

STEEL BUILDING SYSTEMS - SECTION 13120

1.0 - GENERAL

1.1 Section Includes

- A. Pre-engineered building and components including the following:
 - 1. Structural steel frame.
 - 2. Roof covering system including exterior roof panels, panel attachments, sealants, mastics, trim and flashings.
- B. Roof accessories including the following:
 - 1. Roof curbs.
 - 2. Roof walkways.

1.2 Related Sections

- A. Section 03300 - Cast-in-Place Concrete: Foundations and anchor bolts.
- B. Section 08810 - Glass: Glass and glazing requirements for glazed openings.
- C. Section 09910 - Paints and Coatings: Finish painting of structural members, doors, roof curbs, and factory prime painted miscellaneous items.

1.3 References

- A. AAMA 101 - Voluntary Specification for Aluminum and Poly (Vinyl Chloride) (PVC) Prime Windows and Glass Doors; American Architectural Manufacturers Association.
- B. American National Standards Institute (ANSI):
 - 1. ANSI 156.2 - Bored and Preassembled Locks and Latches.
 - 2. ANSI 250.1 - Salt Spray Resistance: Acceptance Criteria for Prime Painted Steel Doors and Frames.
 - 3. ANSI 250.3 - Test Procedure and Acceptance Criteria for Factory Applied Finish Painted. Steel Surfaces for Steel Doors and Frames.
- C. ASTM International (ASTM):
 - 1. ASTM A 36/ASTM A 36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A 325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 3. ASTM A 490 - Standard Specification for Structural Bolts, Alloy Steel, Heat Treated, 150 ksi Minimum Tensile Strength.
 - 4. ASTM A 500 - Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 5. ASTM A 529/A 529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality.
 - 6. ASTM A 563 - Standard Specification for Carbon and Alloy Steel Nuts.
 - 7. ASTM A 572/A 572M - Standard Specification for High-Strength

- Low-Alloy Columbium-Vanadium Steel.
8. ASTM A 653/A 653M - Standard Specification for Steel Sheets, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
 9. ASTM A 792/A 792M - Standard Specification for Steel Sheet, 55 percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process.
 10. ASTM A 1011 - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy and High-Strength Low Alloy with Improved Formability.
 11. ASTM B 117 - Standard Practice for Operating Salt Spray (Fog) Apparatus.
 12. ASTM D 635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position.
 13. ASTM D 870 - Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.
 14. ASTM D 1737 - Method of Test for Elongation of Attached Organic Coatings with Cylindrical Mandrel Apparatus.
 15. ASTM D 1929 - Standard Test Method for Ignition Properties of Plastics.
 16. ASTM D 2244 - Standard Practice for Calculation of Color Tolerances and Color Differences from Instrumentally Measured Color Coordinates.
 17. ASTM D 2794 - Standard Test Method for Resistance of Organic Coatings to the Effects of Rapid Deformation (Impact).
 18. ASTM D 2843 - Standard Test Method for Smoke from the Burning or Decomposition of Plastics.
 19. ASTM D 4214 - Standard Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films.
 20. ASTM E 72 - Standard Test Methods of Conducting Strength Tests of Panels for Building Construction.
 21. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 22. ASTM E 96 - Standard Test Methods for Water Vapor Transmission of Materials.
 23. ASTM E 283 - Standard Test Method for Determining Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors Under Specified Pressure Differences Across the Specimen.
 24. ASTM E 774 - Standard Specification for Sealed Insulating Glass Units.
 25. ASTM E 1592 - Standard Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference.
 26. ASTM E 1886 - Standard Test Method for Performance of Exterior Windows, Curtain Walls, Doors, and Impact Protective Systems Impacted by Missile(s) and Exposed to Cyclic Pressure Differentials.
 27. ASTM G 23 - Practice for Operating Light-Exposure Apparatus (Carbon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials.
 28. ASTM G 26 - Practice for Operating Light-Exposure Apparatus (Xenon-Arc Type) With and Without Water for Exposure of Nonmetallic Materials.

D. AWS D1.1 - Structural Welding Code; American Welding Society.

- E. Factory Mutual (FM): Wind classification rating system.
- F. IAS AC472 International Accreditation Services.
- G. NAIMA 202 - Standard for Flexible Fiber Glass Insulation Used in Metal Buildings; North American Insulation Manufacturers Association.
- H. SDI 100 - Recommended Specifications for Standard Steel Doors and Frames; Steel Door Institute.
- I. UL 580 - Tests for Wind Uplift Resistance of Roof Assemblies; Underwriters Laboratories Inc.
- J. UL 723 - Standard for Test for Surface Burning Characteristics of Building Materials; Underwriters Laboratories Inc.
- K. MBMA: Metal Building Manufacturer's Association Design Practice Manual

1.4 Definitions

- A. Building Width: Measured from outside to outside of sidewall girts. Typically edge to edge of concrete.
- B. Building Length: Measured from outside to outside of end wall girts. Typically edge to edge of concrete
- C. Building Line: Outside face of steel/girt. (Wall Girts Assumed as 8.5")
- D. Building Eave Height: Measured from the top of the eave member at the outside of the sidewall girt line to the bottom of the sidewall column base plate or to finished floor if columns are on grout or recessed below finished floor.
- E. Bay Spacing: Measured from centerline to centerline of primary frames for interior bays and from centerline of the first interior frame to the center line of end wall girts for end bays. Verify dimension from centerline of endwall girt to edge of slab.
- F. Roof Pitch: The ratio of the vertical rise to the horizontal run (i.e. 1:12 = 1 inch of rise for every foot of horizontal dimension).

1.5 System Description

- A. General:
 - 1. Provide metal building frame, metal roof panels, accessories and miscellaneous materials for a complete enclosure including supports for building components specified in other sections.
 - 2. Design structural systems according to professionally recognized methods and standards and legally adopted building codes.
 - 3. Design under supervision of professional engineer licensed in the jurisdiction of the Project.
- B. Design Requirements:
 - 1. Roof pitch: 1:12.
 - 2. Dead loads, including the weight of all indicated permanent construction:

- a. Elements required for support of lights and light battens, hanging fixtures, mechanical equipment, piping, ceiling hanger wires, and all other items required to provide a complete building and not specifically indicated on the drawings.
- 3. Wind Loads:
 - a. Roof Wind Load: Calculate in accordance with applicable code, using 120 mph Basic Wind Speed.
 - b. SSR Roof System tested and certified to meet Factory Mutual FM wind classification rating for the regional requirements and complying with the 2021 IBC.
 - c. SSR Roof System tested and certified to meet Underwriters Laboratories UL wind uplift rating for the region as required by the 2021 IBC.
 - 1) Panels tested in accordance with U.S. Corp of Engineers ASTM E 1592.
 - 2) Panel fastening meeting uplift requirements based on tested fastener values with appropriate Safety Factors.
 - 3) Purlin strength with SSR roof panel determined and tested in accordance with AISI procedures.
- C. Performance Requirements:
 - 1. System to withstand gravity and lateral loads in compliance with contract documents.
 - 2. Refer to contract drawings for additional concentrated loads to pre-engineered building hanger beams and support jacks.
 - 3. Allowable Deflections: Deflection/drift criteria shall follow recommendations outlined in AISC Design Guide 3 and MBMA Serviceability recommendations.
 - 4. Construct assembly to permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects, when subject to temperature range of 100 degrees F (37 degrees C) in a 24 hour period.
 - 5. Design and fabricate roof systems free of distortion or defects detrimental to appearance or performance. Some oil canning in rolled panels especially in the flats of the panel is normal and is not cause for rejection.
- D. Serviceability Criteria: Deflection limits for major components based on VP Buildings standards unless otherwise noted. Deflection requirements on hangars with sliding or fabric doors need to be included for the door support frames both from dead load deflection in inches and uplift deflection in inches. This may differ from the building due to the specific door requirements and should be supplied to eliminate future deflection issues.

1.6 Submittals

- A. Submit under provisions of Section 01350.
- B. Design Data: Provide detailed design criteria and calculations prepared by a licensed structural engineer.
- C. Certification: Manufacturer certification that the building conforms to the contract documents and manufacturer's standard design procedures.

- D. Shop Drawings: Show building layout, primary and secondary framing member sizes and locations, cross-sections, and product and connection details.
 - 1. Anchor Bolt Installation Drawings: Layouts with minimum bolt diameters (anchors are typically by others in the metal building industry).
- E. Product Data and Information on manufactured products to be incorporated into the project.
- F. Selection Samples: For each finish product specified, two complete sets of color chips representing manufacturer's full range of available colors and patterns.
- G. Verification Samples: For each finish product specified, two samples, minimum size 6 inches (150 mm) square, representing actual product, color, and patterns.
- H. Certificates: Welder certifications

1.7 Quality Assurance

- A. Manufacturer Qualifications: Not less than 5 years experience in the actual production of specified products.
 - 1. Member of the Metal Building Manufacturer's Association (MBMA).
 - 2. Primary manufacturer of frames, secondary steel, roof and wall sheeting, and trim.
- B. Installer Qualifications - Firm experienced in application or installation of systems similar in complexity to those required for this project, plus the following:
 - 1. Acceptable to or licensed by manufacturer. (Provide documentation prior to start of work)
 - 2. 3 years experience with systems. (Minimum)
 - 3. Successfully completed not less than 5 comparable scale projects using this system.
- C. Mock-Up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
 - 1. Finish areas designated by Architect.
 - 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 - 3. Refinish mock-up area as required to produce acceptable work.

1.8 Delivery, Storage, And Handling

- A. Store products in manufacturer's unopened packaging until ready for installation.
- B. Store and dispose of solvent-based materials, and materials used with solvent-based materials, in accordance with requirements of local authorities having jurisdiction.

1.9 Project Conditions

Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products

under environmental conditions outside manufacturer's absolute limits.

1.10 Warranty

- A. Manufacturer shall warranty installed system for the periods described herein, starting from Date of Substantial Completion against all the conditions indicated below. When notified in writing from Owner, manufacturer/installer shall, promptly and without inconvenience and cost to Owner, correct said deficiencies.
 - a. No Dollar Limit (NDL) Weathertight Endorsement: Warranty Period: 20 years.
 - 2. Finish Warranty:
 - a. Finish coating shall not peel, blister, chip, crack or check in finish, and shall not chalk in excess of 8 numerical ratings when measured in accordance with ASTM D 4214.
 - b. Finish coating shall not change color or fade in excess of 5 NBS units as determined by ASTM D 2244.
Panel finish Warranty: 25 years.
 - 3. Performance Warranty: Furnish written warranty, stating metal roofing system and flashing (flashing under premium warranty only) under this Section will be maintained in watertight condition and defects resulting from the following items will be corrected without cost to Owner for a period of 20 years.
 - a. Faulty workmanship.
 - b. Defective materials including sealants and fasteners.
 - c. Water infiltration.
- B. **Standard manufacturer's roofing guarantees (or warranties) which contain language regarding the governing of the guarantee (or warranty) by any state other than the State of Alabama, must be amended to exclude such language, and substituting the requirement that the Laws of the State of Alabama shall govern all such guarantees (or warranties).**

2.0 - PRODUCTS

2.1 Manufacturers

- A. Acceptable Manufacturer: Varco Pruden Buildings (Basis of Design) or pre-approved equal
- B. Requests for substitutions will be considered in accordance with provisions of Section 01360.

2.2 Structural Steel Framing

- A. Primary Framing: Rigid Frame (RF Series) solid web framing consisting of tapered or uniform depth rafters rigidly connected to tapered or uniform depth columns. Provide a span that supports the loads at bay spacing indicated. Frames can have a roof pitch as low as 1/2:12 and span can typically range from 30 feet to 300 feet (9.14 m to 91.5 m) in increments of 1/16 inch (1.6 mm) spacing, with the steel yield of 55 ksi.
- B. End Wall Framing: Corner posts, end posts and rake beams.

