5 to 10 fc (16.14 to 108 lux), with an adjustment for turn-on and turn-off levels within that range.
3. Time Delay: Thirty-second minimum, to prevent false operation.
4. Lightning Arrester: Air-gap type.
5. Mounting: Twist lock complying with NEMA C136.10, with base.

3. DAYLIGHT-HARVESTING SWITCHING CONTROLS

- a. Manufacturers: "Basis-of-Design Product": Subject to compliance with requirements, provide products by Intelligent Lighting Controls INC. or comparable products by one of the following.

1. Cooper Industries, Inc.
2. Eaton Corporation.

3. Hubbell Building Automation, Inc.
 4. Leviton Mfg. Company Inc.
 5. Lithonia Lighting; Acuity Lighting Group, Inc.
 6. NSi Industries LLC; TORK Products.
 7. Sensor Switch, Inc.
 8. Tyco Electronics; ALR Brand.
- b. Ceiling-Mounted Switching Controls: Solid-state, light-level sensor unit, with separate power pack mounted on luminaire, to detect changes in indoor lighting levels that are perceived by the eye.
- c. Electrical Components, Devices, and Accessories:
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120°F (0 to 49°C).
 3. Sensor Output: Contacts rated to operate the associated power pack, complying with UL 773A. Sensor is powered by the power pack.
 4. Power Pack: Dry contacts rated for 20 -A ballast load at 120- and 277-V ac, for 13 -A tungsten at 120-V ac, and for 1 HP at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. General Space Sensors Light-Level Monitoring Range: 10 to 200 fc (108 to 2152 lux), with an adjustment for turn-on and turn-off levels within that range.
 6. Atrium Space Sensors Light-Level Monitoring Range: 100 to 1000 fc (1080 to 10 800 lux), with an adjustment for turn-on and turn-off levels within that range.
 7. Skylight Sensors Light-Level Monitoring Range: 1000 to 10,000 fc (10 800 to 108 000 lux), with an adjustment for turn-on and turn-off levels within that range.
 8. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling.
 9. Set-Point Adjustment: Equip with deadband adjustment of 25, 50, and 75 percent above the "on" set point, or provide with separate adjustable "on" and "off" set points.
 10. Test Mode: User selectable, overriding programmed time delay to allow settings check.
 11. Control Load Status: User selectable to confirm that load wiring is correct.
 12. Indicator: Two digital displays to indicate the beginning of on-off cycles.

4. DAYLIGHT-HARVESTING DIMMING CONTROLS

- a. Manufacturers: "Basis-of-Design Product": Subject to compliance with requirements, provide products by Intelligent Lighting Controls INC. or comparable products listed below:
1. Cooper Industries, Inc.
 2. Hubbell Building Automation, Inc.
 3. Leviton Mfg. Company Inc.
 4. Lithonia Lighting; Acuity Lighting Group, Inc.
- b. System Description: Sensing daylight and electrical lighting levels, the system adjusts the indoor electrical lighting levels. As daylight increases, the lights are dimmed.
1. Lighting control set point is based on two lighting conditions:

- a. When no daylight is present (target level).
 - b. When significant daylight is present.
 2. System programming is done with two hand-held, remote-control tools.
 - a. Initial setup tool.
 - b. Tool for occupants to adjust the target levels by increasing the set point up to 25 percent, or by minimizing the electric lighting level.
 - c. Ceiling-Mounted Dimming Photo-Sensor: Dimming control module with onboard controls, light-level sensor unit, to detect indoor lighting levels. Device shall be compatible with LED fixtures with 0-10V Dimming Ballast.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by nearby connected dimmable ballast.
 3. Blue enhance photodiode
 4. Light-Level Sensor Set-Point Adjustment Range: 10 to 140 fc
 5. UL 94HB flame retardant housing
 6. Housing shall not exceed 2.5" diameter base and 2" height.
 7. Device shall have a minimum five-year warranty.
 - d. Ceiling-Mounted Dimming Controls: Solid-state, light-level sensor unit, with separate controller unit, to detect changes in lighting levels that are perceived by the eye.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Sensor Output: 0- to 10-V dc to operate electronic dimming ballasts. Sensor is powered by controller unit.
 3. Power Pack: Sensor has 24-V dc, Class 2 power source, as defined by NFPA 70.
 4. Light-Level Sensor Set-Point Adjustment Range: 20 to 60 fc (120 to 640 lux).
5. INDOOR OCCUPANCY SENSORS
- a. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide product Intelligent Lighting Controls INC.; product name or designation or comparable product by one of the following.
 1. Bryant Electric; a Hubbell company.
 2. Cooper Industries, Inc.
 3. Hubbell Building Automation, Inc.
 4. Leviton Mfg. Company Inc.
 5. Lightolier Controls.
 6. Lithonia Lighting; Acuity Lighting Group, Inc.
 7. Lutron Electronics Co., Inc.
 8. NSi Industries LLC; TORK Products.
 9. RAB Lighting.

10. Sensor Switch, Inc.
 11. Square D; a brand of Schneider Electric.
- b. General Requirements for Sensors: Wall- or ceiling-mounted, solid-state indoor occupancy sensors with a separate power pack.
1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
 2. Operation: Unless otherwise indicated, turn lights on when coverage area is occupied, and turn them off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 15 minutes.
 3. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor is powered from the power pack.
 4. Power Pack: Dry contacts rated for 20-A ballast load at 120- and 277-V ac, for 13-A tungsten at 120-V ac, and for 1 hp at 120-V ac. Sensor has 24-V dc, 150-mA, Class 2 power source, as defined by NFPA 70.
 5. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch (13-mm) knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door.
 6. Indicator: Digital display, to show when motion is detected during testing and normal operation of sensor.
 7. Bypass Switch: Override the "on" function in case of sensor failure.
 8. Automatic Light-Level Sensor: Adjustable from 2 to 200 fc (21.5 to 2152 lux); turn lights off when selected lighting level is present.
- c. PIR Type: Ceiling mounted; detect occupants in coverage area by their heat and movement.
1. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm).
 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 3. Detection Coverage (Corridor): Detect occupancy within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling.
- d. Ultrasonic Type: Ceiling mounted; detect occupants in coverage area through pattern changes of reflected ultrasonic energy.
1. Detector Sensitivity: Detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. (56 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. (186 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.

5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet (27.4 m) when mounted on a 10-foot- (3-m-) high ceiling in a corridor not wider than 14 feet (4.3 m).
- e. Dual-Technology Type: Ceiling mounted; detect occupants in coverage area using PIR and ultrasonic detection methods. The particular technology or combination of technologies that control on-off functions is selectable in the field by operating controls on unit.
 1. Sensitivity Adjustment: Separate for each sensing technology.
 2. Detector Sensitivity: Detect occurrences of 6-inch- (150-mm-) minimum movement of any portion of a human body that presents a target of not less than 36 sq. in. (232 sq. cm), and detect a person of average size and weight moving not less than 12 inches (305 mm) in either a horizontal or a vertical manner at an approximate speed of 12 inches/s (305 mm/s).
 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. (93 sq. m) when mounted on a 96-inch- (2440-mm-) high ceiling.
6. SWITCHBOX-MOUNTED OCCUPANCY SENSORS
 - a. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide product Intelligent Lighting Controls INC. ; product name or designation or comparable product by one of the following.
 1. Bryant Electric; a Hubbell company.
 2. Cooper Industries, Inc.
 3. Hubbell Building Automation, Inc.
 4. Leviton Mfg. Company Inc.
 5. Lightolier Controls.
 6. Lithonia Lighting; Acuity Lighting Group, Inc.
 7. Lutron Electronics Co., Inc.
 8. NSi Industries LLC; TORK Products.
 9. RAB Lighting.
 10. Sensor Switch, Inc.
 11. Square D; a brand of Schneider Electric.
 12. Watt Stopper
 - b. General Requirements for Sensors: Automatic-wall-switch occupancy sensor, suitable for mounting in a single gang switchbox.
 1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked or intended location and application, and shall comply with California Title 24.
 2. Operating Ambient Conditions: Dry interior conditions, 32 to 120°F (0 to 49°C).
 3. Switch Rating: Not less than 800-VA fluorescent at 120 V, 1200-VA fluorescent at 277 V, and 800-W incandescent.
 4. Sensor must also be compliant with LED fixtures.
 - c. Wall-Switch Sensor Tag WS1:
 1. Standard Range: 180-degree field of view, field adjustable from 180 to 40 degrees; with a minimum coverage area of 900 sq. ft. (84 sq. m).
 2. Sensing Technology: Dual technology - PIR and ultrasonic.

3. Switch Type: SP. SP, dual circuit. SP, manual "on," automatic "off."
4. Voltage: 277 V; passive-infrared type.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

d. Wall-Switch Sensor Tag WS2:

1. Standard Range: 210-degree field of view, with a minimum coverage area of 900 sq. ft. (84 sq. m).
2. Sensing Technology: PIR.
3. Switch Type: SP, dual circuit.
4. Voltage: 277 V dual-technology] type.
5. Ambient-Light Override: Concealed, field-adjustable, light-level sensor from 10 to 150 fc (108 to 1600 lux). The switch prevents the lights from turning on when the light level is higher than the set point of the sensor.
6. Concealed, field-adjustable, "off" time-delay selector at up to 30 minutes.
7. Concealed "off" time-delay selector at 30 seconds, and 5, 10, and 20 minutes.
8. Adaptive Technology: Self-adjusting circuitry detects and memorizes usage patterns of the space and helps eliminate false "off" switching.

7. EMERGENCY SHUNT RELAY

- a. Manufacturers: Basis-of-Design Product: Subject to compliance with requirements, provide product by Intelligent Lighting Controls, INC; product name or designation or comparable product by one of the following.
 1. Lighting Control and Design; Acuity Lighting Group, Inc.
 2. Watt Stopper.
- b. Unit shall be provided with pushbutton test switch and LED indicator light.
- c. Housing shall be fire rated V-0, 176°F (80°C)
- d. Unit shall also be approved to be wired as a bypass device.
- e. Description: Normally closed, electrically held relay, arranged for wiring in parallel with manual or automatic switching contacts; complying with UL 924.
 1. Coil Rating: 277 V.

8. CONDUCTORS AND CABLES

- a. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- b. Classes 2 and 3 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 18 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."
- c. Class 1 Control Cable: Multiconductor cable with stranded-copper conductors not smaller than No. 14 AWG. Comply with requirements in Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

PART 3 - EXECUTION

1. GENERAL INSTALLATION

- a. The basis of design shall be subject in compliance with controls, provide Intelligent Lighting Controls, INC. systems or a comparable equal.
- b. In the event that the on-board lighting controls does not meet the proposed budget, individual space base controls (ceiling mounted or wall mounted), shall be installed in each space to meet the observed energy code requirements. Contractor will be responsible for coordinating the proper layout with the selected lighting rep to provide shop drawings for approval prior to ordering any device.
- c. Stand alone or panel based daylight sensors shall be installed in spaces to meet the observed energy code. Provide all relays, panels, and devices to ensure a complete fully functioning system.

2. SENSOR INSTALLATION

- a. Coordinate layout and installation of ceiling-mounted devices with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, smoke detectors, fire-suppression systems, and partition assemblies.
- b. Install and aim sensors in locations to achieve not less than 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.

3. CONTACTOR INSTALLATION

- a. Mount electrically held lighting contactors with elastomeric isolator pads to eliminate structure-borne vibration, unless contactors are installed in an enclosure with factory-installed vibration isolators.

4. WIRING INSTALLATION

- a. Wiring Method: Comply with Division 26 Section "Low-Voltage Electrical Power Conductors and Cables." Minimum conduit size is 1/2 inch (13 mm).
- b. Wiring within Enclosures: Comply with NECA 1. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- c. Size conductors according to lighting control device manufacturer's written instructions unless otherwise indicated.
- d. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.

5. IDENTIFICATION

- a. Identify components and power and control wiring according to Division 26 Section "Identification for Electrical Systems."
 - 1. Identify controlled circuits in lighting contactors.
 - 2. Identify circuits or luminaires controlled by photoelectric and occupancy sensors at each sensor.
- b. Label time switches and contactors with a unique designation.