- C. End Wall Framing: Half-loaded full frames.
- D. End Wall Framing: Full frames with end posts, for future expansion.
- E. Steel Surface Preparation: SSPC-SP 2.

2.3 Secondary Framing

- A. Purlins: Zee-shaped; depth as required; with minimum yield strength of 60,000 psi (410 MPa); simple span or continuous span as required for design. G-30 galvanized standard material with G-90 availability. Welded members are manufacturer's standard primer.
 - 1. Purlin Size: as required.
- B. Girts: Zee- or Cee-shaped; depth as required, with minimum yield strength of 60,000 psi (410 MPa); simple span or continuous span as required for design. G-30 galvanized standard material with G-90 availability. Welded members are manufacturer's standard primer.
 - 1. Girt Size: 8.5 inches (216 mm).
- C. Transbay Members: Bar joist, parallel chord, secondary joists; simple span, utilizing materials, sizes and yield strength as required.
- D. Wind Bracing: Portal, torsional, diagonal bracing or diaphragm in accordance with manufacturer's standard design practices; utilizing rods, angles, and other members, with minimum yield strengths as required for design but in most cases, 50 ksi.
- E. Primary Frame Flange Bracing: Attached from purlins or girts to the primary framing, minimum yield strength as required for design but in most cases 60 ksi.
- F. Truss Purlins: Truss purlins are used as roof secondary structurals when bay spacing exceeds the limits of standard zee purlins . They are constructed of cold-formed lipped hat section chords and continuous, cold-formed round tubing diagonals .
 - 1. Truss purlin span range is a minimum of 14 feet 6 inches (4267 mm) up through 60 feet 0 inches (18288 mm) inclusive.
 - 2. Truss purlins are available in two member depths: 20.5 inches (520 mm) and 29.5 inches (749 mm).
 - 3. Truss Purlins are available in two end seat heights: 2.5 inches (63 mm) and 8.5 inches (316 mm).
 - 4. Roof slope: 1/4:12 thru 5/8:12.

2.4 Miscellaneous Framing

- A. Base Angles: 2 inch by 3 inch by 0.060 inch (50 mm by 75 mm by 1.5 mm) galvanized steel angles, with minimum yield strength of 55 ksi (380 MPa), anchored to the floor slab or grade beam with power driven fasteners or equivalent at a maximum spacing of 4 feet (1220 mm) on center and not more than 6 inches (150 mm) from the end of any angle member. Anchors are not provided by the metal building manufacturer.
- B. Door Headers and Jambs: Zee- or Cee-shaped; depth as required; with minimum yield strength of 60 ksi (410 MPa).

2.5 Roof Covering System

- A. Roof Panels: SSR Standing Seam Roof Panels; 24 inches (610 mm) wide

net coverage, with 3 inches (75 mm) high major ribs formed at the panel side laps, formed for field seaming using electrically operated seaming machine.

1. Side joints: Factory applied sealant for field seaming.
2. Material: Galvalume steel -Thickness: 24 gage.
3. Standard Roof pitches ranges from 1/4 inch (6 mm):12 up to 4 inches (102 mm):12
4. Side laps: Two factory-formed interlocking ribs, with one weather sealed joint, field-seamed into place to form a double-fold 360 degree seam.
5. Length: Continuous from eave to ridge up to 52 feet (15.9 m) in length.
6. End laps, where required: 4 inches (102 mm) wide, located at a support member.
7. Panel-to-roof purlin structural attachments: SSR clips with movable tabs which interlock with seamed SSR panel ribs and provide for 1-5/8 inches (41 mm) of panel movement in either direction from center of clip to compensate for thermal effects.
8. Rake edge of roof shall be attached to the building structure in a manner which will allow thermal expansion of the SSR roof panels along the gables and will provide the uplift resistance required by code.
9. SSR roof will meet the requirements for UL Class A wind uplift for the region as required by the 2021 IBC. Certification includes IAS.
10. The KXL paint system is a PVDF finish applied to the galvalume surface to give a long life color that resists fading and chalking. KXL is a 1 mil nom. PVDF finish with 70 percent Kynar 500 or Hylar 5000 standard.
11. Exposed fasteners are stainless steel capped painted to match the selected color from the VP color chart or special ordered if a special color roof is provided

2.6 Insulation

- A. Schedule:
 1. Roof insulation: Refer to Section 07213
- B. Thermal Blocks: High density, 3/4 inch (19 mm) thick expanded polystyrene, for installation over the purlin.
- C. Thermal Blocks: Superblock; 1 inch by 3-1/2 inch (25 mm by 89 mm) extruded polystyrene thermal spacer strips capped by 22 gage (0.76 mm) galvanized channels, with swaged end for interconnection along the purlin run, metal tabs at 2 feet (610 mm) on center at SSR clip locations, and pre-punched fastener holes.
 1. Sky-Web II: Superior fall protection and insulation support for pre-engineered buildings.
 - a. The Sky-Web II system has a flame spread index of 3 or less and a smoke developed index of less than 10 as tested in accordance with U.L. 723.
 - 1) The system is compatible with all VP framing systems.
 - 2) The system should be ordered so splices are made at the frame lines.
 - b. The basic mesh is knotted mesh on a 2.75 inch x 2.75 inch grid. The mesh is made from twisted twine of DuPont

- nylon type 6-6 fiber. The mesh covering the interior bays is made from #21 twine.
- c. The mesh has double selvage along the two edges in the machined direction.

2.8 Roof Accessories

- A. Eave Gutters: Roll-formed 26 gage (0.45 mm) steel sheet, with gutter straps, fasteners and joint sealant; manufacturer's standard color.
1. Downspouts: 29 gage 8 inches by 8 inches in 10 foot lengths, with downspout elbows and downspout straps; same color as wall panels unless specified otherwise.
- B. Roof Curbs: Welded units fabricated for shingled installation with roof panels; minimum 18 gage (1.22 mm) Galvalume coated steel, with welds cleaned and treated with protective coating compatible with the Galvalume substrate.
1. Top of curbs horizontal with 1-1/2 inch (38 mm) perimeter flange.
2. Curb walls insulated with 1-1/2 inch (38 mm), 3 pcf (48 kg/cu m) density rigid glass fiber insulation.
3. Water diversion: Integral 4 inch (102 mm) high by full length cricket on upslope side.
4. Exposed curb flanges pre-drilled for correct fastener locations.
5. Upslope and down slope curb flanges with integral welded inside and outside cell closures compatible with the roof panel profile.
6. Curb framing: Mounted on secondary structural members and installed from the top; compatible with the thermal expansion and contraction properties of the roof on which it is used.
7. Opening size: As indicated on drawings.
8. Roof Access Hatch: Manufacturer's standard 30 by 36 inch (762 by 914 mm) opening, with curb.
9. Curbs for SSR Roof panels: Concealed fastener.

2.9 Materials

- A. Structural Steel Plate, Bar, Sheet, and Strip for Use in Bolted and Welded Constructions: ASTM A 572/A 572M, A 529/A 529M, A 1011 or A 36/A 36M Modified 50, with minimum yield strength of 55,000 psi (380 MPa).
- B. Galvanized Structural Steel Material for Use in Roll Formed or Press Broken Secondary Structural Members: ASTM A 563, with minimum yield strength of 60,000 psi (410 MPa).
- C. Galvanized Steel Sheet for Roll Formed or Press Broken Roof and Wall Coverings, Trim and Flashing: ASTM A 653/A 653M, with minimum yield strength of 50,000 psi (345 MPa).
- D. Galvalume Steel Sheet Used in Roll Formed or Press Broken Roof Covering: Aluminum-zinc alloy-coated steel sheet, ASTM A 792/A 792M, with minimum yield strength of 50,000 psi (345 MPa); nominal coating weight of 0.5 oz per sq. ft. (152 kg/sq. m) both sides, equivalent to an approximate coating thickness of 0.0018 inch (0.05 mm) both sides.
- E. Hot Rolled Steel Shapes: W, M and S shapes, angles, rods, channels and other shapes; ASTM A 500, ASTM A 572/A 572M or ASTM A 36/A 36M as applicable; with minimum yield strengths required for the design.

- F. Structural Bolts and Nuts Used with Primary Framing: High strength, ASTM A 325 bolts and ASTM A563 Grade C nuts.
- G. Bolts and Nuts Used with Secondary Framing Members: High Strength ASTM A 325 Bolts and ASTM A 563 Grade C nuts.
- H. Panel Fasteners:
 - 1. For Galvalume and KXL finished roof panels: Stainless steel-capped carbon steel fasteners with integral sealing washer.
 - 2. Concealed Fasteners: Self-drilling type, of size as required.
 - 3. Provide fasteners in quantities and location as required by the manufacturer.
- I. Flashing and Trim: Match material, finish, and color of adjacent components. Provide trim at rakes, including peak and corner assemblies, high and low eaves, corners, bases, framed openings and as required or specified to provide weathertightness and a finished appearance.
- J. Plastic Parts: Glass fiber reinforced resin or thermoformed ABS (Acrylonitrile-Butadiene-Styrene).
 - 1. ABS: Minimum 1/8 inch (3 mm) thick.
 - 2. Color: Manufacturer's standard color.
- K. Sealants, Mastics and Closures: Manufacturer's standard type.
 - 1. Provide at roof panel end laps, side laps, rake, eave, transitions and accessories as required to provide a weather resistant roof system; use tape mastic or gun grade sealant at side laps and end laps.
 - 2. Provide at wall panel rakes, eaves, transitions and accessories.
 - 3. Closures: Formed to match panel profiles; closed cell elastic material, manufacturer's standard color.
 - 4. Tape mastic: Pre-formed butyl rubber-based, non-hardening, non-corrosive to metal; white or light gray.
 - 5. Gun grade sealant: Non-skinning synthetic Elastomeric based material; gray or bronze.

2.10 Fabrication

- A. Fabrication: Fabricate according to manufacturer's standard practice.
 - 1. Fabricate structural members made of welded plate sections by jointing the flanges and webs by continuous automatic submerged arc welding process.
 - 2. Welding operators and processes: Qualified in accordance with AWS D1.1.
 - 3. Field connections: Prepare members for bolted field connection by making punched, drilled, or reamed holes in the shop.
- B. Component Identification: Mark all fabricated parts, either individually or by lot or group, using an identification marking corresponding to the marking shown on the shop drawings, using a method that remains visible after shop painting.

2.11 Finish

- A. Schedule of Finishes:
 - 1. Roof finish and color: To be selected.
 - 2. Soffit panels finish and color: To be selected.
- B. Shop Coat: Manufacturer's standard rust inhibitive primer paint; manufacturer's standard color.
 - 1. Finish all structural steel members using one coat of manufacturer's standard shop coat, after cleaning of oil, dirt, loose scale and foreign matter.

- C. KXL Pre-Painted Finish: 1 mil (0.025 mm) 70 percent Kynar 500, Hylar 5000 coating on exterior surface.
 - 1. Color: Interior Finish: Off white 0.5 mil (0.01 mm) washcoat.

3.0 - EXECUTION

3.1 Examination

- A. Verification of Conditions: Examine areas and conditions under which work is to be performed and identify conditions detrimental to proper and or timely completion.
 - 1. Verify foundations are properly installed, to correct dimensions and within acceptable tolerances.
 - 2. Verify location of covered or built-in work.
 - 3. Do not proceed until unsatisfactory conditions have been corrected.