6. FIELD QUALITY CONTROL

- a. Testing Agency: Owner will engage a qualified testing agency to evaluate lighting control devices and perform tests and inspections.
- b. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections.
- c. Perform the following tests and inspections with the assistance of a factory-authorized service representative:
 - 1. Operational Test: After installing time switches and sensors, and after electrical circuitry has been energized, start units to confirm proper unit operation.
 - 2. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
- d. Lighting control devices will be considered defective if they do not pass tests and inspections.
- e. Prepare test and inspection reports.

7. ADJUSTING

- a. Occupancy Adjustments: When requested within 18 months from date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose.
 - 1. For occupancy and motion sensors, verify operation at outer limits of detector range. Set time delay to suit Owner's operations.
 - 2. For daylighting controls, adjust set points and deadband controls to suit Owner's operations.
 - 3. Align high-bay occupancy sensors using manufacturer's laser aiming tool.

8. DEMONSTRATION

- a. Coordinate demonstration of products specified in this Section with demonstration requirements for low-voltage, programmable lighting control systems specified in Division 26 Section "Network Lighting Controls."
- b. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain lighting control devices.

END OF SECTION 260923

SECTION 262213 - LOW-VOLTAGE DISTRIBUTION TRANSFORMERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install dry-type non-linear transformers.

1.2 REFERENCES

- A. IEEE C57.12.91 - Test Code for Dry-Type Distribution and Power Transformers.
- B. NEMA ST 20 - Dry-Type Transformers for General Applications.
- C. UL 1561 - Dry-Type General Purpose and Power Transformers.

1.3 SUBMITTALS

- A. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, KVA, and impedance ratings and characteristics, no load core loss, full load winding conductor loss, full load losses, efficiency at 25 percent, 50 percent, 75 percent and 100 percent rated loads, percent regulation with 80 percent and 100 percent power factor loads, sound level, tap configurations, insulation system type and rated temperature rise.
- B. Indicate K-factor where applicable.
- C. Base data for electrical characteristics on actual laboratory tests of typical transformers.
- D. Provide operation and maintenance manual.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.
- B. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Dry-Type and Non-Linear Transformers
 1. Siemens
 2. Square D.
 3. General Electric.
 4. Cutler-Hammer.
 5. Westinghouse

6. Hevi-Duty

2.2 DRY-TYPE NON-LINEAR TRANSFORMERS

- A. Factory assembled, air cooled, dry-type, shielded isolation transformers; ratings as scheduled; capable of operating at 100 percent load continuously at an ambient temperature of 40 degrees C.
- B. Insulation system and average winding temperatures rise for rated kVA as follows:
 - 1. kVA Rating: 15-300.
 - 2. Insulation Class: 220.
 - 3. Temperature Rise degrees C: 150.
- C. Provide electrostatic winding shield with separate insulated grounding connection.
- D. Provide neutral bar sized for 200 percent of secondary phase conductors.
- E. Manufactured and tested in accordance with IEEE C57.12.91, UL 1561, and NEMA ST 20 at K factor rating of 13.
- F. Provide K-13 rating for transformers 1TXD2 & 2TX2 only.

2.3 GENERAL

- A. Maximum Case Temperature: 50 degrees C rise above ambient at its warmest point.
- B. Winding Taps, Transformers Less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
- C. Winding Taps, Transformers 15 kVA and Larger: Two 2-1/2 percent below and two 2-1/2 percent above rated voltage, full capacity taps on primary winding.
- D. Sound Levels: Maximum noise level as follows:

kVA Rating	Noise Level Decibels
0 - 9	40
10 - 50	45
51 - 150	50
151 - 300	55

- E. Basic Impulse Level: 10 kV for transformers less than 300 kVA; 30 kV for transformers 300 kVA and larger.
- F. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

- G. Mounting: Provide transformers 75 kVA and below suitable for wall, floor or trapeze mounting; transformers larger than 75 kVA suitable for floor mounting.
- H. Coil Conductors: Continuous copper windings with terminations welded or brazed to ends of the windings.
- I. Core: High grade, non-aging silicon steel with high magnetic permeability.
- J. Isolate core and coil from enclosure using vibration absorbing mounts.
- K. Nameplate: Include transformer connection data.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Set transformer plumb and level. Mount enclosure on vibration isolators to minimize noise transmission from the enclosure to supporting structure. Set floor mounted transformers at 10-degree angle to wall on a neoprene pad on housekeeping pads.
- B. Install transformer so that enclosure does not make contact with wall surface. Transformer must meet the minimum clearance requirements listed below:
 - 1. Walls: 6 inches
 - 2. Ceiling: 3 feet
 - 3. Side by side: 2 feet
- C. Use flexible conduit, 2-foot minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- D. Ground neutral connection to service ground per codes.
- E. Provide 6" concrete housekeeping pad for all transformer shown to be mounted on grade.
- F. Provide all mounting equipment and accessories for all wall mounted and suspended transformers.

3.2 FIELD QUALITY CONTROL

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure primary and secondary voltages and make appropriate tap adjustments.

END OF SECTION 262213

SECTION 262413 - SWITCHBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install main and distribution switchboards. Utilize switchboard construction for boards greater than 1200 amperes.

1.2 REFERENCES

- A. NEMA PB 2 - Dead Front Distribution Switchboards.
- B. NEMA PB 2.1 - Instructions For Safe Handling, Installation, Operation and Maintenance of Deadfront Switchboards Rated 600 Volts or Less.
- C. UL Standard 891.

1.3 SUBMITTALS

- A. Indicate detailed dimensions for the front and side views.
- B. Indicate conduit entrance locations and requirements.
- C. Indicate enclosure material finish and NEMA classification type.
- D. Indicate nameplate legends.
- E. Indicate size and number of bus bars and ground; switchboard instrument details.
- F. Furnish instructions for handling and installation of switchboard.
- G. Include electrical characteristics including voltage, frame size and trip ratings, withstand ratings, and time-current curves of all equipment and components.
- H. Provide operation and maintenance manual.
- I. Provide one-line diagram.
- J. Indicate cable terminal sizes.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Deliver products to the site with shipping splits and subassemblies sized for passing through openings.

- B. Handle in accordance with NEMA PB 2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

1.5 SPARE PARTS

- A. Keys: Furnish two each to the Owner for each lock.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Square D.
- B. General Electric.
- C. Siemens.

2.2 SWITCHBOARD CONSTRUCTION AND RATINGS

- A. Factory-assembled, dead front, metal-enclosed, and self-supporting switchboard assembly conforming to NEMA PB 2, and complete from incoming line terminals to load-side terminations.
- B. Switchboard electrical ratings and configurations as shown on Drawings. Integrated equipment rating as shown, but not less than 50,000 amperes RMS (sym).
- C. Line and Load Terminations: Accessible from the front only of the switchboard, suitable for the conductor materials and number of conductors used.
- D. Main Section Devices: Individually mounted.
- E. Distribution Section Devices: Panel mounted.
- F. Bus Material: Copper with tin plating, sized in accordance with NEMA PB 2.
- G. Bus Connections: Bolted, accessible from front for maintenance. Provide Belleville washers for and properly torque all connections.
- H. Provide fully rated copper neutral bus.
- I. Provide properly sized copper ground bus through the length of the switchboard.
- J. Enclosure: NEMA PB 2 Type 1 - General Purpose. Align sections at front and rear.
- K. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum one coat corrosion-resisting paint, or plate with cadmium or zinc.

- L. Future Provisions: Fully equip spaces for future devices with bussing and bus connections, suitably insulated and braced for short circuit currents. Continuous current rating as indicated on Drawings. Extend and drill main bus for future addition by means of splice plate.

2.3 SWITCHING AND OVERCURRENT PROTECTIVE DEVICES

- A. Solid-state Molded Case Circuit Breakers
 1. Provide with electronic sensing, timing and tripping circuits for adjustable current settings; ground fault trip; instantaneous trip; and adjustable short time trip.
 2. Provide stationary mounting.
 3. Provide ground fault sensing integral with circuit breaker.
 4. Provide solid-state trip on breakers 400 amperes and greater.
- B. Provide integral ground fault protection on each main device, rated 277/480 volts, 1,000 amps or larger.

2.4 INSTRUMENTATION

- A. Provide solid state circuit monitor with digital output display rated for 120 volts, 60 Hertz and waveform capture feature, Square D Class 3020 CM3350 PowerLogic or approved equal. Provide UL 508 listing.
- B. Provide six-digit LCD readout which will allow local display of the following electrical parameters:
 1. Voltage, phase to phase and phase to neutral.
 2. Current, per phase RMS and 3 phase average.
 3. Demand current, per phase.
 4. Power factor, per phase and 3 phase total.
 5. Real power, 3 phase total.
 6. Reactive power, 3 phase total.
 7. Apparent power, 3 phase total.
 8. Energy (MWH).
 9. Reactive energy (MVARH).
 10. Frequency.
 11. Average demand real power.
- C. Provide the circuit monitor with the following characteristics:
 1. Built-in communications capability which will allow multipoint communication at a 9600 minimum baud rate to a remote computer workstation, programmable controller or other host device.
 2. Adjustable demand interval (5-60 minutes).
 3. Nonvolatile memory for storing all historical data.
- D. Set-up of the monitor shall be accomplished from the front of the device. It shall not be necessary to open the front of the enclosure to reach rear mounted dip-switches. Include set-up parameters for CT ratio, PT ratio, System type 3 or 4 wire, and demand interval.
- E. Provide keyswitch protection for all set-up and reset functions to prevent unauthorized/accidental change of value.

- F. Provide the following monitor accuracy in percent of full scale for:
 - 1. Current Voltage Measurements: Plus or minus 1 percent.
 - 2. Power and Energy: Plus or minus 2 percent.
 - 3. Frequency: Plus or minus 0.5 percent.
 - 4. Power Factor: Plus or minus 4 percent.
 - 5. Data Update Time: 0.817 S (4 wire).
- G. Provide three potential transformers (PT) rated 480/120 volt with metering class accuracy.
- H. Provide three current transformers (CT) having a primary to match the size of the bus and a 5 ampere secondary with metering class accuracy.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install switchboard in locations shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB 2.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.
- C. Provide a 4 inch concrete housekeeping pad with anchor bolts. Bolt equipment to pad plumb and square.
- D. Provide and install laminated copy of the load classification found at the bottom of the schedule on the plans.

3.2 FIELD QUALITY CONTROL

- A. Inspect completed installation for physical damage, proper alignment, anchorage, and grounding.
- B. Measure insulation resistance of each bus section phase-to-phase and phase-to-ground for one minute each.
- C. Check tightness of accessible bolted bus joints using a calibrated torque wrench in accordance with manufacturer's recommended values.

3.3 ADJUSTING AND CLEANING

- A. Adjust all operating mechanisms for free mechanical movement.
- B. Touch-up scratched or marred surfaces to return to "as new" condition.
- C. Adjust trip and time delay settings to values shown on Drawings or as required.

END OF SECTION 262413

SECTION 262416 - PANELBOARDS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install distribution, lighting and appliance branch circuit panelboards.

1.2 REFERENCES

- A. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

1.3 SUBMITTALS

- A. Include outline and support point dimensions, NEMA enclosure type, voltage, main bus ampacity and material, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

1.4 SPARE PARTS

- A. Keys: Furnish two keys to Owner for each panelboard, all keyed alike.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Basis of design product: Subject to compliance with requirements, provide Siemens or a comparable product by one of the following:
 - 1. Square D
 - 2. General Electric

2.2 GENERAL

- A. Conform to UL standards and bear UL label. Form cabinets from code gauge galvanized steel. Form fronts of code gauge cold rolled steel bonderized after fabrication.
- B. Provide cabinet fronts with concealed hinges, concealed adjustment means, door-in-door type construction and master keyed flush lock. Finish front in manufacturer's standard gray enamel. Door-in-door shall allow for the interior of the panel to be accessed without the removal of any screws or bolts.
- C. Provide with main lugs and breakers or fuses as scheduled on the drawings. Provide main lug connection to accommodate T & B compression connector on end of cable. Attach connector

to panel bus with two bolts per lug. Provide captive type bolts or studs to facilitate reinstallation of the lugs with the wire attached.