3.2 Preparation

- A. Framing Erection: Erect framing in compliance with AIS Specification and the latest edition of the MBMA metal building systems manual.
- B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as required by manufacturer.

3.3 Erection Of Frame

- A. Install in accordance with manufacturer's instructions.
- B. Do not erect frames without complete installation of tie beams and anchorages.
- C. Set column base plates with non-shrink grout to full plate bearing.
- D. Do not field cut or alter structural members without written approval.
- E. After erection, prime bolts, welds, abrasions, and surfaces not primed with primer used in shop painting.

3.4 Installation Of Roof System

- A. Install in compliance with manufacturer's instructions.
- B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
- C. Fasten cladding system to structural supports, aligned level and plumb.
- D. Locate end laps over supports. End lap panels according to manufacturer's recommendations. Place sidelaps over adjacent panel and mechanically seam or stitch fastener per erection guidelines.
- E. Provide expansion joints where indicated and/or required.
- F. Use concealed fasteners.
- G. Install sealant and gaskets to prevent weather penetration.

- H. Install system free of rattles, noise due to thermal movement, and wind whistles.
- I. Install gutter system in compliance with manufacturer's instructions.
- J. Seal wall and roof accessories watertight and weathertight with sealant in compliance with building manufacturer's standard procedures.
- K. Rigidly support and secure gutters and downspouts. Joint lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
- L. Tolerances:
 - 1. Framing Members: 1/4 inch (6 mm) from level; 1/8 inch (3 mm) from plumb.
 - 2. Racking: 1/8 inch (3 mm) from true position. Provide shoring to maintain position prior to cladding installation.

3.5 Field Quality Control

- A. Testing by Contractor:
 - 1. Roof installation inspection by roof manufacturer's representative; as required as part of warranty provision.
- B. Testing by Owner:
 - 1. High Strength Bolted Connections: Specification for Structural Joints Using ASTM A 325 or A 490 Bolts, with minimum testing of bolted connections per the arbitration inspection procedure.
 - 2. Welded Connections: AWS. Visual inspection of 100 percent of welds. Ultrasonic inspection of 50 percent of full and partial penetration welds. A rejection rate greater than 5 percent will increase the inspection to 100 percent.
 - 3. General Testing: For materials and installed tolerances.

END OF SECTION

SECTION 15000 – HVAC

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SECTION 15010 – General Provisions

PART 1 – GENERAL

1.1 SCOPE

- A. HVAC means Heating, Ventilation and Air Conditioning.
- B. Provisions of this Section apply to all HVAC and Building Management and Control System (BMCS) work.
- C. Include the provisions of General, Supplementary and Special Conditions and provisions of the Specifications shall apply to and form a part of this Section.
- D. Provide all labor, materials, equipment, and services necessary for the completion of all HVAC work shown or specified, except work specifically specified to be done or furnished under other sections of the Specifications. Include performing all operations in connection with the complete HVAC installation in strict accordance with the specification and applicable drawings subject to the terms and conditions of the Contract.
- E. Give required notices, file drawings, obtain and pay for permits, deposits and fees necessary for the installation of the HVAC work. Obtain and pay for inspections required by laws, ordinances, rules, regulations or public authority having jurisdiction. Obtain and pay for certificates of such inspections, and file such certificates with Owner.
- F. "Provide" means to furnish and install, complete and ready for operation.
- G. All equipment shall be U.L. or E.T.L. Listed as an assembly.

1.2 DRAWINGS:

- A. HVAC Drawings are diagrammatic and subject to requirements of Architectural Drawings. HVAC Drawings indicate generally the location of components and are not intended to show all fittings or all details of the work. Coordinate with Architectural, Structural, Electrical, Plumbing and other Building Drawings.
- B. Follow the Drawings closely, check dimensions with Architectural Drawings and field conditions. DO NOT scale HVAC Drawings for location of system components.
- C. Make no changes without Architect's written permission. In case of doubt, obtain Architect's decision before proceeding with work. Failure to follow this instruction shall make the Contractor liable for damage to other work and responsible for removing and repairing defective or mislocated work.
- D. Do not scale Drawings to locate ceiling diffusers. Coordinate with lighting, ceiling grids and/or reflected ceiling plans.

1.3 APPLICABLE CODES AND STANDARDS:

- A. Comply with the current editions of the following Codes and Standards:
 - 1. ANSI/ASHRAE 15 - Code for Building Services Piping.
 - 2. ANSI B9.1 - Safety Code for Mechanical Refrigeration.
 - 3. NFPA 99 - Health Care Facilities.

3. NFPA 70 - National Electrical Code.
4. NFPA 90A - Air Conditioning and Ventilating Systems.
5. NFPA 91 - Blower and Exhaust Systems.
6. NFPA 101 - Life Safety Code.
7. Other Standard as referenced in other Sections of Divisions 15.
8. Local Building Code (International Building Code if no local Building Code in effect).
9. Local Plumbing Code (International Plumbing Code if no local Plumbing Code in effect).
10. Local Gas Code (International Gas Code if no local Gas Code in effect).
11. Local Mechanical Code (International Mechanical Code if no local Code in effect).

1.4 QUALIFICATIONS OF SUBCONTRACTOR:

- A. The HVAC Contractor shall meet the following qualifications:
1. The HVAC Contractor must be approved by the Architect.
 2. The HVAC Contractor shall have been in business as a HVAC Contractor for at least three (3) years prior to Bid Date.
 3. The HVAC Contractor shall have a satisfactory experience record with HVAC installations of character and scope comparable with this project and have completed five projects of the same cost (or more) as the cost of this project, and for at least three (3) years prior to the Bid Date shall have had an established service department capable of providing service inspection or full maintenance contracts.
 4. Contractor must have bonding capacity for project of this size and must bond the project.

1.5 CONFLICTS AND INTERFERENCES:

- A. If systems interfere or conflict, the Architect shall decide which equipment to relocate regardless of which was first installed.

1.6 WORKMANSHIP:

- A. Do all work in a neat and first-class manner. Remove and replace work not done in such manner as directed by the Architect.

1.7 COOPERATION:

- A. Cooperate with all other crafts. Perform work in a timely manner. Do not delay the execution of other work.

1.8 VISITING SITE:

- A. Visit site and become familiar with location and various conditions affecting work. No additional allowance will be granted because of lack of knowledge of such conditions.

1.9 SCHEDULED WORK HOURS AND FACILITY OCCUPANCY:

- A. Schedule all connections to existing systems and shutdowns with the Architect/Owner.

PART 2 - PRODUCTS

2.1 MATERIALS, SUBSTITUTIONS AND SUBMITTALS:

- A. Unless otherwise noted, provide new, standard, first-grade materials throughout. Equipment and materials furnished shall be fabricated by manufacturer regularly engaged in their production and shall be the standard and current model for which replacement parts are available. HVAC equipment shall be substantially the same equipment of a given manufacturer which has been in successful commercial use and operation for at least three (3) years.
- B. Where materials or products are specified by manufacturer's name, brand, trade name, or catalog reference, such named materials or products shall be the basis of the Bid, without substitution, and shall be furnished under the Contract unless requests for substitutions are approved as noted below. Where two or more brands are named the choice of these shall be optional with the Contractor.
- C. Substitutions will be considered only if written request for approval has been received by the Architect ten (10) days prior to the date established for receipt of Proposals. Each request shall include the name of the material or equipment for which substitution is proposed, specification section/paragraph number and a complete description of the proposed substitute including drawings, cuts, performance and test data, samples and any other information necessary for evaluation. A statement setting forth any changes in other materials, equipment or other Work that incorporation of the substitute may require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution is final.
- D. If the Architect approves any proposed substitution prior to receipt of Proposals, approval will be set forth in an Addendum. Do not rely upon approvals made in any other manner. Prior approval to be secured for "equal" or "approved equal" manufacturer.
- E. No substitutions will be considered after the Contract has been executed, except as described in the General Conditions.
- F. Submittal data and shop drawings, except controls, shall be submitted at one time, partial submittals will not be considered. Provide submittal in three (3) ring binders with tab sheets for each major item of equipment. Before ordering materials and equipment, submit to Architect and obtain his approval of a detailed list showing each item which is to be furnished by make, trade name, catalog number, or the like; together with manufacturer's specifications, certified prints, and other data sufficient for making comparisons with items specified. When approved, such schedule shall be of equal force with these specifications in that no variation there from shall be allowed except with Architect's written approval. Number of Shop Drawings and procedure shall be as directed by the Architect.
- G. Architect and / or Engineer's approval of submittal data does not relieve the contractor of his responsibility to comply with the contract documents.

- H. It is the responsibility of the Mechanical contractor to coordinate all Electrical requirements of the submitted equipment with the Electrical contractor. Any increase in cost due to a variance between the contract documents and the submitted equipment shall be the responsibility of the Mechanical Contractor.
- I. All pressure vessels shall be constructed and tested in accordance with applicable ASME Codes and shall bear ASME stamps. Certificates of inspection and approval shall be submitted to Architect.
- J. Similar items of equipment shall be the product of the same Manufacturer.
- K. See section, "ALTERNATES" in other section of the Specifications and Bid accordingly.

2.2 SHOP DRAWINGS:

- A. Before starting work, submit and obtain approval of detailed drawings of the following, fully dimensioned (including elevations of ductwork and piping) and drawn not less than 1/4"= 1'-0" scale. Submit one (1) set of paper or bond.
 - 1. Ductwork (do not scale diffuser locations, coordinate with ceiling grids and lighting layout). See Section 15860 "DUCT ACCESSORIES".
 - 2. Plenum casings.
 - 3. Complete mechanical equipment and fan room plans showing location of equipment, conduit stubs for motors, floor drains, and equipment pads and foundations.
 - 4. Equipment piping.
- B. Submit complete control and power wiring diagrams for approval before installing controls. See Section 15900 "CONTROLS".

2.3 RECORD DRAWINGS:

- A. When work starts, obtain white prints of the HVAC Drawings. All corrections, variations, and deviations, including those required by change orders, if any, must be recorded in colored ink or colored pencil at the end of each working day on these drawings. The marked prints shall be available at all times for the Architect's inspection.
- B. Prior to examining the request for final payment or making any response thereto, the Architect shall receive from the Contractor one (1) complete set of the white prints, marked as stated above, indicating the actual completed installation of the work included under this Contract.
- C. The Architect will forward the marked white prints to the Consulting Engineers for review. They will then be returned by the Architect to the Contractor for use in preparing record drawings.
- D. When work is completed Contractor shall purchase from the Architect (At Architects' printing cost) one (1) set of mylar reproducible prints of HVAC Drawings for use in preparing record drawings. Contractor shall transfer the information from the marked white prints to the mylar record drawings, removing all superseded data in order to show the actual completed conditions.
 - 1. Accurately shown location, size and elevation of new exterior piping work and its relationship to any existing piping and utilities, obstructions, etc., contiguous to

the area of work.

2. Block out areas modified by change-order and identify them by change-order number.
- E. Ductwork and Control Drawings may be a set of mylar reproducible shop drawings, up-dated to show actual conditions at completion of work.
- F. HVAC piping drawings may be prepared as noted in paragraph "D" above, or HVAC piping may be added to the ductwork shop drawings as noted in paragraph "E" above.

2.4 MOTORS, STARTERS AND ELECTRICAL EQUIPMENT:

- A. Provide electrical equipment compatible with the current shown on electrical drawings. Verify current characteristics before ordering equipment.
- B. Should the Contractor with the Architect's and Engineer's approval make changes in electrical equipment from those shown on the Electrical Drawings, he shall be responsible for the coordination and cost of required changes.
- C. Provide factory installed fuses in all equipment requiring fusing for branch circuit protection.
- D. Motors:
 1. 1750 RPM open drip-proof construction unless otherwise shown or specified. Integral horsepower three phase motors shall be of premium energy-efficient design with apparent efficiency (power factor X efficiency) not less than ASHRAE 90.1.
 2. All motors served by variable frequency drives (VFD's) shall be inverter duty rated.
 3. Unless shown otherwise motors less than 1/2 HP shall be single phase, motors 1/2 HP and larger shall be three phase.
 4. Allis-Chalmers, General Electric, Goulds, Louis Allis, and Westinghouse.
- E. Do not run motors until correct overload elements are installed in starters. Trading overload elements for elements of correct size for motors actually furnished shall be included in this Section.
- F. Starters shall be in motor control centers, furnished mounted on packaged equipment or furnished in this section and installed under "ELECTRICAL SECTION" as indicated and/or shown on the Electrical Drawings. All starters furnished with fused control circuit transformers.
- G. Starters shall be equipped with melting alloy terminal overload protection, in a 3 phase. Starters, unless indicated otherwise, shall be across-the-line type with overload and low voltage protection. Starting equipment shall comply with local utility company requirements.
- H. Starters to be Square "D", Allen-Bradley, Cutler-Hammer or approved equal.
- I. For single phase motors provide manual starters equal to Square "D" Class 2510. When installed in equipment rooms provide surface mounted enclosure, and when installed in finished walls outside equipment rooms provide flush mounted enclosure, key operated.

- J. Key operated manual starters with Flush enclosures, equal to Square "D" Class 2510.
- K. For three phase motors, provide magnetic line voltage starters with NEMA I enclosures and melting alloy overload elements.
- L. Provide H-O-A switches, fused control circuit transformers, auxiliary contacts, etc., as shown on control diagrams or required by control sequences and/or arrange for these items to be furnished with the starters or motor control centers specified in Electrical Work.
- M. All starters shall be by the same manufacturer.
- N. Provide thermal overload with equipment for motors 1/2 HP and less at 120/1/60.

2.5 SLEEVES:

- A. For pipe through floors inside rated chases or through non-fire-rated walls: 20 gauge galvanized steel, 1/2" larger than pipe or covering.
- B. For uninsulated pipe through fire rated walls or partitions or floors outside chases: Pipe Shields, Inc., Model WFB or approved equal at walls, Model DFB at floors.
- C. For insulated pipe passing through fire rated partitions or walls or floors outside chases: Pipe Shields, Inc., Model WFB-CS for hot lines, VFB-CS-CW for cold lines. Insulation: Calcium silicate for hot lines and foamglass for cold lines, thickness specified for adjacent pipe covering.
- D. For pipe through concrete beams: Schedule 40 black steel pipe, 1/2" larger than pipe or covering. Pipe covering passing through sleeve: calcium silicate in a 24 gauge galvanized steel shield similar to Pipe Shields, Inc. thermal hanger shield. Caulk space between bare pipe insulation jacket and beam with fire retardant rope at both ends of the sleeve and seal with 3M Brand fire barrier caulk CD 25 or Putty 303, thickness and application in strict accord with manufacturer's recommendations, minimum thickness 1".
- E. At Contractor's option, instead of the factory fabricated sleeves specified above for pipe passing through floors and fire rated walls and partitions substitute 20 gauge galvanized steel sleeve 1/2" larger in diameter than pipe or pipe covering and seal one end of sleeve (both ends if both ends are exposed) with 3M Branch Fire Barrier Caulk CP25 or Putty 303, thickness and application in strict accord with manufacturer's recommendations, minimum thickness 1". Where pipe is insulated, insulation shall be continuous thru sleeve, calcium silicate for hot lines and foamglass for cold lines. In exposed areas, after product has dried it shall be sanded smooth for painting under painting section.
- F. Set sleeves before concrete is poured or masonry is erected. In existing construction, grout sleeves firmly in place.
- G. Sleeves for ducts: See Fire Dampers (See Section 15860 "DUCT ACCESSORIES").
- H. Extend sleeves 1-1/2" above finish floor and waterproof.
- I. Where exposed ducts pass through walls and partitions, provide 4" wide 20 gauge galvanized steel closure plates except at grilles and registers. Fit closure plates snugly to duct and secure to wall. Grout around ducts and sound absorbers at equipment room walls.

- J. Where exposed pipes pass through walls and partitions in finished spaces, provide chrome plated F & C plates or escutcheons.

2.6 ACCESS DOORS:

- A. Doors in non-fire rated walls and ceilings: 17-gauge steel with hinges and screwdriver latches, Bilco, Milcor, Miami-Carey, or equal. Doors in fire rated walls and ceilings: UL labeled with fire rating equal to fire rating of wall or ceiling. Provide door styles compatible with adjoining surfaces as selected by Architect. Size doors to permit removal of equipment and/or maintenance, minimum size 18" X 18".
- B. Mark lay-in ceilings with paper brads at maintenance access points. Bend ends of brads over above ceiling tile.

PART 3 – EXECUTION

3.1 PROTECTION OF ROTATING PARTS:

- A. Equip exposed belt drives with belt guards with holes for measuring speeds of driven shafts.
- B. Provide exposed couplings with coupling guards.
- C. Equip propeller fans with guards.
- D. Equip inlets and outlets of open centrifugal fans with 1-1/2" #10 Diamond mesh galvanized steel screens.
- E. All motors or other equipment exposed to weather shall be provided with weatherproof covers.

3.2 PROTECTION OF EQUIPMENT:

- A. During construction, protect mechanical equipment from damage or deterioration.
- B. When installation is complete, clean equipment and make ready for painting.
- C. During construction all ductwork, piping, and equipment shall be stored in a clean/dry location. Any ductwork or piping stored outside that is not protected shall be removed from the job site. Installed ductwork and piping shall have open ends covered at the end of each work day to prevent dust, dirt, and water from entering the ductwork and piping.

3.3 INSTALLATION OF EQUIPMENT:

- A. Install equipment to provide normal service access to all components.
- B. Provide sufficient space for removing components, install equipment to provide such clearance.
- C. Install equipment in accordance with manufacturer's instructions. If manufacturer's instructions conflict with contract documents, obtain Architect's decision before proceeding.
- D. All equipment shall be firmly fastened in place:
 - 1. Roof curbs shall be secured to deck and structure and curb mounted items shall be secured to curbs.

2. Pad mounted equipment shall be secured to pads using poured in place anchor bolts or cinch anchors.
3. Vibration isolators shall be secured to floors, pads or structure and equipment shall be bolted to the isolators.

3.4 EQUIPMENT SUPPORTS:

- A. Provide supports for ductwork, piping and equipment. Hot dip galvanize after fabrication all grillage, supports, etc., located outdoors.
- B. Set all floor-mounted equipment, other than condensate pumps, on concrete pads or rails (as indicated of height shown, but not less than 4" high). Coordinate pad height with condensate drain trap requirements. Chamfer rails and pads 1". Where shown, provide reinforced floating pads mounted on vibration isolators. Form, reinforce and pour any pads and rails required but not shown on Structural and Architectural Drawings.

3.5 CUTTING AND PATCHING:

- A. Set sleeves and inserts and lay-out and form openings in walls, beams, girders and structural floors in this Section.
- B. Cut, patch and repair as required to accomplish HVAC Work and finish to match adjacent work. Architect's approval required before cutting any part where strength or appearance of finished work is involved.

3.6 INCIDENTAL WORK:

- A. Provide all motors incidental to the Mechanical Systems. Wiring of motors, switches and starters is included in "ELECTRICAL SECTIONS".
- B. Do all control wiring required for Mechanical work.
- C. Provide motor starters as specified above.
- D. Submit refrigerant piping diagrams as prepared by the HVAC Contractor and/or refrigeration equipment manufacturer for approval.
- E. Final water connections to services are included in this Section.
- F. Permanent drain connections for AC units, etc., and auto air vents to nearest floor drain are included in this Section.
- G. Outside air intakes shall be a minimum of 6'-0" above grade or 3'-0" above roof.
- H. Door louvers are not included in this Section.
- I. Items obviously omitted from drawings and/or specifications shall be called to attention of the Architect prior to submitting Bid, after award of Contract any changes or rearrangements necessary to complete Contract shall be at no additional cost to Owner.
- J. All return air and exhaust air grilles shall be covered with filter media if they are started and operated during construction.

3.7 FLASHING:

- A. General: Furnish all fans curbs, pitch cups, metal base flashing and counter flashing required for HVAC Work. Installation of above items is specified in "ROOFING SECTION" with coordination by HVAC Contractor.
- B. Fan curbs for power roof ventilators are specified with the fans.
- C. Pitch Cups: 20 gauge galvanized steel, at least 8" deep, bases mitered and soldered and extending at least 4" horizontally.
- D. Metal Base Flashing: Galvanized steel for ferrous items, and stainless steel for stainless steel duct and aluminum for aluminum duct. Minimum thickness 22 gauge (0.034") galvanized steel, 20 gauge (0.038") stainless steel, 0.032" aluminum. Bases mitered and soldered extending out at least 4" horizontally and 8" vertically.
- E. Metal Counter Flashing: Of material and gauges specified for base flashing, lapping base flashing at least 3".

3.8 EXCAVATION AND BACKFILLING:

- A. Include all excavation and backfilling required to bring the work to line and grade shown, including excavation of rock and all other materials which may be encountered.
- B. Excavate trenches wide enough for proper installation of work. Grade trench bottoms evenly. Provide bell holes as necessary to insure uniform bearing for pipes. Excavate minimum 6" below pipe. Refill cuts below required pipe grade with sand or compacted gravel. Support pipe continuously along its entire length. Do not use piers to support piping.
- C. Backfill after inspection by Architect and authorities having jurisdiction. Backfill compacted areas with "Engineered Fill", sand or fine gravel in accordance with requirements of "Sitework". Backfill paved areas with sand or fine gravel compacted to meet requirements of Paving Section. Backfill shall be free of rock, wood, steel, brick, etc. Do not disturb pipe. Restore or repair pavements and the like after backfilling, matching adjacent work.

3.9 DEMOLITION:

- A. Certain existing HVAC equipment to be removed and/or relocated as shown or noted. Equipment removed will remain the property of the Owner unless designated otherwise. Remove from the premises all items not retained by the Owner.

3.10 CONNECTIONS TO EXISTING SYSTEMS:

- A. Make connections to existing systems only at time authorized, in writing, by Owner.
- B. Do not take heating system out of service during occupied working, office or school hours during heating season.
- C. Drain existing systems and fill, vent, test, balance and put existing systems into operation after connections have been made.
- D. Repair existing insulation at points of connection to existing work.

3.11 HVAC INSTALLATION OF AND CONNECTIONS TO ITEMS FURNISHED BY OTHERS OR SPECIFIED IN OTHER SECTIONS:

- A. Duct Mounted Smoke Detectors: Install in duct.

3.12 PAINTING:

- A. Refinish equipment damaged during construction to new condition.
- B. Paint all non-potable water pipe and insulation yellow in accordance with Plumbing Code using paint of type specified in Painting Section.
- C. Paint un-insulated duct surfaces visible through grilles and registers flat black.

3.13 PIPE IDENTIFICATIONS:

- A. Identify all piping exposed to view or accessible through removable ceilings or access panels with plastic snap-on pipe line markers. Color code markers in accordance with ANSI A13.1. Show pipe contents and direction of flow. Markers on lines 8" OD and smaller shall be taped in place; on lines over 8" OD secure with spring clips.
- B. Submit samples of all labels, tags, stencils, chains, etc., for approval.
- C. Protect all factory identification tags, nameplates, model and serial numbers, stenciling, etc., during construction and replace if damaged.
- D. Label Spacing and Extent:
 - 1. On straight run of pipes; Above suspended ceilings space labels approximately 10 feet on center; elsewhere, 20 feet on center.
 - 2. Wherever a pipe enters or leaves a room or building.
 - 3. At change of direction.
 - 4. At main valves and control valves (not equipment valves).
 - 5. On risers, just above and below floors.