- D. Provide all panelboards with copper bus of the ratings scheduled and designed for all indicated devices and spaces, complete with taps and trim.
- E. Provide panelboards, designated with "NL" on Drawings, UL listed for nonlinear loads, bearing UL label, and neutral bar rated at 200 percent of phase buses.
- F. Minimum integrated short circuit rating 10,000 amps RMS symmetrical for 240 volt panelboards; 14,000 amperes RMS symmetrical for 480 volt panelboards or as shown on the drawings. Integrated ratings may be based on tested series ratings in conjunction with feeder breaker actually used.
- G. Size bus bars to limit the temperature rise within the panelboard to 50 degrees C over a 40 degrees C ambient temperature.
- H. Provide adequate space and provisions for wire No. 6 AWG and larger conductors to terminate with compression type connector to main lugs.
- I. Connect all two-section panelboards with copper cable of an ampacity greater than the main bus ampacity.

2.3 DISTRIBUTION PANELBOARDS (1200 AMPS AND SMALLER)

- A. Enclosure: Type 1, unless scheduled otherwise.
- B. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled.
- C. Provide plated copper grounding bus.
- D. Provide integral ground fault protection on each main device, rated 277/480 volts, 1,000 amps or larger.
- E. Provide 100% rated main breaker for all panels 600A and above.

2.4 BRANCH CIRCUIT PANELBOARDS

- A. Lighting and Appliance Branch Circuit Panelboards: Circuit breaker type.
- B. Enclosure: Type 1; unless indicated otherwise.
- C. Provide insulated neutral bus and separate copper grounding bus bonded to enclosure.

- D. Molded Case Circuit Breakers: Bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled.
- E. Sequence phase all adjacent breakers. All circuit breaker connection straps shall be rated at 100 amperes minimum.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards plumb surface or flush mount as scheduled, in conformance with NEMA PB 1.1. Mount securely to walls or structural spaces. Mount floor mounted panelboards on 4 inch housekeeping pads.
- B. Height: Install wall mounted panelboards at 6 feet to the top of the enclosure.
- C. Provide filler plates for unused spaces in panelboards.
- D. Provide GFCI rated breakers for all normal non-GFI type receptacles located in the hangers.
- E. Provide typewritten circuit directory for each branch circuit panelboard mounted in permanent, clear Lexan card holder located on inside of door. Prepare directories only after permanent room numbers have been assigned. Do not use room numbers shown on construction drawings. Identify each circuit with type of load and room number or location.
- F. Stub three empty 1 inch conduits to accessible location above ceiling out of each recessed panelboard.
- G. Provide a minimum of four(4) 20A spare breaker in each panel or in one panel of a multiple panel section.
- H. Arrange branch circuit connections in three phase lighting and appliance panelboards such that when two or three circuits are run with a common neutral, each circuit is connected to a different phase.
- I. Distribute loading on circuits in panelboards to balance the load as evenly as possible in each phase.
- J. Provide and install a laminated copy of the load classification, that will indicate the connected and demand loads, in the bottom interior face of each panel.
- K. Terminate only one conductor under each lug of branch circuit breakers.
- L. Do not make splices or taps in panelboard gutters.

3.2 FIELD QUALITY CONTROL

- A. Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers.

END OF SECTION 262416

SECTION 262726.13 - WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install specification grade wiring devices, including:
 - 1. Wall switches.
 - 2. Wall dimmers.
 - 3. Receptacles.
 - 4. Floor mounted service fittings.
 - 5. Occupant sensors.
 - 6. Device plates and box covers.

1.2 REFERENCES

- A. NEMA WD 2 - Semiconductor Dimmers for Incandescent Lamps.

1.3 SUBMITTALS

- A. Provide data sheets to include all device specifics.
- B. Furnish samples upon request of A/E.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Switches and Receptacles
 - 1. Hubbell.
 - 2. Leviton.
- B. Dimmers
 - 1. Leviton.
 - 2. Lutron.
- C. Cover Plates: Match device manufacturer.
- D. Floor Mounted Service Fittings
 - 1. Hubbell.
 - 2. RCI.
 - 3. Square D.
 - 4. Walker.
- E. Occupant Sensors
 - 1. Hubbell.
 - 2. Leviton.

3. Pass & Seymour
- 2.2 DEVICE COLOR
- A. Coordinate color selection with Architect during submittal phase.
- 2.3 SWITCHES
- A. 20A, 120-277V Single Pole: "1221", Hubbell.
- B. 20A, 120-277V Double Pole: "1222", Hubbell.
- C. 20A, 120-277V Three Way: "1223", Hubbell.
- D. 20A, 120-277V Four Way: "1224", Hubbell.
- E. 20A, 277V Single Pole with Pilot Light: "1221PL", Hubbell.
- F. 20A, 120-277V Single Pole, locking type: "1221L", Hubbell.
- 2.4 MOTOR RATED SWITCHES
- A. All motor rated switches shall be toggle type, provided with NEMA Rated enclosure, (NEMA 4 for exterior).
- B. Switches shall have a minimum 5 year warranty.
- C. Quiet switch, Industrial Grade, back and side wire.
- D. Provide with pole configuration to match the device load to be served. Refer to manufacturer device cut sheet prior to submittal.
- E. Voltage Rating shall be 600VAC
- F. Provide with black or red color with pilot light for all VAV and terminal units, mounted above the ceiling.
- 2.5 DIMMERS
- A. Rated for LED(0-10V) with toggle/pushbutton with 120/277V.
- B. 1500 watts minimum rating; larger size as necessary to accommodate load shown on contract drawings. Fully rated, gangable without breaking off cooling fins.
- 2.6 RECEPTACLES
- A. 15A, 125V, 2P3W Clock: NEMA 5-15R; "5235", Hubbell.
- B. 20A, 125V, 2P3W Duplex: Tamper resistant, NEMA 5-20R; "SC63H", Hubbell.
- C. 20A, 125V, 2P3W Simplex: NEMA 5-20R; "5361", Hubbell.
- D. 20A, 125V, 2P3W Duplex: NEMA 5-20R; "5362", Hubbell.

- E. 20A, 125V, 2P3W Duplex Ground Fault Interrupting: NEMA 5-20R; "GF5362", Hubbell.
- F. 20A, 125V, 2P3W Duplex Isolated Ground: NEMA IG5-20R; "IG5362", Hubbell.
- G. 20A, 125V, 2P3W Duplex Surge Suppression with Light and Alarm: NEMA 5-20R; "5352S", Hubbell.
- H. 20A, 125V, 2P3W Duplex Surge Suppression, Isolated Ground with Light and Alarm: NEMA IG5-20R; "IG5352S", Hubbell.
- I. 20A, 125V, 2P3W Duplex Hospital Grade: NEMA 5-20R; "8300", Hubbell.
- J. 20A, 125V, 2P3W Duplex Hospital Grade, Ground Fault Interrupting: NEMA 5-20R; "GF8300", Hubbell.
- K. 20A, 125V, 2P3W Duplex Hospital Grade, Isolated Ground: NEMA IG5-20R; "IG8300", Hubbell.
- L. 20A, 250V, 2P3W Simplex: NEMA 6-20R; "5461", Hubbell.
- M. 30A, 125V, 2P3W Simplex: NEMA 5-30R; "9308", Hubbell.
- N. 30A, 250V, 2P3W Simplex: NEMA 6-30R; "9330", Hubbell.
- O. 50A, 125V, 2P3W Simplex: NEMA 5-50R; "9360", Hubbell.
- P. 50A, 250V, 2P3W Simplex: NEMA 6-50R; "9367", Hubbell.
- Q. 20A, 125V, Duplex USB Receptacle with two USB ports for a minimum 3.6 amps of power. Leviton T5832, Topgreener TU-2204A, or approved equal.
- R. Heat trace or other loads continuously plugged in outdoors. Provide Crouse-Hinds WRLD-1 cover. Install round plug on cord supplied with heat trace or other equipment to match weatherproof bushing on receptacle cover.

2.7 OCCUPANT SENSORS

- A. Self-Contained
 1. Leviton 6775.
 2. Single gang, gangable device designed to fit behind a standard decorator switch plate.
 3. Infrared detector behind a fresnel lens.
 4. Detection Range
 - a. 2700 square feet field of view.
 - b. 180-degree sensing field.
 - c. 40 foot sensing distance.
 5. Adjustable Time-Out Delay: 30 seconds - 30 minutes.
 6. Adjustable Ambient Override: 4 foot candles to full daylight.
- B. Network

1. Sensor.
 - a. Leviton 6778.
 - b. Self-mounting, ceiling bracket.
 - c. Infrared detector behind a fresnel lens.
 - d. Detection Range
 - 1) 8 to 14 micrometer frequency spectrum of bodily emitted infrared radiation.
 - 2) 110-degree sensing field over 400 gross square feet.
 - e. Time Delay: 30 seconds - 30 minutes.
2. Control Unit
 - a. Leviton 6779.
 - b. Enclosure: Galvanized, heavy duty for mounting to a 4 inch or 4-1 1/16 inch square box.
 - c. Control up to five sensors.
 - d. Power Rating
 - 1) 2400 watts fluorescent at 120 volts.
 - 2) 4800 watts fluorescent at 277 volts.
3. Auxiliary Relays for Additional Load
 - a. 120 Volt: Leviton 6783-120.
 - b. 277 Volt: Leviton 6783-277.

2.8 FLOOR MOUNTED SERVICE FITTINGS

- A. Recessed Fittings (In Grade)
 1. Floor Box Outlet
 - a. Provide Legrand Evolution 6 Series.
 - b. Two(2) 20A duplex receptacles.
 - c. Minimum two(2) data outlets at each location.
 - d. Coordinate final finish with architectural drawings. Cover finishes shall match the surface(carpet, slab, etc.) where installed.
- B. Flush Floor Fittings (On Grade)
 1. Duplex Receptacle
 - a. 20A, 125V, 2P3W, NEMA 5-20R: "5362", Hubbell.
 - b. Brass cover with flaps: "S-3925", Hubbell.
 - c. 4-inch square, fully adjustable box with round ring: "B-2529", Hubbell.
 2. Data Outlet
 - a. Brass cover with 1-inch and 2-1/8-inch plugs: "S-2725", Hubbell.
 - b. 4-inch round, fully adjustable box with round ring: "B-2529", Hubbell.

2.9 COVER PLATES

- A. Provide one piece cover plates for all group mounted devices.
- B. Provide nylon thermoplastic of the same manufacturer and color as the device.

- C. Weatherproof Cover Plate: Gasketed cast metal with hinged gasketed device covers.
- D. Exposed Box Cover Plate: Stamped steel handy box covers.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install receptacles and switches only in electrical boxes which are clean and free from excess building materials, debris, etc.
- B. Install wall switches with OFF position down.
- C. Where switches and other devices are mounted at one location, provide single coverplate to cover all devices.
- D. Align the tops of all group mounted devices. Install plumb and aligned in the plane of the wall.
- E. Derate ganged dimmers as instructed by manufacturer; do not use common neutral.
- F. Install convenience receptacles in vertical position with grounding pole on bottom unless otherwise noted.
- G. Provide ground fault circuit interrupting type devices in all locations requiring weatherproof devices. Where located near water outlets or sinks.
- H. Do not use feed through feature for ground fault interrupting devices. Install GFI device at each location. GFI circuit breaker will not be acceptable.
- I. Install plates on all devices and blank outlets in finished areas. Use jumbo size plates for outlets installed in masonry walls.
- J. Install galvanized steel plates on outlets in unfinished areas.
- K. Install galvanized steel plates on outlet boxes and junction boxes above accessible ceilings.
- L. All receptacles shown in the valet and car wash area shall be GFI type with flip weatherproof cover.
- M. Provide a minimum of two(2) spare devices for each usb receptacle, lighting occupancy sensors (all types), and photo sensors.
- N. All switches shall be decorative pushbutton or rocker type.
- O. There shall be an aesthetic uniformity for all the light switches, and receptacles.
- P. Mounting Heights:

1. Refer to drawing cover sheet or contact A/E.
 2. Convenience Receptacles Above Counter or Backsplash: 6 inches above counter or backsplash in horizontal position.
 3. Receptacles for Water Coolers: Mount directly behind water cooler to eliminate visibility of cord and attachment plug. Coordinate elevation with the cooler to be installed prior to installation of box.
 4. Install devices in mill work as shown in details and elevations or as directed by A/E.
- Q. Electrical Water Coolers:
1. Provide GFI receptacles for all electrical water coolers. Coordinate exact power connections and requirements with plumbing plans. Provide connection to 120V receptacle circuit at each location shown.
- R. Network Occupant Sensors
1. Coordinate the sensors and the control units for compatibility. Provide auxiliary relays as necessary.
 2. Verify the sensor coverage of the approved manufacturer and provide the necessary sensors, control units and auxiliary relays required to adequately cover and control the indicated area. Where corridors are covered, install ceiling mounted back-to-back sensors.