3.14 VALVE TAGS:

- A. 2" X 3" laminated plastic with 1/2" numbers engraved at top indicating type service and valve number, leaving space for further engraving by others. Secure tags with chains to valve yoke or stem, not handles.
- B. Valve tags colors: Brass tags with black numbers.
- C. Valve tag locations: At all valves on mains, risers and branches.
- D. Valve tag numbers: Starting with Number 1, number tags in sequence from the lowest point to the highest point in the building. In existing building extend existing sequences.

3.15 VALVE CHARTS:

- A. In all mechanical rooms, provide charts showing number and locations of all valves, type of service, etc. Frame with aluminum, under glass.
- B. In existing buildings include existing valves in the charts of new valves.

3.16 EQUIPMENT IDENTIFICATIONS:

- A. Provide 2" X 3" or larger laminated plastic nameplates with 1/2" numbers and letters in colors specified below. Screw tags to equipment in obvious locations. Engrave equipment designation and numbers as shown on plans and drawings on upper half of tags, leaving lower half of tag for future engraving by Owner.
- B. Provide similar nameplates for motor starters furnished under this section.
- C. Secure nameplates with acorn head screws.
- D. Colors:
 - 1. Equipment connected to utility power only - black letters on white nameplates.
 - 2. Equipment connected to emergency power - red letters on white nameplates.

3.17 EXHAUST FAN IDENTIFICATIONS:

- A. 2" X 3" or larger laminated plastic nameplates with red letters and numbers on white background, identifying type of fans, number according to plans, and rooms served. Engrave on upper half of tag, leaving lower half for engraving by Owner. Fasten with acorn head screws.

3.18 ACCESS DOORS:

- A. Provide access doors for valves, fire dampers, dampers, controls, air vents, and other items located above non-lift-out ceilings or behind partitions or walls.

3.19 USE OF HVAC SYSTEM DURING CONSTRUCTION:

- A. Ducted HVAC systems may be used during construction as long as the following conditions are met:
 - 1. All AC units shall have filters installed in the AC units that are equal to the filters that are scheduled for each piece of equipment. The contractor shall be responsible for changing the filters in all AC units during construction at a minimum of every 30 days starting from the day the AC units are started. At the completion of the project, the contractor shall replace all filters.
 - 2. All return air and outside air openings shall be protected with temporary filter media. The temporary filter media shall be changed by the contractor. Temporary filter media is required to protect the installed ductwork. During or after construction, if any ductwork is observed without temporary filter media, the contractor shall be solely responsible for cleaning the entire ductwork system and AC unit. Temporary filter media shall be changed bi-weekly at a minimum.
 - 3. All AC units shall have all correct motor overload elements installed and all safeties shall be wired and operational prior to temporary use of the AC unit.
 - 4. Temporary controls and temporary control sequences may be utilized by the contractor until the permanent controls and control sequences are installed. Temporary control methods shall be the sole responsibility of the contractor.
 - 5. All AC units required to have factory start-up shall have factory start-up completed prior to use.
 - 6. The building envelope for the area served by the AC units shall be substantially complete prior to using the AC units during construction.

- B. Ductless split systems shall NOT be used during construction. Protect all indoor sections of ductless split systems during construction to prevent dust, dirt, or water from entering the unit.

3.20 WARRANTY AND INSTRUCTIONS:

- A. See General Conditions - One-Year Warranty.
- B. Contractor shall and hereby does warrant all materials, workmanship and equipment furnished and installed by him to be free from defects for a period of one (1) year after date of substantial completion of the Contract. Should any defects in materials, workmanship, or equipment be made known to Contractor within the one (1) year warranty period, Contractor shall replace such materials, workmanship, or equipment without charge.
- C. All centrifugal, reciprocating, screw or scroll type refrigeration compressors shall bear five (5) year non-pro-rated parts warranty. All Furnaces shall bear ten (10) year non-prorated warranty.
- D. After completion of the work, Contractor shall operate the equipment which he installs for a period of ten (10) working days, as a test of satisfactory operating conditions. During this time, Contractor shall instruct the Owner's operating personnel in the correct operation of the equipment. Furnish necessary oral and written operating instructions to the Owner's representative.
- E. Provide five (5) sets of manufacturer's operating and maintenance manuals and parts lists including nearest manufacturer's sales and service representative by name, address and phone for all equipment and materials furnished. Provide a maintenance schedule listing routine maintenance operations and suggested frequency. Include all warranty dates on equipment and guarantees. Include names, address and phone of any subcontractor and work performed. Bind above items in loose leaf three (3) ring binders with tab for each class of equipment.
- F. During the period of tests, adjust all controls, regulators, etc., to comply with these Specifications.
- G. Supply initial charges of refrigerant, refrigeration lubricating oil; and anti-freeze necessary for the correct operation of the equipment. Maintain these charges during the guarantee period, with no additional cost to the Owner, unless loss of charge is the fault of the Owner.
- H. Make available to the Owner, without additional cost, service and adjustment of the equipment for the guarantee period.
 - 1. Service shall include:
 - a. On call nuisance issues.
 - b. Replenishing refrigerant and antifreeze if loss occurs due to system failure.
 - 2. Service shall not include:
 - a. Routine maintenance of the equipment unless specified in specific equipment specification section(s).

3.21 PROJECT CLOSE-OUT DOCUMENTS:

- A. Prior to the issuance of a certificate for final payment, submit to Architect and obtain his approval of the following:
1. A letter signed by the subcontractors for HVAC, Electrical, and Temperature Control work stating that they have jointly checked each power circuit and control circuit and mutually agrees that controls and power circuits will function properly.
 2. Record drawings - sheet metal work (reproducible).
 3. Record drawings - piping (reproducible).
 4. Record drawings - control systems (reproducible).
 5. Control manufacturer's letter of certification (3).
 6. Air balance report (3).
 7. Equipment Submittal Data (3).
 8. Equipment operating and maintenance manuals (3).
 9. Maintenance schedule (3).
 10. Equipment warranty dates and guarantees (3).
 11. List of Owner's Personnel who have received maintenance instructions.

END OF SECTION 15010

SECTION 15020 - Testing, Balancing and Adjusting (TBA) 15020

PART 1 - GENERAL

1.1 SCOPE:

- A. Provisions of this section apply to all HVAC work.
- B. All tests shall be witnessed by the Architect in addition to authorities having jurisdiction. A minimum of 48 hour notice is required prior to performance of test.
- C. Provide complete report to Engineer for approval TEN (10) working days prior to Engineer's final site visit.

1.2 QUALIFICATIONS:

- A. All TBA work shall be performed by an independent Test and Balance Agency specializing in Testing, Balancing and Adjusting of HVAC Systems.
- B. All TBA work shall be under supervision of a qualified registered professional engineer regularly engaged in the TBA Agency.
- C. TBA Agency shall be an AABC or NEEB Member and/or shall obtain written approval from the Architect prior to Bidding.

1.3 APPROVAL:

- A. Application for approval of the TBA agency shall be submitted prior to Bid.
- B. Submittal information regarding the TBA agency to include:
 - 1. List of at least five (5) projects successfully completed of similar size and scope.
 - 2. Copy of reporting forms to be used for this project indicating scope of TBA work.
 - 3. Name of registered engineer in charge with resume of qualifications. List of personnel that will perform TBA work on project and qualifications.
 - 4. List of instruments to be used with dates of latest calibrations.
 - 5. List of memberships in AABC, NEBB or other similar organizations.

PART 2 - PRODUCTS

2.1 INSTRUMENTS:

- A. All instruments used for the TBA work shall be calibrated within six (6) months and checked for accuracy prior to start of work.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS:

- A. After HVAC system has been installed, Test, Balance and Adjust System for proper operation, air distribution, flow rates, temperatures and humidities. Correct any noise and/or vibration conditions.
- B. Include a "Deficiency List" with the TBA air and water balance report. Deficiency list shall

include TBA items which are not in accordance with Contract Documents.

- C. Perform all tests as required by local codes. Contractor shall furnish testing equipment.
- D. If local Codes are more stringent, local Codes shall govern.

3.2 AIR SYSTEM:

- A. When system has been completed, remove all trash and dirt, set grille bars and diffuser patterns for required throws and adjust and balance air duct systems so air quantities at outlets are as directed and distribution from each supply outlet is free from drafts and excessive noise, and uniform over the face of each outlet. Do all testing and balancing with filters blanked to provide pressure drops midway between clean condition and manufacturer's recommended change-out condition. Balance air quantities to within 10% of indicated air quantities.
- B. Make adjustments so dampers and volume adjusters close to air outlets will have the least pressure drop consistent with volume requirements. Obtain additional pressure drop required for balancing of shorter runs by adjusting dampers at branch duct take-offs. Adjustable fan drives shall be used for making final adjustments of total air quantities. Change sheaves and belts as required to adjust AC units to proper airflow.
- C. Direct reading velocity meters may be used for comparative adjustment of individual outlets, but measure air quantities in ducts having velocities of 1000 feet per minute or more with pitot tubes. Cap pitot tube openings in low pressure ducts with plastic plugs. Cap pitot tube openings in medium and high pressure ducts and kitchen and laboratory exhaust ducts with Duro-Dyne test ports.
- D. Permanently mark settings of dampers and other volume adjusting devices so they can be restored if disturbed.
- E. When air balancing has been completed, submit to Architect an air balance log, including design and actual air quantities, pressures, etc., in each branch duct and at each grille, register, and outlet. Individual outlet air rates are required for boots on boot-box systems.
- F. Include for each system the following information:
 - 1. Fan rpm, motor amps, motor nameplate amps, and amp rating of starter heater.
 - 2. Total air quantity supplied by each system and/or fan.
 - 3. Total outside air quantity supplied by each system.
 - 4. Provide velocity pressure across each duct mounted smoke detector and list manufacturer's required velocity pressure range.
 - 5. Air flow at all grilles.
 - 6. Static pressure profile thru each air handler.

3.3 COILS:

- A. Provide the following:
 - 1. Entering and leaving air temperatures.
 - 2. Outside air temperature at time of test.

3.4 START-UP AND SERVICE:

- A. At the beginning of the first heating season, adjust and balance operating phases and repeat at the beginning of the first cooling season or vice-versa, as the case may be, all without charge.
- B. The Contractor and Factory Representative of the boilers, chillers, AC units and major HVAC equipment shall place every item of such equipment into satisfactory operation with all automatic and safety devices. Further, all adjustment service required shall be performed during the warranty period. Adjustment services does not include lubricating fans or motors and does not include changing filters or adjusting belts.
- C. In addition, submit equipment manufacturers' start-up reports for items listed above. See "Project Close-Out".

END OF SECTION 15020

SECTION 15050 – Materials and Methods- HVAC

PART 1 – GENERAL

1.1 SCOPE:

- A. Include Section 15010, "GENERAL PROVISIONS - HVAC", with this Section.

PART 2 – PRODUCTS

2.1 MATERIALS:

- A. All pipe, fittings and valves shall be manufactured in the United States of America.

2.2 HVAC DRAIN PIPING:

- A. Standard weight galvanized steel pipe ASTM A-120 with galvanized malleable iron fittings, or type "L" hard copper with wrought copper sweat fittings, at Contractor's option.
- B. Provide drain traps for AC Unit drain pans. Size traps as required to drain under operating conditions.

2.3 REFRIGERATION PIPING:

- A. ACR hard drawn copper tubing with wrought copper sweat fittings. Joints: Silfossed with continuous flow of dry nitrogen through lines.
- B. Size suction and discharge lines so as to insure oil return at minimum loading.
- C. Small lines 5/8" OD and smaller may be soft copper with flare fittings, provided that all joints are exposed for visual inspection.
- D. Refrigerant piping shall be sized and installed as recommended by the equipment manufacturer. Provide lift traps or double suction risers as required for oil return.

2.4 PIPE HANGERS:

- A. General: Pipe hangers, Grinnell, PHD, Michigan Hanger, or Elcen. Grinnell figure numbers are given for reference. Provide copper clad or plastic coated hangers on bare copper lines. Provide stainless steel or plastic coated hangers in Pool areas subject to chlorine atmosphere.
- B. Equip pipe hangers with vibration isolators as specified under sub-section 2.15 "VIBRATION ISOLATORS".
- C. Pipe hangers for steam and condensate lines: Adjustable swivel roll hangers, Grinnell Fig. 171.
- D. Pipe hangers for lines 3" and smaller (other than steam and condensate lines), adjustable wrought ring hangers, Grinnell Fig. 97 or wrought clevis hangers, Grinnell Fig. 260.
- E. Pipe hangers for lines 4" and larger (other than steam and condensate lines), adjustable wrought ring hangers, Grinnell Fig. 260.
- F. Parallel piping graded in same direction may be grouped on trapezes. Trapezes for line 4" and smaller, Unistrut P2000 channel, or equal, with rods sized as specified below for largest pipe on trapeze. Guide lines on (but not anchor to) trapezes using Unistrut Series

P1100 clamps. Trapezes shall not exceed 3' in length. Space lines to allow at least 3" clear between adjacent pipe or pipe covering and between pipes or pipe covering and rods. Space trapezes as specified for pipe hangers based upon smallest size of pipe on trapeze.

- G. Provide riser clamps on pipe risers on each floor. Clamps in contact with copper or plastic pipe, plastic coated.
- H. Beam Clamps: Grinnell Fig. 229.
- I. Inserts for hangers in concrete structures: Underwriter's listed cast iron inserts. Grinnell Fig. 282.
- J. For fasteners in existing concrete structures use drilled in expansion anchors with load rating at least 150% of pipe hanger rating (power driven anchors are not acceptable).
- K. Size rods for pipe hangers not smaller than the following: 3/8" rods for pipe up to 2", 1/2" for 2-1/2" and 3" pipe, 5/8" rods for 4" and 5" pipe, 3/4" rods for 6" pipe, and 7/8" rods for 8" and 10" and 12" pipe, 1" rods for 14" and 16" pipe and 1-1/8" rods for 18" pipe.
- L. Space pipe hangers at maximum: 5' intervals for cast iron pipe. Pipe hanger spacing for screwed, solder joint and welded piping: 1/2", 6 ft.; 3/4" to 1-1/4", 8 ft.; 1-1/2" to 2-1/2", 10 ft.; 3", 12 ft.; 4", 14 ft.; 5", 12 ft. 6", 10 ft., 8" and over, 6 ft. Polypropylene and PVC plastic pipe 4 ft. horizontally maximum or as directed by manufacturer if closer, and 10 ft. vertically. Install additional hangers at change of direction and valve clusters.
- M. Install pipe hangers on insulated pipe (other than steam and condensate lines) over pipe covering. Provide factory fabricated insulated pipe shields equal to Pipe Shields, Inc. "Thermal Hanger Shields" at hangers. Provide shield insulation of waterproofed calcium silicate for hot water piping and foamglass for chilled water piping, same thickness as adjacent pipe covering. At Contractor's option, pipe shields may be field fabricated using waterproof calcium silicate or foam glass insulation with ASJ and 20 gauge galvanized steel protector. Shield length: 1.5 times nominal pipe size but not less than 4".
- N. Wrap bare copper refrigerant lines with sheet lead at hangers.

2.5 VIBRATION ISOLATION:

- A. General: Mount all piping and rotating equipment using vibration isolators as specified below. Amber Booth, Korfund, Mason Industries, Peabody, Vibration Eliminator Co., or VMC. Mason Industries part numbers are given for reference. Minimum 95% isolation efficiency.
- B. Mount air handling unit sections in contact with concrete pad on single layer of ribbed neoprene on top of housekeeping pads as shown. Neoprene vibration pad shall cover the entire surface of the unit in contact with the concrete pad.
- C. Provide snubbing isolators, similar to those specified above for pipe hangers for flexible connections at fans.

PART 3 – EXECUTION

3.1 PIPE INSTALLATION:

- A. Cut pipe square and ream full size after cutting. Clean pipe. Make threaded joints with Teflon tape. Do not spring pipe into place.
- B. Provide welding material and labor in accordance with the welding procedures of the

Heating, Piping, and Air Conditioning Contractors' National Association or other approved procedure conforming to the requirements of ANSI B31.9 "Building Service Piping". Employ only welders fully qualified in the above specified procedure and currently certified by recognized testing authority. Use either electric arc or oxyacetylene welding. Provide full perimeter welds at both face end and collar end of each slip-on flange.

- C. Install piping to allow for expansion. Make connections to all equipment to eliminate undue strains in piping and equipment. Furnish necessary fittings and bends to avoid spring of pipes during assembly.
- D. Pitch air conditioning unit drain lines down in direction of flow 1" in 20'. Grade chilled water, hot water and condenser water supply and return lines down to drains and up to air vent.
- E. Install chrome plated floor and ceiling plates on pipe passing through finished surfaces in finished spaces.
- F. Make horizontal water and steam supply line size reductions using eccentric reducers with tops flat in water lines and bottoms flat in steam lines.
- G. Install 3/4" ball or gate valve drains with hose adapters at low points of water piping and at bases of all risers or where shown provide large drains.
- H. Make connections to equipment using screwed unions in sizes 2" and smaller and flanged unions in sizes 2-1/2" and larger. Install unions in all piping connections to each piece of equipment. Provide rubber grommets at pipe penetrations to equipment casings.
- I. Wherever ferrous pipes or tanks and copper tubing connect, provide dielectric insulation unions or couplings, equal to EPCO.
- J. Near heating and air conditioning equipment requiring water valved and capped water outlets of sizes shown, for connection to equipment, including reduced pressure principal backflow preventers shall be provided. Make final connections under HVAC work. Note that all piping and insulation downstream of backflow preventer must be painted yellow.
- K. Run piping concealed, except where specifically shown or specified exposed. Plumb all vertical lines and run mains parallel to building walls unless specifically shown otherwise. All piping shall be run as high as practical and not on the floor unless otherwise indicated.
- L. Lay underground pressure piping so top of pipe is at least 18" below finished grade. Support all underground piping solidly along body of pipe. Strongly suspend other piping from building construction.
- M. Pipe shall be braced at flexible connections to prevent blowouts under operating conditions.

3.2 REFRIGERATION SYSTEM:

- A. Split Systems: When system is complete, but before the pipe covering has been installed, test components with dry nitrogen and make tight at equipment manufacturer's recommended test pressures. Then evacuate the system to 26" Hg. vacuum which the system shall hold for 24 hours. After passing the above tests, charge and leak test under operating conditions using electronic leak detector.
- B. Split and Packaged Systems: Check operation of refrigeration cycle and report head pressure, suction pressure and oil pressure.

END OF SECTION 15050

SECTION 15080 – Piping Specialties-HVAC

PART 1 – GENERAL

1.1 SCOPE:

- A. Provisions of this section apply to all HVAC work.

PART 2 – PRODUCTS

2.1 SPECIALTIES - REFRIGERANT:

- A. Install molded desiccant core filter dryer in each liquid line. Provide throw away dryers for lines 1/2" and smaller. Provide replaceable core dryers for lines 5/8" and larger. Dryers shall be Sporlan "Catchall".
- B. Install moisture indicating sight glass in each liquid line.
- C. Service valves: Wing cap valves, Henry, or approved equal.
- D. Expansion valves: Thermostatic valves with external equalizers, Sporlan, or approved equal.
- E. Install suction line accumulators in all outdoor heat pumps and condensing units where refrigerant lines exceed 85' in length, or where recommended by manufacturer.
- F. Refrigerant circuit access ports located outdoors shall be fitted with locking-type, tamper-resistant caps. Provide owner with any tools necessary to un-lock the caps.

PART 3 – EXECUTION

3.1 INSTALLATION:

- A. Specialties shall be installed in accordance with manufacturer's recommendations.
- B. See Details for mounting instructions and accessories.

END OF SECTION 15080

SECTION 15180 – Insulation

PART 1 – GENERAL

1.1 SCOPE:

- A. Include Section 15010 "GENERAL PROVISIONS - HVAC", with this Section.
- B. Repair existing insulation at points of connection to existing work.
- C. "Exposed" is defined as: Exposed to view when construction is complete. Items which are not "exposed" are "concealed".
- D. "Attic" is defined as any ceiling space that is adjacent to the roof.
- E. Insulate all items subject to sweating or loss of heat.
- F. All insulation shall be installed by licensed applicator and applied in accordance with the Manufacturer's Recommendations.

1.2 INSULATION REQUIREMENTS:

- A. Comply with NFPA 90A.
- B. Pipe hanger shields are specified in Section 15050 "MATERIALS AND METHODS - HVAC".
- C. Use insulation and adhesives with Underwriter's Laboratories flame spread rating not over 25 without evidence of continued progressive combustion, and smoke developed rating not exceeding 50 for all other pipe, duct and equipment insulation.

PART 2 - PRODUCTS

2.1 FOAM PLASTIC PIPE COVERING:

- A. Fire retardant foamed plastic pipe covering, maximum K factor at 75°F mean temperature not exceeding 0.27 BTU/(hr) (sq. ft.) (°F/in). Armstrong "Armaflex II", or approved equal.
- B. Pipe covering may be seamless insulation slipped over piping before erection or may be slit longitudinally and installed over erected piping.
- C. Make fitting covers from segments of pipe covering.
- D. Cement all joints and seams in accordance with manufacturer's instruction using Armstrong 520 adhesive.
- E. Fit pipe hangers over insulation (See PIPE HANGERS). Use hanger shields as specified under pipe hangers.
- F. Thermal performance shall be as follows:
 - 1. 1" thick: R=4.2.
 - 2. 2" thick: R=8.0.

2.2 ALUMINUM JACKET PIPING COVER:

- A. 0.010" thick corrugated aluminum jacket with laminated polyethylene and draft paper adhered liner.
- B. Securely rivet jacket in place and band with flat aluminum bands 18" o.c.
- C. Finish fittings on aluminum jacketed lines with 1/8" thick (dry) coat of vinyl acrylic mastic reinforced with glass cloth.

2.3 DUCT INSULATION, EXTERNAL FOR CONCEALED:

- A. Formaldehyde free flexible glass fiber insulation with foil-scrim-craft (FSK) facing equal to Johnson Manville Micro-Lite AXG®. Flame spread classification, 25 or less, smoke developed rating not exceeding 50. Minimum density, 3/4 lb./cu. ft., 2" thickness, installed R=6.0 minimum.