END OF SECTION 262726.13

SECTION 262726.16 - DECORATOR STYLE WIRING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install specification grade wiring devices including:
 1. Wall switches.
 2. Wall dimmers.
 3. Receptacles.
 4. Floor mounted service fittings.
 5. Device plates and box covers

1.2 REFERENCES

- A. NEMA WD 2 - Semiconductor Dimmers for Incandescent Lamps

1.3 SUBMITTALS

- A. Furnish samples upon request of A/E.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Switches and Receptacles
 1. Hubbell.
 2. Pass & Seymour
 3. Leviton.
- B. Dimmers
 1. Lutron.
 2. Hubbell.
 3. Pass & Seymour.
 4. Leviton.
- C. Cover Plates: Match device manufacturer.
- D. Floor Mounted Service Fittings
 1. Hubbell.
 2. Wiremold/ Legrand.
 3. RCI
 4. Square D
- E. Occupant Sensors
 1. Hubble

2. Novitas.
3. Leviton

2.2 DEVICE COLOR

- A. All devices shall be white except in selected high finish areas where the color section shall be coordinate with Architect during submittal phase.

2.3 SWITCHES

- A. 20 Ampere, 120 to 277 Volt Single Pole: Hubbell 2121.
- B. 20 Ampere, 120 to 277 Volt Double Pole: Hubbell 2122.
- C. 20 Ampere, 120 to 277 Volt Three Way: Hubbell 2123.
- D. 20 Ampere, 120 to 277 Volt Four Way: Hubbell 2124.
- E. 20 Ampere, 277 Volt Single Pole with Pilot Light: Hubbell 2121PL7.
- F. 20 Ampere, 120-277V Single Pole, Locking Type: Hubbell 1221L.

2.4 DIMMERS

- A. Single pole or three way slide switch: Lutron NTETS-1000*.
- B. 600 W incandescent slide: Lutron NTV-600.
- C. 1000 W incandescent slide: Lutron NTV-1000.
- D. 1500 W incandescent slide: Lutron NTV-1500.
- E. 600 W incandescent 3-way slide: Lutron NTV-603*.
- F. Variable Speed controller: Lutron NTFS-12E.
- G. 1000 W incandescent 3-way slide: Lutron NTV-1003*.
- H. 1500 W incandescent 3-way slide: Lutron NTV-1503*.
- I. 600 W low voltage slide: Lutron NTVLV-600.
- J. 1000 W low voltage slide: Lutron NTVLV-1000.
- K. 1500 W low voltage slide: Lutron NTVLV-1500.
- L. 600 W low voltage 3-way slide: Lutron NTVLV-603.

- M. 1000 W low voltage 3-way slide: Lutron NTVLV-1003*.
- N. 1500 W low voltage 3-way slide: Lutron NTVLV-1503*.
- O. 40 Lamp fluorescent slide: Lutron NTHF-40'.

2.5 RECEPTACLES

- A. 15A, 125V, 2P3W Clock: NEMA 5-15R, Hubbell 5235.
- B. 15A, 125V, 2P3W Duplex, Tamper Resistant: NEMA 5-15R, Hubbell SG62H.
- C. 20A, 125V, 2P3W Simplex: NEMA 5-20R, Hubbell 5361.
- D. 20A, 125V, 2P3W Duplex: NEMA 5-20R, Hubbell 2162.
- E. 20A, 125V, 2P3W Duplex, Ground Fault Interrupting: NEMA 5-20R, Hubbell GF5362.
- F. 20A, 125V, 2P3W Duplex, Isolated Ground: NEMA IG5-20R, Hubbell IG2162.
- G. 20A, 125V, 2P3W Duplex, Surge Suppression with Light and Alarm: NEMA 5-20R, Hubbell 5362S.
- H. 20A, 125V, 2P3W Duplex, Surge Suppression, Isolated Ground with Light and Alarm: NEMA IG5-20R, Hubbell IG5362S.
- I. 20A, 125V, 2P3W Duplex, Hospital Grade: NEMA 5-20R, Hubbell IG8300HS.
- J. 20A, 125V, 2P3W Duplex, Hospital Grade, Ground Fault Interrupting: NEMA 5-20R, Hubbell GF8300.
- K. 20A, 125V, 2P3W Duplex, Hospital Grade, Isolated Ground: NEMA IG5-20R, Hubbell IG8362S.
- L. 20A, 250V, 2P3W Simplex: NEMA 6-20R, Hubbell 5461.
- M. 30A, 125V, 2P3W Simplex: NEMA 5-30R, Hubbell 9308.
- N. 30A, 250V, 2P3W Simplex: NEMA 6-30R, Hubbell 9330.
- O. 50A, 125V, 2P3W Simplex: NEMA 5-50R, Hubbell 9360.
- P. 50A, 250V, 2P3W Simplex: NEMA 6-50R, Hubbell 9367.
- Q. Heat trace or other loads continuously plugged in outdoors. Provide Crouse-Hinds WRLD-1 cover. Install round plug on cord supplied with heat trace or other equipment to match weatherproof bushing on receptacle cover.

2.6 FLOOR MOUNTED SERVICE FITTINGS

- A. Above Floor Fittings (On Grade); Hubbell:
 - 1. Duplex Receptacle:
 - a. 15A, 125V, 2P3W, NEMA 5-20R: 5362.
 - b. Satin aluminum housing with 3/4-inch nipple: SC-3091
 - c. 4-inch square, fully adjustable box: B-2429.
 - 2. Duplex Receptacle:
 - a. 20A, 125V, 2P3W, NEMA 5-20R: 5362.
 - b. Low profile, nonmetallic housing: SCP-3092.
 - c. 4-inch square, fully adjustable box: B-2429.
 - d. Receptacle and housing color: [Ivory] [Brown] [Gray].
 - 3. Back-to-Back Duplex Receptacle:
 - a. 15A, 125V, 2P3W, NEMA 5-15R: 5261.
 - b. Satin aluminum housing with 3/4-inch nipple: SC-3092.
 - c. 4-inch square, fully adjustable box: B-2429.
 - 4. Back-to-Back Data Outlet:
 - a. Satin aluminum housing with 3/4-inch nipple: SC-3190.
 - b. 4-inch square, fully adjustable box: B-2429.
 - 5. Data Outlet:
 - a. Low profile, nonmetallic housing: SCP-3090.
 - b. 4-inch square, fully adjustable box: B-2429.
 - c. Housing color: [Ivory] [Brown] [Gray].
 - 6. Furniture Feed Outlet
 - a. Satin aluminum housing with 3/4-inch nipple: SC-3098.
 - b. Blank plate: SS-309-BF.
 - c. Plate with knockout for 3/4-inch flex: SS-309-SF.
 - d. 4-inch square, fully adjustable box: B-2429.
- B. Above Floor Fittings (Above Grade); Hubbell:
 - 1. Back-to-Back Duplex Receptacles:
 - a. 2-20A, 125V, 2P3W, NEMA 5-20R
 - b. Brushed aluminum housing with poke-through assembly and junction box.
 - c. Product: PT7-PP2A.
 - 2. Back-to-Back Data Outlet:
 - a. Brushed aluminum housing with poke-through assembly and junction box.
 - b. Product: PT7-TTA.
 - 3. Combination Duplex/Data Outlet:
 - a. 20A, 125V, 2P3W, NEMA 5-20R.
 - b. Brushed aluminum housing with poke-through assembly and junction box.
 - c. Product: PT7-P2TA.
 - 4. Furniture Feed Outlet:
 - a. Brushed aluminum housing: FR-80.
 - b. Blank plate: SS-309-B.
 - c. Plate with knockout for 3/4-inch flex: SS-309-S.
 - d. Poke-through assembly with junction box: PT-7.
- C. Flush Floor Fittings (On Grade); Hubbell:
 - 1. Duplex Receptacle:
 - a. 20A, 125V, 2P3W, NEMA 5-20R: 5362.

- b. Brass cover with flaps: S-3925.
- c. 4-inch square, fully adjustable box with round ring: B-2529.
- 2. Data Outlet:
 - a. Brass cover with 1-inch and 2-1/8-inch plugs: S-2725.
 - b. 4-inch round, fully adjustable box with round ring: B-2529.
- D. Flush Floor Fittings (Above Grade); Hubbell:
 - 1. Combination Duplex/Data Outlet:
 - a. Product: PT7-F.
 - b. Aluminum carpet flange and thermoplastic lift cover with poke-through assembly and junction box.
 - c. Flange and Cover Color: [Ivory] [Brown] [Gray] [Black].
 - 2. Furniture Feed Outlet:
 - a. Product: PT7-FF.
 - b. Aluminum carpet flange with poke-through assembly and junction box
 - c. Flange and Cover Color: [Ivory] [Gray].

2.7 COVER PLATES

- A. Provide one piece cover plates for all group mounted devices.
- B. Provide 302/304 satin smooth, stainless steel.

** OR **

- C. Provide nylon thermoplastic of the same manufacturer and color as the device Color may vary from room to room at A/E discretion.
- D. Weatherproof Cover Plate: Gasketed cast metal with hinged gasketed device covers.
- E. Exposed Box Cover Plate: Stamped steel handy box covers.

2.8 OCCUPANT SENSORS

- A. Self-Contained Wall Switch
 - 1. Novitas 01-250.
 - 2. Single gang, gangable device designed to fit behind a standard decorator switch plate.
 - 3. Ultrasonic detector.
 - 4. Manual on/off override.
 - 5. Power rating:
 - a. 800 watts at 120 volts.
 - b. 1200 watts at 277 volts.
 - 6. Adjustable Time-Out Delay: 30 seconds - 30 minutes.
- B. Network
 - 1. Ceiling Mounted Sensor.
 - a. Product: Novitas 01-300
 - b. Passive infrared and ultrasonic detector.
 - 2. Switchpack

- a. Product: Novitas 13-051.
- b. Enclosure: Plenum rated.
- c. Control up to five sensors.
- d. Power Rating: 20 amps at 120/277 volts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install receptacles and switches only in electrical boxes which are clean and free from excess building materials, debris, etc.
- B. Install wall switches with OFF position down.
- C. Gang switches and/or dimmers installed at one location together under one cover plate. Where switches are located together with dimmers, switches shall match dimmers.
- D. Align the tops of all group mounted devices. Install plumb and aligned in the plane of the wall.
- E. Derate ganged dimmers as instructed by manufacturer; do not use common neutral.
- F. Install convenience receptacles in vertical position with grounding pole on bottom unless otherwise noted.
- G. Provide ground fault circuit interrupting type devices in all locations requiring weatherproof devices.
- H. Do not use feed through feature for ground fault interrupting devices. Install GFI device at each location. Ground fault interrupter circuit breaker will not be acceptable.
- I. Install plates on devices and blank outlets in finished areas. Use jumbo size plates for outlets installed in masonry walls.
- J. Install galvanized steel plates on outlets in unfinished areas.
- K. Install galvanized steel plates on outlet boxes and junction boxes above accessible ceilings.
- L. Mounting Heights
 1. Refer to drawing cover sheet or contact A/E.
 2. Convenience Receptacles Above Counter or Backsplash: 6 inches above counter or backsplash in horizontal position.
 3. Receptacles for Water Coolers: Mount directly behind water cooler to eliminate visibility of cord and attachment plug. Coordinate elevation with the cooler to be installed prior to installation of box.
 4. Install devices in mill work as shown in details and elevations or as directed by A/E.
- M. Drill opening for poke-through fitting installation in accordance with manufacturer's instructions.

- N. Provide red receptacles for circuits on emergency. Provide red cover plates engraved EMERGENCY and engraved with panel designation and circuit number.

-- [OR] --

- O. Provide red receptacles for circuits on emergency. Provide 302/304 stainless steel cover plates engraved EMERGENCY and engraved with panel designation and circuit number.
- P. Network Occupant Sensors
 - 1. Coordinate the sensors and the control units for compatibility. Provide auxiliary relays as necessary.
 - 2. Verify the sensor coverage of the approved manufacturer and provide the necessary sensors, control units and auxiliary relays required to adequately cover and control the indicated area. Where corridors are covered, install ceiling mounted back-to-back sensors.

END OF SECTION 262726.16

SECTION 262816 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install disconnect switches, including:
 - 1. Fuses.
 - 2. Enclosures.
 - 3. Circuit Breakers.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. UL 248-8 - Class J Fuses.

1.3 SUBMITTALS

- A. Furnish dimensions and ratings for voltage, ampacity, horsepower and short circuit.
- B. Indicate enclosure material finish and NEMA classification type.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Disconnect Switches
 - 1. Square D.
 - 2. General Electric.
 - 3. Cutler-Hammer.
 - 4. Siemens.
- B. Fuses
 - 1. Bussmann.
 - 2. Gould-Shawmut.
 - 3. Littelfuse.

2.2 DISCONNECT SWITCHES

- A. Fusible Switch Assemblies: Heavy duty; quick-make, quick-break, load interrupter enclosed switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position. Fuse Clips: Designed to accommodate Class J.

- B. Nonfusible Switch Assemblies: Heavy duty; quick-make, quick-break, load interrupter enclosed switch with externally operable handle interlocked to prevent opening front cover with switch in ON position. Handle lockable in OFF position.
- C. Enclosed Circuit Breakers: Thermal magnetic with externally operable handle.
- D. Enclosures: Unless indicated otherwise, provide general purpose, NEMA 1 for indoor locations; and weatherproof, NEMA 4, stainless steel for outdoor locations.
- E. General-Use Snap Switch: Motors of one HP or less as allowed by code.
- F. Construct all current carrying parts of high conductivity copper with silver-plated switch contacts.
- G. Provide solid copper neutral bar where a neutral is present in the circuit.

2.3 FUSES

- A. Fuses 600 Amperes and Less: Class J; as indicated on drawings; time delay, dual element, current limiting, 600 volt.
- B. Fuses Over 600 Amperes: Class L, bolt-on type with time delay and capability to hold 500 percent rated fuse current for a minimum of four seconds and clear 20 times rated fuse current in .01-second or less. Provide fuses with 'O' ring seals between end bells and glass melamine barrel similar to Bussman time delay KRP-C.
- C. Interrupting Rating: 200,000 RMS symmetrical amperes.
- D. Provide all fuses of the same manufacturer.
- E. Install fuses in motor circuits in accordance with motor manufacturer's recommendations.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Provide disconnect switches, where required by NFPA 70, where indicated on drawings, and where required by equipment manufacturer, in a location convenient for maintenance on each switch and adjacent equipment.
- B. Provide fused disconnect switches when required to maintain equipment manufacturer's warranty. Coordinate with Division 23 for warranty requirements of equipment approved by submittal.
- C. Install fuses in fusible disconnect switches. Provide permanent marking inside switch enclosure for fuse type.
- D. Wall mount switches, where possible, or mount on Uni-Strut supports.

- E. Provide spare fuse cabinet in main electrical room complete with three spare fuses for each rating installed for fuse sizes over 600 amperes, and ten percent spare fuses (minimum of three) of each type and rating installed for 600 amperes or less.
- F. Provide fuse identification label showing type and size inside door of each switch.

END OF SECTION 262816

SECTION 262913 - ENCLOSED CONTROLLERS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install starters, contactors, and switches for motor control.
- B. Provide a controller for each motor and piece of equipment where controller is not furnished as an integral part of the equipment and as indicated or specified to provide the Owner a complete and operating system.

1.2 REFERENCES

- A. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.
- B. IEEE 519 - 1992, IEEE Guide for Harmonic Content and Control.

1.3 DESIGN REQUIREMENTS

- A. Provide starters of the type suitable for the application and environment.
- B. Provide NEMA 1 (general purpose) enclosure for interior use starters unless noted otherwise.
- C. Provide NEMA 12 (industrial) enclosure for interior and exterior use in production areas and where shown on Drawings or required by the interior environment.
- D. Provide NEMA 3R (water resistant) enclosure for exterior use starters unless noted otherwise.

1.4 SUBMITTALS

- A. Include data on relays, pilot devices, switching and overcurrent protection. Include trip ratings, size and UL listing.
- B. Indicate enclosure material finish and NEMA classification type.
- C. Provide operation and maintenance manuals for variable frequency motor controllers and motor starters.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Westinghouse
- B. Square D.
- C. Cutler-Hammer.

- D. General Electric.
- E. Siemens.

2.2 MANUAL MOTOR STARTERS

- A. Fractional Horsepower Manual Starter: AC general-purpose, Class A, manually operated, full-voltage controller for fractional horsepower induction motors, with thermal overload unit, pilot light, and toggle operator.
- B. Motor Starting Switch: AC general-purpose Class A manually operated, full-voltage controller for fractional horsepower induction motors, without thermal overload unit, red pilot light, NO auxiliary contact, and toggle operator.

2.3 MAGNETIC MOTOR STARTERS

- A. Magnetic Motor Starters: AC general-purpose, Class A, magnetic controller for induction motors rated in horsepower as indicated.
- B. Provide accessible terminals for wiring directly from the front of the starter.
- C. Contacts: Provide silver, cadmium oxide alloy, double break, non-welding contacts which will not require filing, dressing or cleaning throughout the life of the control equipment.
- D. Provide starter types as scheduled:
 - 1. Full Voltage Starting: Non-reversing type.
 - 2. Two Speed Starting: Two speed, two winding, variable torque type. Include integral time delay transition between FAST and SLOW speeds. Must be compatible with motor installed.
- E. Coils: Pressure molded, 120 volts, 60 hertz. Provide integral control transformer. Overload and Phase Protection Relay: Provide solid state voltage and overload sensing in all three phases for three-phase full voltage starters, in ungrounded phases for single-phase full voltage starters and in all six legs for two-speed full voltage starters. Overload relay shall be self powered solid state type with selectable Class 10 or 20 overload, phase loss and phase current unbalance protection, "2% repeatability, thermal memory, trip test and indication, and FLA adjustment without the use of heaters. The overload relay shall be insensitive to ambient temperature with a range of -20 to 70 degrees Celsius. Nonadjustable phase failure relay shall be integral with overload relay and have an under voltage trip point set at 80% for dropout and 90% for pickup. Relay shall also operate at 6% phase unbalance and 6% phase voltage loss. A single reset button on the door shall permit external reset.
- F. Auxiliary Contacts: Provide each starter with the required auxiliary contacts for the control functions indicated and required, including the holding interlock and pilot light interlocks plus two additional contacts, field convertible to normally closed or normally open NEMA ICS 2 controls. Provide capability to add auxiliary contacts without removing existing wiring or removing the controller from its enclosure.

- G. Selector Switches: HAND/OFF/AUTO for single-speed motors; HAND/OFF/ AUTO with FAST/SLOW selector switch for two-speed motors; in front cover.
- H. Indicating Lights: RUN; red for single-speed motors; FAST/SLOW; red/amber for two-speed motors (push to test type) in front cover. Operate pilot lights by separate interlock not placed across the holding coil.
- I. Control Power Transformers: Provide integral 120 volt secondary control transformer with both primary and secondary fuses for each controller.

2.4 COMBINATION MOTOR STARTER

- A. Combine magnetic motor starter with disconnect in common enclosure as scheduled with adjustable trip, magnetic-only molded case, motor circuit protector.
- B. Provide combination starters with an IER of at least 100,000A (RMS) when used with feeder protective device indicated.

2.5 VARIABLE FREQUENCY MOTOR CONTROLLERS

- A. Manufacturers
 - 1. Allen-Bradley.
 - 2. Cutler-Hammer.
 - 3. General Electric.
 - 4. Siemens.
 - 5. Square D.
 - 6. Toshiba.
- B. Provide variable frequency drive (VFD) motor controllers to vary the speed of standard AC induction motor used on fans and/or pumps. Controllers may be VVI or PWM Type if they comply with this specification. Provide isolation bypass contactors on all VFD motor controllers in order to operate the equipment while the VFD is inoperative or being maintained. Conform to IEEE Standard 519-1981.
- C. Provide VFD controllers that are specially designed for varying the speed of both standard and high efficiency three-phase, squirrel cage induction motors and capable of momentary overloads of 110 percent.
- D. Provide VFD controllers with a continuous current rating of no less than the full load current indicated on the driven motor nameplate. Provide with continuous speed adjustment with corresponding constant volts/hertz excitation.
- E. Provide VFD controllers with an AC to DC converter, DC link filter and an inverter section.
 - 1. Provide inverter section with power transistors. SCPs or gate turn-off devices are unacceptable.
 - 2. Factory mount and wire all components on a dead-front, grounded, free-standing or wall mounted minimum NEMA-1 enclosure arranged for top and bottom conduit entry. Provide free-standing enclosure suitable for mounting on a steel platform or on

- a concrete housekeeping pad, except where VFD controllers are indicated on plan to be installed group mounted or motor control center, provide controller capable of being mounted in motor control centers.
3. Provide front accessible connections and easily removable assemblies. Provide capability to interchange all printed circuit boards in regulator section with other units.
- F. Incorporate the following features on the VFD controller:
1. Input Power: 480 volts plus 5 percent, minus 10 percent/3-phase/60 hertz.
 2. AC input fuses.
 3. Input line filters capable of protecting the electronics against transient voltage spikes or notches. Isolation transformers are unacceptable.
 4. Output motor contactor rated at the full amperage of the VFD. Interlock this contactor with the bypass magnetic starter to provide a mechanical disconnect from the motor when the VFD is off or at zero speed.
 5. Make all control adjustments without the necessity of extender boards on special meters. Provide front access for all adjustable potentiometers.
 6. Electrically isolate logic and control circuits from the power circuits. Ground signal circuit common point.
 7. LEDs for signal tracing and status indication.
 8. Independently adjustable acceleration and deceleration potentiometers; 0.5 to 25 seconds.
 9. Power dip ride-through to allow continuous operation for up to a three cycle line loss.
 10. Local and remote automatic switch.
 11. Motor slip dependent speed regulation.
 12. Frequency stability of 0.5 percent for 24 hours with voltage regulation of plus 2 percent of rated output.
 13. Unidirectional coast to rest upon stop.
 14. Before restoration of power after momentary outage or transfer of power, provide ability to pick up and supply power to driven motor at any speed without damage or provide time delay for motor decay.
- G. Limit the harmonic distortion on the incoming 480V bus to 5 percent or less with a source impedance of 1 percent or less.
- H. Provide the VFD with instantaneous overcurrent trip. Maximum allowable current is 160 percent of nameplate current rating under this specification.
- I. Phase sensitive VFDs will not be acceptable.
- J. Provide electronic I^2t motor protection. Bimetallic overloads are unacceptable.
- K. Provide the VFD with a full load, full speed efficiency of 95 percent or better.
- L. Provide the VFD with a full function current limit, adjustable from 10 percent to 110 percent which is independent of the instantaneous overcurrent trip, basically works as follows: In the event of a motor overload, current is unable to exceed the adjustable preset limit. When the current reaches that limit, it will hold that level for one minute. If the current is not reduced during the one-minute time interval, the motor speed is automatically reduced until the

overcurrent condition is removed. The motor may then return to the required speed after the overcurrent condition is removed.

- M. Provide an integral fault diagnostic center indicating the following conditions:
 - 1. External fault.
 - 2. Processor line fault.
 - 3. Low AC line voltage.
 - 4. High AC line voltage.
 - 5. Current overload.
 - 6. High DC bus voltage.
 - 7. VFD output fault.

- N. Provide VFD with convection cooling.

- O. Provide VFD with controlled regenerative override to apply a decelerating torque to motor without tripping off the line when the speed command is reduced.

- P. Protection against:
 - 1. Input line over/under voltage.
 - 2. AC line transient voltage.
 - 3. Phase loss.
 - 4. Output ground fault. Prevent the VFD from blowing fuses in this condition. Isolation transformers will not be used to prevent this condition.
 - 5. Output line-to-line short circuit.
 - 6. Motor overload.
 - 7. DC over voltage.
 - 8. Over frequency.
 - 9. Over temperature.
 - 10. Electrical isolation between power and logic circuits.
 - 11. DI/DT and DI/DV for semiconductors.