2.4 DUCT INSULATION, INTERNAL:

- A. Glass fiber acoustical/thermal insulation complying with NFPA 90A and UL 181 and having an erosion resistant anti-microbial membrane equal to Johns Manville, Linacoustic ARC® on the air side. Edge coating shall be factory applied to the edges of the liner core. Shop fabrication cuts and field cuts or tears shall be coated with Superseal Duct Butter. NRC (1" thick) not less than 0.70, minimum density 3 lb/cu. ft., and maximum friction correction factor at 2000 fpm average velocity 1.15 (per TIMA test method AHS-1S2-76U). Thermal performance shall be as follows:

- 1. 1" thick: R=4.2.
- 2. 1 1/2" thick: R=6.3.
- 3. 2" thick: R=8.0.

PART 3 - EXECUTION

3.1 HVAC PIPING INSULATION:

- A. Refrigerant Suction Lines and Hot Gas Bypass Lines: "Foam Plastic Pipe Covering", 1" thick. Jacket piping located outdoors with aluminum jacket. All exposed indoor refrigerant piping shall be jacketed with smooth aluminum jacket suitable for painting.
- B. AC Unit Drain Lines: "Foam Plastic Covering", 3/4" thick. Jacket piping located outdoors with aluminum jacket. All exposed indoor **drain** piping shall be jacketed with smooth aluminum jacket suitable for painting.

3.2 AIR TERMINAL DEVICES:

- A. Ceiling Mounted Supply Diffusers: 2" thick duct insulation on back of diffuser, external for concealed (3" in attic).
- B. Fire Dampers for Internally Lined Ducts and Externally Insulated Ducts: 2" thick duct insulation on all sides, external for concealed (3" in attic).

3.3 DUCT INSULATION INTERNAL (AND EXTERNAL WHERE INDICATED):

- A. Apply in accordance with SMACNA "Duct Liner Application Standard" over full coverage adhesive. Coat all edges with adhesive and seal all punctures or tears with mastic before installing ducts. Cut liner to assure overlapped and compressed longitudinal corner

joints. Fasteners shall be sized appropriately for thickness of liner utilized. Provide mechanical fasteners and metal nosings as noted below:

1. For all velocities, provide metal nosings on upstream edge of liner at connections to equipment: Fans, coils, dampers, AC Units, sound absorbers, etc.
2. For velocities up to 2,000 feet per minute: Start fasteners within 3" of the upstream transverse edges of the liner and 3" from the longitudinal joints and space them a maximum of 12" o.c. around the perimeter of the duct, except that they may be a maximum of 12" from a corner break. Elsewhere locate fasteners a maximum of 18" o.c., except that they shall be placed not more than 6" from a longitudinal joint of the liner nor more than 12" from a corner break.
3. For velocities from 2,001 to 4,000 feet per minute: Start fasteners within 3" of the upstream transverse edges of the liner and 3" from the longitudinal joints and space them a maximum of 6" o.c. around the perimeter of the duct, except that they may be a maximum of 6" from a corner break. Elsewhere locate fasteners a maximum of 16" o.c., except that they shall be placed not more than 6" from a longitudinal joints of the liner nor more than 12" from a corner break. In addition to the adhesive edge coating of transverse joints, coat and longitudinal joints with adhesive.
4. For velocities from 4,001 to 6,000 feet per minute: Same as 2 above except that metal nosing shall be installed to secure liner at all upstream transverse edges.
5. Duct size shown does not include allowance for insulation.
6. Where ducts are listed to be lined and wrapped, install wrap per section below "Duct Insulation, External, for Concealed Ducts"

B. Thickness and Extent:

1. Supply and return ductwork in gymnasium: 1" thick.

3.4 DUCT INSULATION, EXTERNAL, FOR CONCEALED DUCTS:

- A. Adhere insulation to duct surface with approved adhesive applied in strips above 6" wide on approximately 12" centers. Flare door staples may be used for securing the insulation until the adhesive sets. Lap jacket and vapor seal all joints and seams with suitable mastic.
- B. On rectangular and flat oval ducts 30" wide and wider, additionally support insulation with weld pins and speed clips 18" on centers. Seal weld pins with mastic and FSK tape.
- C. Thickness and Extent:
 1. Supply and return duct: 2" thick. Supply and return duct located in Attic: 3" thick.
 2. ERU outside air and exhaust duct: 2" thick. ERU outside air and exhaust duct located in Attic: 3" thick.
 3. Exhaust duct connected to exhaust fans: 2" thick..
 4. 2 hour fire wrap on grease exhaust duct equal to Firemaster.

NOTE: Conical and straight spin ins on both lined and unlined ducts shall be insulated. Insulation shall be slit at damper rods, at spin ins and sealed vapor tight.

3.5 DUCT INSULATION, EXTERNAL, FOR OUTDOOR DUCTS:

- A. Insulate all outdoor supply and return ducts with 2" thick 6 #/cu. ft. fiberglass board with FSK jacket in addition to the insulation specified above. Secure board with weld pins and speed clips 12" on centers. Seal clip indentations with mastic. Seal all joints and seams with mastic. Finish with aluminum jacket, 26 gauge, slope so rain will not stand on duct.
- B. Cover all angles, seams and joint reinforcing with insulation and seal vapor tight.

3.6 INSULATION WETTED DURING CONSTRUCTION:

- A. Contractor shall replace any and all insulation wetted during construction at his own expense.

END OF SECTION 15180

1.00 GENERAL:

1.01 DESCRIPTION OF WORK:

- A. This section describes the design, performance and installation of an air purification system intended for use as part of another manufacturer's air handling unit or mounted on the duct as shown on the plans, details and equipment schedules.

1.02 REFERENCED CODES & STANDARDS:

- A. The following codes and standards are referenced through out. The edition to be used is that currently enforced by the authority having jurisdiction (AHJ) or in absence of such direction that referenced by the current enforceable IBC code or as indicated by the contract documents, except where specifically referenced by this section of the specifications.

1. ASHRAE Standards 62 & 52
2. National Electric Code NFPA 70
3. UL 867 including ozone chamber test required as of December 21, 2007

1.03 RELATED WORK:

1. Testing, Adjusting and Balancing
2. Facility Access and Protection
3. Ductwork
4. Filters
5. Water and Refrigerant Piping
6. Electrical Wiring
7. Control Wiring

1.04 QUALITY ASSURANCE:

- A. Basis of design is Top Product Innovations. Global Plasma Solutions and Phenomenal Aire shall be considered equal subject to meeting all specifications herein.
- B. The Air Purification System shall be a product of an established manufacturer within the USA.
- C. A qualified representative from the manufacturer shall be available to inspect the installation of the air purification system to ensure installation in accordance with manufacturer's recommendation.
- D. Technologies that do not address gas disassociation such as UV Lights, Powered Particulate

Filters and/or polarized media filters shall not be considered. Uni-polar ion generators shall not be acceptable. "Plasma" particulate filters shall not be acceptable.

- E. Projects designed using ASHRAE Standard 62, IAQ Procedure shall require the manufacturer to provide Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2013 to validate acceptable indoor air quality at the quantity of outside air scheduled with the technology submitted.
- F. The Air Purification System have been tested by UL or Intertek/ETL to prove conformance to UL 867-2007 including the ozone chamber testing and peak ozone test for electronic devices. Manufacturers that achieved UL 867 prior to December 21, 2007 and have not been tested in accordance with the newest UL 867 standard with the ozone amendment shall not be acceptable. All manufacturers shall submit their independent UL 867 test data with ozone results to the engineer during the submittal process. All manufacturers shall submit a copy with their quotation. Contractors shall not accept any proposal without the proper ozone testing documentation.
- G. The maximum allowable ozone concentration per the UL 867-2007 chamber test shall be 0.007 PPM. The maximum peak ozone concentration per the UL 867-2007 peak test as measured 2 inches away from the electronic air cleaner's output shall be no more than 0.0042 PPM. Manufacturers with ozone output exceeding these ozone values shall not be acceptable.

1.05 SUBMITTALS:

- A. Product Data: Submit manufacturer's technical product data for ion generators including:
 - 1. Schedule of plasma generators indicating unit designation, number of each type required for each unit/application.
 - 2. Data sheet for each type of plasma generator, and accessory furnished; indicating construction, sizes, and mounting details.
 - 3. Performance data for each type of plasma device furnished.
 - 4. Indoor Air Quality calculations using the formulas within ASHRAE Standard 62.1-2013 to validate acceptable indoor air quality at the quantity of outside air scheduled (when projects are designed with outside air reduction).
 - 5. Product drawings detailing all physical, electrical and control requirements.
 - 6. Copy of UL 867 independent ozone test.
- B. Operating & Maintenance Data: Submit O&M data and recommended spare parts lists.

1.06 PRODUCT DELIVERY, STORAGE AND HANDLING:

- A. Deliver in factory fabricated shipping containers. Identify on outside of container type of product and location to be installed. Avoid crushing or bending.
- B. Store in original cartons and protect from weather and construction work traffic.
- C. Store indoors and in accordance with the manufacturers' recommendation for storage.

1.07 WARRANTY:

- A. Equipment shall be warranted by the manufacturer against defects in material and workmanship for a period of twenty-four months after shipment, whichever occurs first. Labor to replace equipment under warranty shall be provided by the owner or installing contractor.

2.00 PRODUCTS

2.01 GENERAL:

- A. The air purification system(s) shall be of the size, type, arrangement and capacity indicated and required by the unit furnished and shall be of the manufacturer specified.
- B. Basis of Design: Top Product Innovations Type C unit
- C. All other Suppliers of comparable products requesting prior approval shall:
 - 1. Submit for prior approval in accordance with the requirements of Section 15010.
 - 2. In addition, manufacturers submitting for prior approval for Bi-Polar Ionization must as part of the prior approval request provide their ASHRAE 62.1-2013 calculations that prove conformance to the ASHRAE Standard with the reduction of outside air to the scheduled values. A letter on the manufacturer's letterhead requesting prior approval must accompany the request for prior approval stating their calculations are ASHRAE compliant. A third party validation study performed on a previous installation of the same application shall also be included.
 - 3. Submit independent test data from ETL or UL showing ozone levels produced during the UL 867 ozone chamber test. Manufacturers without this test data shall not be acceptable.

2.02 BI-POLAR IONIZATION DESIGN & PERFORMANCE CRITERIA"

- A. Each piece of air handling equipment, so designated on the plans, details, equipment schedules and/or specifications shall contain a Plasma Generator with Bi-polar Ionization output as described here within.
- B. The Bi-polar Ionization system shall be capable of:
 - 1. Effectively killing microorganisms downstream of the bi-polar ionization equipment (mold, bacteria, virus, etc.).
 - 2. Controlling gas phase contaminants generated from human occupants, building structure and furnishings.
 - 3. Capable of reducing static space charges.
 - 4. Increasing the interior ion levels, both positive and negative, to a minimum of 800 ions/cm³ measured 5 feet from the floor.
- C. The bi-polar ionization system shall operate in a manner such that equal amounts of positive and negative ions are produced. Uni-polar ion devices shall not be acceptable.
 - 1. Air exchange rates may vary through the full operating range of a constant volume or VAV system. The quantity of air exchange shall not be increased due to requirements of the air purification system.
 - 2. Velocity Profile: The air purification device shall not have maximum velocity profile.

- D. Humidity: Plasma Generators shall not require preheat protection when the relative humidity of

the entering air exceeds 85%. Relative humidity from 0 - 100%, condensing, shall not cause damage, deterioration or dangerous conditions within the air purification system. Air purification system shall be capable of wash down duty.