- Q. Provide VFD with 0.5 percent speed regulation.

- R. Mount following on door of VFD:
 - 1. Hand-off automatic selector switch with indicator lights.
 - 2. Manual speed potentiometer.
 - 3. Speed meter 0 to 100 percent.
 - 4. Non-fused disconnect switch.

- S. Provide the VFD with a three-position HOA switch to accept a 4-20 ma signal for the automatic operation as described in Division 25 - Controls and required by the sequence of operation.

- T. Specifically select VFD to provide quiet operation with standard motor. Select controller so sound level in spaces adjacent to mechanical room do not exceed a N.C. of 35. After installation, if adjacent spaces do exceed N.C. of 35, replace controller at no additional cost.

- U. Provide portable service analyzer, one total for project, capable of being plugged into controller without modification. Portable service analyzer to have capability to run, stop and

control unit, and indicate satisfactory operation or isolate the source of malfunction to the smallest replaceable unit.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install motor control equipment in accordance with manufacturer's instructions.
- B. Select and install heater elements in motor starters to match installed motor characteristics.
- C. Mount with operating handle at 5'-6" above finished floor. Align the tops of all grouped starters. Install plumb and aligned in the plane of the wall in which they are installed.
- D. Provide supports of galvanized angle or other suitable material where mounting motor starters on wall or other rigid surface is impractical. Do not support starters from conduit alone. Locate motor starters that are mounted on equipment served so that the starter will not inhibit the removal of any service panel or interfere with required access.
- E. Mount in accessible location to allow sufficient room for maintenance on itself and adjacent items.
- F. Securely mount all starters indicated.
- G. Coordinate with other trades as required for control and interconnections with motors provided under other Divisions.

END OF SECTION 262913

SECTION 262916 - ENCLOSED CONTACTORS

PART 1 - GENERAL

1.1 SUBMITTALS

- A. Furnish written verification that contactor type is compatible with all controlling devices.
- B. Indicate enclosure material finish and NEMA classification type.
- C. Provide operation and maintenance manual.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. ASCO.
- B. Cutler-Hammer.
- C. General Electric.
- D. Siemens.
- E. Square D.

2.2 MECHANICALLY HELD CONTACTORS

- A. Mechanically held for three-wire control.
- B. Encapsulate coils and internally wire to prevent continuous operation.

2.3 GENERAL

- A. Coil Operating Voltage: 120 volts, 60 hertz with cover mounted H.O.A. switch.
- B. Contacts: Provide the number of contacts for the control functions indicated plus two additional contacts, field convertible to normally open or normally closed contacts.
- C. Provide solderless pressure wire terminals.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Coordinate controlling devices such as time clocks and photocells with contactor furnished for compatible system.
- C. Identify with nameplate. Label each circuit controlled.

END OF SECTION 262916

SECTION 265113- INTERIOR LIGHTING FIXTURES, LAMPS AND BALLASTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install light fixtures associated with building, including:
 - 1. Interior luminaires and accessories.
 - 2. Lamps.
 - 3. Ballasts.

1.2 SUBMITTALS

- A. Include product data for fixtures, including photometric data, reflectance, lens, lamps, ballasts, poles and lighting control.
- B. Furnish samples upon request.
- C. Provide operation and maintenance manual.

1.3 RELATED SECTIONS

- A. Section 26 05 13 Medium Voltage Cables
- B. Section 26 05 19 Low-Voltage Electrical Power Conductors and Cables
- C. Section 26 05 23 Control Voltage Electrical Power Cables
- D. Section 26 09 23 Lighting Control Devices

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Lighting Fixtures
 - 1. Manufacturers of individual lighting fixtures shall be as scheduled on Drawings, and indicate quality and design features required.
 - 2. Products of other manufacturers will be considered upon submittal of proper data.
- B. Drivers
 - 1. Advance.
 - 2. Eldo
 - 3. Samsung
 - 4. Universal
- C. LED LAMPS

1. Samsung
2. Philips
3. Nichia
4. Cree

2.2 GENERAL

- A. Provide lighting fixtures of the size, type and rating indicated, complete with lamps, lampholders, reflectors, ballasts, starters, wiring and accessories.
- B. Where fixtures are recessed mounted in ceiling system, provide trim and accessories required for installation in the ceiling system installed.
- C. It is the intent of the drawings and specifications to indicate the type of fixture for each intended use. It is generally intended that rooms of similar usage and configuration will have similar fixture types. Where fixture type is not indicated, it is the duty of the Contractor to request clarification prior to proceeding with the work.
- ~~D. All fixtures shall meet or exceed the latest Chicago Plenum Rating requirements.~~
- E. Contractor shall be provided with a \$15,000 allowance for any lighting modifications.

2.3 INTERIOR LUMINAIRES AND ACCESSORIES

- A. High Bay, LED Fixtures
 1. Where enclosed and gasketed type fixtures are specified, provide luminaires designed for continuous operation in ambient temperature of 55 degrees C.
 2. Provide cast aluminum driver housing with baked electrocoat paint finish. Provide single ballast in single ballast housing for both single and twin fixture assembly.
 3. Provide positive aligning disconnect to allow optical assembly to be disconnected from driver housing without exposing live metal parts.
 4. Provide optical assembly with separate safety chain, supported from structure above.
- B. Recessed LED Luminaires: Prewired type, provide trim type required for ceiling system installed.

2.4 LED LUMUNIARES AND DRIVERS

- A. All Luminaires
 1. Comply with IES LM-79-08 Approved Method for measuring lumen maintenance of LED light sources.
 2. All LED's on the first floor shall have 4000K color temperature.
 3. LED fixtures shall meet or exceed the minimum delivered lumen level specified on fixture schedule.
 4. Comply with IES LM-80-08 Approved Method for electrical and photometric measurement of SSL product.

5. Comply with In-Situ testing for more reliable results.
6. LED's shall be Restriction of Hazardous Substances Directive (RoHS) compliant.
7. LED arrays shall be sealed, high performance, long life type; minimum 70% rated output at 50,000 hours.
8. LED luminaires shall deliver a minimum of 100 lumens per watt.
9. Drivers shall be solid state and accept 120 through 277 VAC at 60 Hz input.
10. The LED light source shall be fully dimmable with use of compatible dimmers switch designated for low voltage loads.
11. Luminaires shall have internal thermal protection.
12. Luminaires shall not draw power in the off state. Luminaires with integral occupancy, motion, photo-controls, or individually addressable luminaires with external control and intelligence are exempt from this requirement. The power draw for such luminaires shall not exceed 0.5 watts when in the off state.
13. Indoor luminaires shall have a minimum CRI of 80.
14. LED package(s)/module(s)/array(s) used in qualified luminaires shall deliver a minimum 70% of initial lumens, when installed in-situ, for a minimum of 50,000 hours. *High bays shall have a minimum of 70,000 hours*
15. Luminaires shall be fully accessible from below ceiling plane for changing drivers, power supplies and arrays.
16. LED drivers shall be provided with minimum 5-year manufacturer warranty of full replacement of board and driver. Indirect fixtures shall be provided with a minimum 10-year manufacturer warranty.
17. All LED fixtures shall be provided with lenses unless noted otherwise.

B. Downlights

1. All downlights shall be provided with 0-10V driver.
2. Drivers shall dim light down to 1%.
3. Downlights shall have wet location UL listing.
4. LED drivers and modules shall be fully accessible from below ceiling. Where installed in hard ceilings, LED hardware shall be fully accessible from below for maintenance purposes.
5. Downlight housings shall not exceed height of 8-1/4".

C. Power Supplies and Drivers

1. Power Factor 0.90 or higher
2. Maximum driver case temperature not to exceed driver manufacturer recommended operation.
3. Solid-state control components to be integral or external per each specified luminaire. Remote control gear to be enclosed in Class 1, Class 2, or NEMA 3R enclosures as required.

D. Controller and Control System

1. System electronics driver / controller to use coordinated communication protocols: DMX512, 0-10V, DALI, or proprietary as required.

2. The Contractor to ensure that external control equipment is compatible with LED control requirements
3. Provide connector types and wiring as appropriate for un-interrupted communication between devices, considering distance maximums, field obstructions, and accessibility.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support surface-mounted luminaires to ceiling using bolts, screws, or approved clips.
- B. Install recessed luminaires with proper frames in accordance with manufacturer's recommendations.
- C. Locate recessed luminaires as indicated on reflected ceiling plan.
- D. Support pendant or bracket fixtures as indicated and as recommended by manufacturer for job conditions encountered.
- E. Provide two supplemental 12 gauge slack hanger wires from opposite corners of troffers installed in grid ceiling to the structure above.
- F. Wall mount exit fixtures where shown above doors. Coordinate fixture location with actual door arrangement as indicated. Connect exit fixtures to unswitched power source as indicated.
- G. Connect fixtures designated as night lights to unswitched circuit and burn continuously.
- H. Install lamps in luminaires and lampholders.
- I. Connect all exit lights to unswitched emergency circuit.
- J. Refer to architectural reflected ceiling plans to ensure the correct ceiling types (gypsum, ACT, or open to structure). Provide flange kit, grid clips, etc. for proper installation as shown per location on architectural plans.
- K. Flex conduit is only allow for installation with a maximum length of 6' from the junction box.
- L. Provide additional safety chain for all LED High Bay fixtures.

3.2 FIELD QUALITY CONTROL

- A. Coordinate receipt and installation of all fixtures with regard to the overall schedule of the project.
- B. Align luminaires and clean lenses, diffusers, and downlight trims at completion of work. Clean paint splatters, fingerprints, dirt and debris from installed luminaires.
- C. Demonstrate proper operation of all luminaires and controls.
- D. Refer to Section 16050 regarding lamp replacement prior to final acceptance.
- E. Contract shall conduct field inspection to verify that all fixtures are functioning properly prior to the final punch by the A/E firms.

END OF SECTION 265113

SECTION 283100 - FIRE DETECTION AND ALARM

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. The contractor shall furnish and install a peer to peer, networked, LAN based 24 VDC, electrically supervised, analog “intelligent”, fire alarm (and communication) system as specified herein and indicated on the drawings. This system shall include, but not be limited to, all control equipment, remote transponder panels, power supplies, signal initiating and indicating devices, conduit, wire fittings, and all other accessories required to provide a complete and operational system as herein specified.
- B. Network communications protocol shall be based on a standard, non-proprietary computer LAN technology. This technology must provide true peer to peer communication capability among all components of the network system for high security and reliability. Systems providing central point polling and processing or master/slave relationships shall not be acceptable.
- C. The initiating Device Circuit (IDC) shall be wired as style B. The Initiating Appliance Circuit (IAC) shall be wired as Style Y. The Signaling Line Circuit (SLC) shall be wired as Style 4.
- D. Work Included:
 - 1. Control Equipment.
 - 2. Power Supplies.
 - 3. Signal initiating.
 - 4. Signaling devices.

1.2 RELATED SECTIONS

- A. Section 26 05 33.19 – Conduit For Electrical Systems.
- B. Section 26 05 19 – Low-Voltage Electrical Power Conductor and Cables.

1.3 REFERENCES

- A. NFPA 70 - National Electrical Code.
- B. NFPA 72 - National Fire Alarm Code.
- C. NFPA 101 - Life Safety Code.
- D. UL 38 - Manual Alarm Stations.
- E. UL 217 - Smoke Detectors - Single/Multiple Station.
- F. UL 228 – Door Holder-Closers.

- G. UL 268 - Smoke Detectors - Systems.
- H. UL 268A – Duct Smoke Detectors.
- I. UL 464 – Audible Signaling Appliances.
- J. UL 521 - Heat Detectors.
- K. UL 864 – Control Panels.
- L. UL 1638 – Visual Signaling Appliances.
- M. Local and State Building Codes.

1.4 SUBMITTALS

- A. Furnish shop drawings indicating conduit and cable sizes and routing. Include zone designations. Provide complete floor plans indicating all device locations. Provide riser diagram, indicating risers and interface with other systems.
- B. Furnish product data including all individual devices dimensions and installation.
- C. Furnish complete sequence of operation, alarm, signal and control zones and interface with other systems.
- D. Indicate all detection, monitoring, and signal zones.
- E. Furnish sample of proposed graphic and text automation.

1.5 QUALITY ASSURANCE

- A. Provide an equipment supplier that is an authorized and designated representative of the Fire Alarm Manufacturer to sell, install, and service the proposed manufacturer's equipment. Verify the equipment supplier has technical factory training specifically for the system proposed.
- B. The installing contractor and equipment supplier shall be licensed by the State Fire Marshall to sell, install, and service fire alarm systems.
- C. Provide staff installation superintendents who are licensed by the State Fire Marshall's office for such purpose and under whose supervision installation, final connections, and testing will be performed.
- D. The equipment supplier to be actively engaged in the business of selling, installing, and servicing fire alarm systems for at least seven (7) years and have a minimum of ten (10) such installations in operation.
- E. Provide an equipment supplier with 24 hour, 365 days per year emergency service with qualified and state licensed service technicians.

1.6 COORDINATION

- A. Coordinate all requirements surrounding installation of the fire alarm system with all trades including, but, not exclusive of the elevator system, electrical system, sprinkler system, access control security system, and HVAC/controls system. Provide adequate coordination to insure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system to provide a complete, functional and completely supervised life safety system.
- B. Provide two (2) male/female modular telephone jacks at Digital Alarm Communicator Transmitter (DACT) for connection to telephone system.

1.7 NETWORK COMMUNICATION

- A. The network communication protocol shall utilize non-proprietary LAN technology incorporating a non-collision, token-passing protocol for high reliability. Systems utilizing collision recovery software will be deemed unacceptable.
- B. Network systems shall be inherently regenerative with high speed data communication of 156 KBPS minimum to insure timely and accurate transmission of system status with minimal delay.
- C. Each network node (fire alarm panel, annunciator, computer, etc.) shall store its own program locally and communicate equally with all other nodes in the network. Failure of any node will not affect any other node or communications among surviving nodes. Upon line fault(s), each node shall immediately regenerate communication with the largest group of nodes still intact with the respective node(s). Regeneration shall not require pre-designation or programming. Total network annunciation, within the regenerated network(s) shall be maintained.
- D. Minimum network capacity shall be at least 100 nodes and provide 200,000 points of detection or more. There shall be no limit as to the type, mix, or quantity of any node type (as long as total network capacity is not exceeded). The proposed networked system shall have a 20% expansion capacity for future consideration and use.
- E. Network wide annunciators or computer shall function as network nodes and not be physically dependent upon availability of fire alarm panel nodes. Network annunciation may be fully field programmable as to which network activities the units will perform and annunciate. All annunciators and/or computer terminals on the network shall be capable of full designated annunciation. Each annunciation unit must be fully capable of annunciating and controlling ALL network points and activity (if selected). Annunciators with limited capacities of annunciation less than the entire network (including expansion) capacity shall be unacceptable. Network shall support multiple network annunciators as may be required.
- F. System network shall provide the capability to integrate across the network conventional fire alarm control systems via independent sub-networks in order to provide expanded monitoring capacity.

- G. Each node shall be so designed to act as a network data repeater to reshape and regenerate data signals in order to insure adequate signal strength over extended media lengths. Each node shall also incorporate electromagnetic isolation from the network media. Dedicated repeaters shall be available where needed, to extend physical media lengths or distances.
- H. The network shall be available for use with either wire or fiber optic media paths or both. System shall accommodate wire media of 24 AWG with no shield required.
- I. Network communications path shall be available in style 4 or style 7.
- J. Network or node programming shall not require programmed node to be taken off-line or disrupt normal node routines. Programming shall not require chip replacement or re-burns as herein specified. Network wide programming shall be capable of being accomplished from any remote command center or network annunciator location.
- K. Peer to peer cooperative control by event capability shall allow nodes to initiate output and control functions based on input received from other nodes on the network. This interactive control shall NOT be dependent on a central processing computer or host panel. Each node shall store its own program in non-volatile memory.

1.8 SYSTEM OPERATION

- A. Verification Sequence
 1. If an intelligent smoke detector senses a trouble level of smoke, provide for the interface module to automatically initiate a "check" mode. Provide a minimum of four consecutive samples of the prospective detector. Upon completion of the consecutive smoke trouble conditions, the detector is considered "checked" and the system goes directly into an alarm mode.
 2. Provide alarm verification, as field programmed, to initiate the verification sequence after the above "check" procedure. Provide a field programmable delay period (0-50 seconds) before proceeding to resample the detector. Initiate all alarm sequences specified if three or more samples verify an alarm condition still exists. Log in memory the number of verification events that have occurred for each selected device.
- B. Alarm detection Sequence
 1. Upon detection by any initiating device, flash the system common alarm LED on the CPU module and sound the internal audible trouble device. Acknowledging the alarm condition silences the audible trouble device and causes the flashing common alarm LED to illuminate steady.
 2. Indicate all applicable information on an 80 character display associated with the alarm condition including: zone, device type, device location, and time of alarm.
 3. Any remote annunciator LED's associated with the alarm point illuminate as herein specified.
 4. Relay the alarm signal to the remote DACT.
 5. Execute all automatic events programmed to the alarm point and activate the associated indicating devices and/or outputs.

6. Sound alarm tones. Generate multiple distinct digital messages as predetermined by event initiated programs.
 7. Activate all audible/visual alarm devices.
 8. Deactivate AHU's and FCU's.
- C. Trouble Detection Sequence
1. Upon trouble detection, flash the system trouble LED on the CPU module and sound the internal audible trouble device. Acknowledging the trouble condition silences the audible trouble device and causes all trouble LED's to illuminate steady.
 2. Indicate all applicable information on an 80 character display associated with the trouble condition and its location.
 3. Provide priority for unacknowledged alarms / messages over any trouble displays and priority precedence on the annunciator.
 4. Illuminate any remote trouble annunciators LED's as herein specified.
- D. Auxiliary and Remote
1. Maintain in operation all designated "non-silenceable" auxiliary control functions, even upon silencing of audible alarms, until such time as the control panel is cleared and reset manually (i.e. fan control outputs, central station interface, elevator recall interface, etc.).
 2. Provide annunciator(s) that duplicate the control panel alarm status indicators for selected system zones/points and annunciate any system trouble conditions as herein specified.

1.9 MAINTENANCE SERVICE

- A. Provide continued program of system maintenance in compliance with NFPA 72.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

The basis of design shall be Notifier. If manufacturer is not provided please provide unit with equal specifications with the following manufacturers.

- A. Honeywell.
- B. Simplex Grinnell.

2.2 FIRE ALARM CONTROL PANEL

- A. Provide a control panel modular in design utilizing distributed solid state, field programmable microprocessors. Provide capacity for the required active detection and output points with space for use and expansion. Provide hinged door with key lock and a transparent window for viewing all alarm/trouble indicators and LCD annunciator.

- B. Provide programmable non-volatile RAM memory. Provide capability to communicate with monitor and control all other modules in the panel via internal serial communications techniques. Provide detection upon removal, disconnection or failure of any control panel module.
- C. Maintain all custom time or control-by-event programs for specified events in non-volatile memory. Provide for no program loss, if system primary and secondary power failure occurs.
- D. Provide a real-time clock circuit to execute custom line control programs and time/date stamp system events.
- E. Provide touchpad controls and indicators for use by the system operator to program all control panel and system parameters. Provide custom display of alpha numeric labels for all intelligent detectors, zones, and addressable modules. Store label information in non-volatile memory.
- F. Provide an 80 character alpha numeric liquid crystal display (LCD). Provide light emitting diodes (LED's) for AC power, system alarm, system trouble, display trouble and disable.
- G. Provide a keypad with capability to control all system functions, status readouts, manual control action, and entry of any alphabetic or numeric information. Include means to enter multiple five-digit passwords to prevent unauthorized manual control or programming from the keypad. Provide multiple levels of password protection.
- H. Provide interface for supervised remote LCD annunciators.
- I. Provide for monitoring and controlling of each loop of intelligent detectors and addressable modules. Include an independent microprocessor control capable of alarm detection with automatic default mode if a failure occurs in the system central processor unit, internal connections, or other modules.
- J. Provide for receiving digital/analog information from an intelligent detectors and process for this information to determine normal, alarm, trouble, and sensitivity conditions. Use analog information for automatic test and determination of maintenance requirements. Individually monitor all intelligent detectors for sensitivity variation and initiate a trouble condition should detector sensitivity "drift" toward either threshold or false alarming or non-alarming conditions. Monitor each detector's sensitivity, and if need be, electronically adjust the detector sensitivity as required for existing conditions within UL recommended limits.
- K. Communicate continuously with each intelligent detector and addressable module on its loop and verify its proper function and individual status. Perform communication with up to 198 such devices per loop an average of every three seconds or less.
- L. Control Switches
 - 1. Acknowledge / step switch.
 - 2. Signal silence switch.
 - 3. System reset switch.
 - 4. System test switch.
 - 5. Lamp test.

- M. Non-Lock Walk Test: Provide a special non-lock “walk test” mode where each initiating device is manually placed in alarm. Pulse the system audible devices from the control panel on detection of each such alarm and automatically reset the panel, permitting a single serviceman to functionally test the entire system.
- N. Automatic Detector Test
1. Provide a special automatic detector test feature which permits reading and adjusting the sensitivity of all intelligent detectors from the main control panel. In addition, permit the functional testing of any intelligent detector or addressable interface device individually or by zone from the main control panel. Indicate the results of the test on the LCD display.
- O. System Diagnostics
1. Provide special software to detect, diagnose, and report failures and isolate such failures to a printed circuit board level. Periodically perform independent self test routines as a self operational /performance test for each module via its resident, independent processor. Report any irregularities via the LCD display and trouble indicators.
 2. Provide a lamp test function to test all system indicators including the LCD display and test the panel trouble device for proper operation.
 3. Provide a keyboard test function allowing the user to interactively confirm that all keys are functional and operating correctly.
 4. Provide independent timer software to detect and report failure of any microprocessor circuit, memory, or software. The function of this safeguard software/circuitry is to restart the respective processor and maintain proper operation of the system. In addition the master CPU has control over a hardware reset terminal which can perform a system-wide restart. Systems employing tape or disk drive rebooting will not be acceptable.
- P. Field Programming
1. Provide a 100 percent field programmable system without the need for external computers, PROM programmers, or replacement of memory IC’s. Systems requiring factory programming / reprogramming or field replacement of IC memory chips will not be acceptable. All programming may be accomplished through the front control panel indicators and switches or via CRT/keyboard unit. Store all programs in non-volatile RAM memory.
 2. Secure programming with an appropriate, pre-selected, five digit password security code of the highest security level. Do not require the system to be taken off-line or prohibit the system from performing its normal operations and routines while in the system programming mode.
 3. Initiate all programming functions via special system “prompting “menus via the system main CPU. Provide a means to “review “all programmed functions at any time subsequent to initialization.
 4. Provide the capability to revise/change programmed functions or system expansion at anytime subsequent to initialization as described herein, without factory modifications or factory reprogramming. Field programming via the use of external computers may be considered provided programming can be accomplished on-site

and the owner permanently furnished with required programming apparatus as part of this contract.

Q. Event History

1. Store a minimum of 400 system events in chronological order of occurrence. Include event history for all system alarms, troubles, operator actions (i.e acknowledge, silence, reset, program entry, etc.), unverified alarms, circuit/point alterations, component failures. Time and date stamp events and record and/or review without purging the history file. Store events in non-volatile buffer memory.
2. Automatically overwrite the oldest event(s) in memory beyond the initial 400 events.

R. Power Supply

1. Provide an integral power supply for the panel and all fire alarm peripherals. Provide all control panel and peripheral power needs with filtered power.
2. Design all power supplies to meet UL and NFPA requirements for power limited operation on all external signaling lines, including initiating circuits and indicating circuits. Provide UL listing for all power –limited circuit applications and use positive temperature coefficient devices for current limiting.
3. Provide input power rated at 120 volts, 60 hertz. Provide internal supervised batteries and automatic charger. Provide both positive and negative ground fault supervision, battery charger fail condition, AC power fail indicators. Provide supervision of modular expansion power supplies as may be required.
4. Power supply must be able to supply twenty percent (20%) excess power supply capacity to allow for future expansion.
5. Control Panel must be connected to primary and secondary power source.

2.3 DIGITAL ALARM COMMUNICATOR TRANSMITTER (DACT)

- A. Provide UL listed DACT adjacent to FACP. Provide all required equipment in accordance with NFPA 72 for remote central station reporting.
- B. Provide supervised connections from DACT to FACP. Provide modular telephone jacks for connections to telephone system.
- C. Provide alarm signal to fire department.

2.4 FIELD DEVICES

A. Monitor Modules

1. Provide addressable monitor modules where required to interface to contact alarm devices. Provide monitor modules to connect a supervised zone of conventional initiating devices (an N.O. dry contact device, including 4-wire smoke detectors) to an intelligent SLC loop. Mount in a 4 inch square electrical box. Wire each zone for Class B, field selectable.
2. Provide address-setting means and store an internal identification code, which the control panel shall use to identify the type of device. No binary coding shall be required. Flash status/power LED under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel.

The LED may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected.

3. Provide a magnetic test feature to field test the unit for functional operation. Provide an automatic test feature to permit functional testing of the device from the main control panel. Indicate results of the test on the LCD display.

B. Control Modules

1. Provide control/relay modules where required to provide audible alarm interface and/or relay control interface. Providing control modules to connect a supervised zone of conventional indicating devices (any 24 volt polarized audio/visual indicating appliance) to an intelligent loop. Mount in a standard 4 inch electrical box. Wire each zone Class B, field selectable. The control module may be optionally wired as dry contact (Form C) relay. Provide power for the relay actuation from the intelligent detector loop to reduce wiring connection requirements. Provide audiovisual power form a separate loop from the main control panel or from supervised remote power supplies.
2. Provide address setting means and store an internal identification code which the control panel shall use to identify the type of device. No binary coding shall be required. Flash status LED under normal conditions, indicating that the control module is operational and in regular communication with the control panel. The LED may be placed into steady illumination by the control panel, indicating that an alarm condition has been selected.

C. Remote LCD Annunciators

1. Contractor shall install and annunciator in an open accessible area at or adjacent to the main ground level entrance to building.
2. Provide supervised remote LCD annunciators. Provide field programmable annunciators to annunciate selected given points and/or zones. Configure each annunciator as remote system control and annunciator unit. Provide alarm and trouble LCD's per annunciated function.
3. Provide a local alarm/trouble Piezo sounder and acknowledge/lamp test switch. Provide a common trouble LCD and on-line/pilot LCD indicators. Zone LCD indicators to flash upon receipt of alarm (or trouble) conditions and revert to steady state upon system or annunciator acknowledgement. Silence local sounder upon acknowledging.
4. Duplicate system control capability as follows: System acknowledge/ trouble silence, signal silence, lamp test, system reset, signal silence LCD, and system alarm and trouble LCD's.

D. Intelligent Photoelectric Smoke Detectors

1. Provide analog photoelectric smoke detectors. Provide detectors utilizing the photoelectric principal to measure smoke density and on command from the control panel, send data to the panel representing the ANALOG level of smoke density. Provide automatic sensitivity "drift" compensation to provide longer term stability and reliability. Provide a "maintenance alert" feature whereby the detector initiates a trouble condition should the units sensitivity approach the outside limits of the normal sensitivity window. Provide the detector with extensive RF and EMF noise

reduction circuitry. Provide self compensating solid state LED light source and photosensitive circuitry.

2. Provide a calibrated test method whereby the detectors will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself by activating the detector magnetic test switch, or may be activated remotely on command from the control panel.
3. Provide address-setting means and store an internal identification code for each detector, which the control panel can use to identify the type of detector.
4. Provide dual alarm and power/status LED's. Flash status LED's under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LED's may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected and verified. Provide an output connection in the base to connect an external remote alarm LED.
5. Provide semi-flush ceiling mounted, modular detector head with twist-lock base. Provide in smooth attractive white finish, and back-sealed against dirt, vermin, and back pressure. Provide with fine mesh insect/contaminate screen. Provide UL listing with respective control panel.

E. Intelligent Thermal Detectors

1. Provide analog thermal detectors. Provide detectors utilizing dual electronic thermostats to measure temperature levels in its chamber and on command from the control panel, send data to the panel representing the analog temperature level.
2. Provide a calibrated test method whereby detectors will simulate an alarm condition and report that condition to the control panel. Such a test may be initiated at the detector itself, by activating a magnetic switch, or may be activated remotely on command from the control panel.
3. Provide address-setting means and store an internal identification code for each detector, which the control panel can use to identify the type of detector.
4. Provide dual alarm and power/status LED's. Flash status LED's under normal conditions, indicating that the detector is operational and in regular communication with the control panel. Both LED's may be placed into steady illumination by the control panel, indicating that an alarm condition has been detected. Provide an output connection in the base to connect an external remote alarm LED.
5. Provide semi-flush, ceiling mounted, modular detector head with twist-lock base. Provide in smooth attractive white finish.

F. Intelligent Duct Detectors

1. Provide duct mounted intelligent photoelectric smoke detectors. Provide detectors operating on the same principles and exhibiting the same basic characteristics as area type intelligent smoke detectors. Provide units capable of interchanging /accepting either photoelectric or ionization type sensors. Provide detectors operating in air velocities of 300 FPM to 4,000 FPM without adverse effects on detector sensitivity. Provide detectors which interface directly to the system without interface zone modules.
2. Provide a noryl molded plastic enclosure with integral conduit knockouts. Provide housing with gasket seals to insure proper seating of the housing to the associated ductwork. Provide sampling tubes that extend a minimum of 75% across the width of the duct. Provide porosity filters to reduce sensor/chamber contamination. Provide with integral SPDT auxiliary control.

- G. Addressable Manual Pull Stations
 1. Provide dual action type manual pull stations. On command from the control panel, send data to the panel representing the state of the manual station.
 2. Provide address-setting means and store an internal identification code, which the control panel can use to identify the type of device. Flash status LED's under normal conditions, indicating that the manual station is operational and in regular communication with the control panel. The LED may be placed into steady illumination by the control panel, indicating that an alarm condition has been initiated via the station.
 3. Provide semi-flush mounted stations on standard electrical box. Construct of hi-impact red molded Lexan with instructions for station operation in raised white letters.

- H. Strobes
 1. Provide flush wall mounted visual alarm devices operable on 24 volts DC, utilizing a high intensity solid state xenon strobe tube to comply with ADA and NFPA. Connect strobe lights to supervised circuits.
 2. Provide Lexan cover for strobes in corridors, restrooms, and other areas subject to damage.

- I. Electronic Horn/Strobes
 1. Provide solid state electronic audible alarm devices operable at 24 volts and polarized supervised. Provide temporal audible tones. Electro-mechanical solenoids or contacts will not be acceptable.
 2. Provide visual alarm devices integral with audible alarm devices, operable on 24 volts DC, utilizing a high intensity solid state xenon strobe tube producing 15/75 candela and 110 candela. Connect strobe lights to supervised circuits.
 3. Provide flush mounted, molded of high-impact red thermo plastic.
 4. Provide lexan cover for horn/strobes in corridors, restrooms, and other areas subject to damage.

- J. Water Flow Detectors: provide interface to monitor water flow detectors.

- K. Supervisory Valves: Provide interface to monitor supervisory valves on each fire protection piping valve.

- L. Auxiliary Relays: Provide relays for ventilating and air handling control and interface. Provide heavy duty type rated up to 10 amps at 24 volts DC. Provide with NEMA I dust cover assembly and SPDT contacts.

- M. All notification devices shall be provided with xenon strobe, compliant with current ADA requirements.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Only basic equipment devices have been shown on the contract drawings. Specific wiring between equipment/devices has not been shown. It is the contractor responsibility to submit for approval the complete engineered system configuration and layout showing all devices, wiring, conduit, and locations along with other required information as specified herein.
- B. Field program all devices into software zones for the purpose of general area identification (i.e., floor, wing, etc.) and annunciation. Provide for each device to also be separately annunciated including exact location and device type.
- C. Verify interface requirements for other systems and devices.
- D. Obtain authorization from building officials having jurisdiction.
- E. Each monitoring device shall be assigned its own digital address on the SLC.
- F. All visual notification devices must be synchronized to prevent an effective flash rate of greater than one hertz in any space.

3.2 CABLE INSTALLATION

- A. Provide cable in accordance with NFPA 72, NFPA 70, and local codes. Provide cable sizes conforming to manufacturer's recommendations.
- B. Provide twisted/shielded type cable to guard against outside RF and EMF interference and induced noise.
- C. Provide limited energy FPLP cable (plenum rated) run open in return air ceiling plenums provided cable is UL listed to UL Test 910 for such applications, is of the low smoke producing fluorocarbon type, and complies with NFPA 70, Article 760-4(d) if so approved by the local authority having jurisdiction. Support with J-hooks or D-rings with supports 5'-0" on center.
- D. Install all cable in conduit where exposed or in non-accessible ceiling plenums, chases and wall cavities.
- E. Connect all cable in a supervised fashion per NFPA requirements such that any wiring disarrangement will initiate the appropriate trouble signals via the main control panel per NFPA and UL requirements. Intelligent loops may be T-trapped/branch wired due to inherent dynamic supervision.
- F. Minimize wiring splices. Where required, make in designated terminal boxes or at field device junction boxes. Do not transpose color coded wiring.
- G. Label cable at terminations and pull boxes, junction boxes, and outlet boxes.

3.3 INSTALLATION

- A. Provide system grounding.

- B. Provide dedicated 20 amp, 120 volt circuits to control panel transponders, and remote power supplies.
- C. Provide interfaces to other systems and devices furnished under other divisions and sections.
- D. Provide the services of a manufacturer's representative to instruct Owner in the operations and maintenance of the systems.

3.4 INTERFACE WITH OTHER WORK

- A. Coordinate requirements surrounding installation of the fire alarm system with all trades including, but, not exclusive of the elevator system, electrical system, sprinkler system, and HVAC/controls system. Provide adequate coordination to insure proper installation and interface to all peripheral items required to interact with the fire alarm and communication system to provide a complete and functional life safety system.
- B. Central station connection and service provided by Owner.

3.5 FIELD QUALITY CONTROL

- A. Provide services of manufacturer's representative to instruct Owner's personnel in system operation and maintenance.
- B. Perform the final control panel connections and supervise testing of the system by a state licensed factory trained technical representative of the manufacturer. It shall be subject to the approval of the responsible engineer and owner. Upon completion of the acceptance tests, the owner and/or his representatives shall be instructed in the proper operation of the system.
- C. Functionally test each and every device for proper operation and response. Test each circuit in system for wiring supervision to insure proper wiring installation. Any items found not properly installed or non-functioning shall be replaced or repaired and retested. All testing shall be supervised by a licensed fire alarm superintendent.
- D. Provide complete written report on functional test of entire system. Test and report shall verify function of each device in system, operation of all auxiliary control functions, and proper operation of main fire alarm control panel. Provide copy of test report with maintenance manuals. Test report shall be signed and dated by licensed fire alarm superintendent responsible for supervising final system test and checkout.
- E. Test the system in presence of local authorities having jurisdiction.

END OF SECTION 283100

SECTION 337173 - ELECTRICAL UTILITY SERVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Furnish and install electrical service entrance, including:
 - 1. Arrangement with power company for permanent electric service.
 - 2. Secondary service entrance from power company.

1.2 SYSTEM DESCRIPTION

- A. System Voltage: 277/480 volts, three-phase, four-wire, 60 hertz.
- B. Service Entrance: Underground.

1.3 SUBMITTALS

- A. Submit product data.

1.4 QUALITY ASSURANCE

- A. Install service entrance in accordance with power company's rules and regulations.

PART 2 - PRODUCTS

2.1 METERING EQUIPMENT

- A. Coordinate with the power company and provide equipment, conduits, manholes and equipment pads in accordance with power company directives.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Make arrangements with the power company to obtain permanent electric service to the project.
- B. Provide primary service entrance conduits from power company terminations. Power company will connect conductors to transformer and provide primary cables.
- C. Provide secondary service entrance conduits and wire from power company transformer to building service entrance equipment.
- D. Provide conduit and wiring as directed by power company to remote location for meter.

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ELECTRICAL UTILITY SERVICES

END OF SECTION 337173