E. Equipment Requirements:

1. Electrode Specifications (Bi-polar Ionization):
 - a. Each Plasma Generator with Bi-polar Ionization output shall include the required number of electrodes and power generators sized to the air handling equipment capacity. Unit shall be capable of treating 6,000 CFM (C6.0) or 10,000 CFM (C10.0). Bi-polar ionization tubes manufactured of glass and steel mesh shall not be acceptable due to replacement requirements, maintenance, performance output reduction over time, ozone production and corrosion.
 - b. Electrodes shall be energized when the main unit disconnect is turned on and the fan is operating. Electrodes shall be made from carbon fiber to prevent oxidation over time.
 - c. Electrode pair shall provide a minimum of 140 million ions per cubic centimeter (C6.0) or 200 million ions per cubic centimeter (C10.0), both positive and negative ions in equal quantities. Devices providing less than the rated ion densities shall not be acceptable.

F. Air Handler Mounted Units:

1. Where so indicated on the plans and/or schedules Plasma Generator(s) shall be supplied and installed. The mechanical contractor shall mount the Plasma Generator and wire it to the AHU control power (24VAC) as instructed by the Air Purification Manufacturer's instructions or line voltage subject to power available. Each unit shall be designed with an integral illuminated LED and dry contacts to prove ion output is operating properly. The dry contacts shall close to prove the ion generator is working properly and may be daisy chained in series such that only one dry contact per AHU is required to interface to the BAS or the optional DDC controller. Dry contacts proving power has been applied in lieu of the ion output is actually operating, are not acceptable.

G. Plenum/Duct Mounted Units: Where so indicated on the plans and/or schedules, Plasma Generators(s) shall be supplied and installed. The generator shall be installed through the duct wall and into the air stream with the external power head in a convenient location for visual indication of power, removal and servicing, by the mechanical contractor. The dry contacts shall close to prove the ion generator is working properly and may be daisy chained in series such that only one dry contact per duct is required to interface to the BAS or the optional DDC controller.

H. Ionization Requirements:

1. Plasma Generators with Bi-polar ionization output shall be capable of controlling gas phase contaminants and shall be provided for all equipment listed above.
 - a. The Bi-polar ionization system shall consist of Bi-Polar Plasma Generator and power supply. The Bi-polar system shall be installed where indicated on the plans or specified to be installed and powered by 24VAC.
 - b. Ionization Output: The ionization output shall be controlled such that an equal number of positive and negative ions are produced. Imbalanced levels shall not be acceptable.
 - c. Ionization output from each electrode shall be a minimum of 140 million ions/cc (C6.0) and 200 million ions/cc (C10.0) when tested at 1" from the ionization generator.

- d. All manufacturers shall provide documentation by an independent NELEC accredited laboratory that proves the product has minimum kill rates for the following pathogens given the allotted time and in a space condition:

- A. MRSA - >96% in 30 minutes or less
- B. E.coli - > 99% in 15 minutes or less
- C. TB - > 69% in 60 minutes or less
- D. C. diff - >86% in 30 minutes or less

Manufacturers not providing the equivalent space kill rates shall not be acceptable. All manufactures requesting prior approval shall provide to the engineer independent test data from a NELEC accredited independent lab confirming kill rates and time meeting the minimum requirements stated in section 2.2 B, points 6A, 6B and 6C. Products tested only on Petri dishes to prove kill rates shall not be acceptable.

2. Ozone Generation:
The operation of the electrodes or Bi-polar ionization units shall conform to UL 867-2007 with respect to ozone generation. There shall be no ozone generation during any operating condition, with or without airflow.

I. Electrical Requirements:

1. Wiring, conduit and junction boxes shall be installed within housing plenums in accordance with NEC NFPA 70. The contractor shall coordinate electrical requirements with air purification manufacturer during submittals.

J. Control Requirements:

- 1. All Plasma Generators shall have internal short circuit protection, overload protection, and automatic fault reset.
- 2. Integral airflow sensing shall modulate the Plasma output as the air flow varies or stops. A mechanical air flow switch shall not be acceptable as a means to activate the Plasma device due to high failure rates and possible pressure reversal.
- 3. The installing contractor shall mount and wire the Plasma device within the air handling unit specified or as shown on the plans. The contractor shall follow all manufacturer IOM instructions during installation.
- 4. All Plasma devices shall have a means to interface with the BAS system. Dry contacts shall be provided to prove there are ions being produced. Systems providing indication that power is applied to the Plasma device, but not directly sensing the power at the ion output, shall not be acceptable.
- 5. Plasma systems that use multiple modules with ion output alarm wires wired to the same terminal such that all ion modules must fail to show an alarm status shall not be acceptable.

3.00 EXECUTION:

3.01 GENERAL:

- A. The Contractor shall be responsible for maintaining all air systems until the owner accepts the building (Owner Acceptance).

3.02 ASSEMBLY & ERECTION: PLASMA GENERATOR WITH BI-POLAR IONIZATION:

- A. All equipment shall be assembled and installed in a workman like manner to the satisfaction of the owner, architect, and engineer.
- B. Any material damaged by handling, water or moisture shall be replaced, by the mechanical contractor, at no cost to the owner.
- C. All equipment shall be protected from dust and damage on a daily basis throughout construction.

3.03 TESTING:

- A. Provide the manufacturers recommended electrical tests.

3.04 COMMISSIONING & TRAINING:

- A. A manufacturer's authorized representative shall provide start-up supervision and training of owner's personnel in the proper operation and maintenance of all equipment.

END OF SECTION

SECTION 15760 – HEAT PUMP UNITS

PART 1 – GENERAL

1.1 SCOPE:

- A. Provisions of this Section shall apply to all HVAC work.

PART 2 – PRODUCTS

2.1 HEAT PUMP OUTDOOR UNITS:

- A. Outdoor units: A single or multiple reciprocating compressors, heat transfer coil, fans and inter connecting piping and controls all enclosed in a single casing. For multiple compressor units provide separate refrigerant circuits.
- B. Casings: Designed for outdoor installation, constructed of not lighter than 20 gauge galvanized steel with baked enamel finish over bonderizing. Provide access panels, condenser inlet guards and fan outlet guards.
- C. Compressors: Welded or bolted hermetic, spring isolated, with reversible oil pumps.
- D. Coils: Aluminum fins securely bonded to seamless copper tubes.
- E. Fans: Direct driven propeller fans with weather protection for fan motors.
- F. Provide suction and discharge service valves, liquid stop valve, solenoid change-over valves, and expansion valves.
- G. Controls: Factory wired and located in a readily accessible location. Compressor motor shall have line voltage (multi step) contactor and both temperature and current sensitive overload devices. Include high and low pressure switches, crank case heater, defrost thermostat, and defrost timer.
- H. Mount outdoor units on poured in place pad.
- I. Provide five (5) year non pro rated compressor parts warranty.
- J. Heat pumps (shall be on Alabama Power Company approved services list): shall be manufactured by Trane, Carrier, or approved equal.

2.2 HEAT PUMP - INDOOR UNITS:

- A. Indoor Units: Supply fans, coils, filters, and drip pans, horizontal or vertical as shown.
- B. Casings: Galvanized steel not lighter than 22 gauge, reinforced with angles or formed shapes with baked enamel finish over bonderizing. Casing panels: Removable for access to fans, motors, coils, and bearings. Provide knockouts for piping and electrical connections. Casing shall be insulated with 1" thick neoprene coated duct liner meeting the requirements of NFPA 90A.
- C. Provide statically and dynamically balanced belt or direct driven centrifugal fans with self aligning ball bearings, adjustable speed motor (pulley) (3 speed), (and adjustable motor base). (Size belt drives for 50% overload). Fan motor and drive shall be located inside unit cabinet. Provide fan starting relay for each unit.
- D. Coils: Include direct expansion coils, expansion valves, and electric heating coils.

Refrigerant coils shall consist of non ferrous fins securely bonded to seamless copper tubes, and shall bear ARI approved ratings.

- E. Drain Pans: Provide corrosion resistant coating and insulating corrosion-resistant fill.
- F. Filters: 1" thick throwaway filters. Turn equipment over to Owner with clean filters. Provide filter racks with hinged and latched doors.
- G. Electric Heaters:
 - 1. All heaters shall be listed in the Underwriters Laboratories, Inc. Electrical Appliance and Utilization Equipment list.
 - 2. Heaters shall have ceramic supported nichrome wire elements, flanged mounting plate, NEMA I control box containing contactors for heaters, factory wired to terminal strips and 1/2" insulation between mounting plate and control box. All sheet metal parts in air stream aluminized or galvanized steel. Provide spaces at terminal end of heater so that internal duct insulation will not cause hot spots.
 - 3. Equip heaters with factory wired automatic high limit control and a supplementary independent thermal device to disconnect all power circuits in case automatic high limit fails. Equip heaters shall be supplied with control circuits suitable for 24 volt control, factory wired to terminal blocks in control box.
 - 4. Provide staging as required by Code, but no fewer stages than those shown.
- H. Provide insulated plenum bases as shown.
- I. Units shall be UL listed for scheduled voltage.
- J. Heat pumps (shall be on Alabama Power Company approved services list): shall be manufactured by Trane, Carrier, or approved equal.

2.3 MINI-SPLIT UNITS:

- A. The system shall be a Mitsubishi Electric or equal by Bryant, Daikin, Carrier, split system with Variable Speed Inverter Compressor technology. The system shall consist of a ceiling or wall suspended indoor section with wired, wall mounted controller and a horizontal discharge, single phase outdoor unit.
- B. Quality Assurance
 - 1. The units shall be tested by a Nationally Recognized Testing Laboratory (NRTL) and shall bear the ETL label.
 - 2. All wiring shall be in accordance with the National Electrical Code (N.E.C.).
 - 3. The units shall be rated in accordance with Air-conditioning Refrigeration Institute's (ARI) Standard 210 and bear the ARI Certification label.
 - 4. The units shall be manufactured in a facility registered to ISO 9001 and ISO 14001, which is a set of standards applying to environmental protection set by the International Standard Organization (ISO).
 - 5. A dry air holding charge shall be provided in the indoor section.
 - 6. The outdoor unit shall be pre-charged with R-410a refrigerant.
 - 7. System efficiency shall meet or exceed 13.0 SEER.

C. Delivery, Storage and Handling

1. Unit shall be stored and handled according to the manufacturer's recommendations.
2. The wireless controller shall be shipped inside the carton with the indoor unit and able to withstand 105°F storage temperatures and 95% relative humidity without adverse effect.

D. Warranty

1. The units shall have a manufacturer's parts and defects warranty for a period one (1) year from date of installation. The compressor shall have a warranty of 5 years from date of installation. If, during this period, any part should fail to function properly due to defects in workmanship or material, it shall be replaced or repaired at the discretion of the manufacturer. This warranty does not include labor.
2. Manufacturer shall have over 25 years of continuous experience in the U.S. market.

E. Performance

1. Each system shall perform in accordance to the ratings shown in the table below. Cooling performance shall be based on 80°F DB, 67°F WB (26.7°C DB, 19.4°C WB) for the indoor unit and 95°F DB, 75°F WB (35°C DB, 29.3°C WB) for the outdoor unit. Heating performance shall be based on 70°F DB, 60°F WB (21.1°C DB, 15.6°C WB) for the indoor unit and 47°F DB, 15°F WB (8.3°C DB, 6.1°C WB) for the outdoor unit.

F. Indoor Unit

1. The indoor unit shall be factory assembled, wired and tested. Contained within the unit shall be all factory wiring and internal piping, control circuit board and fan motor. The unit in conjunction with the wired, wall mounted controller shall have a self-diagnostic function, 3-minute time delay mechanism, an auto restart function, and a test run switch. Indoor unit and refrigerant pipes shall be purged with dry nitrogen before shipment from the factory.

2. Unit Cabinet

The casing shall be ABS plastic and have a Munsell 0.70Y 8.59/0.97 finish. Cabinet shall be designed for suspension mounting and horizontal operation. The rear cabinet panel shall have provisions for a field installed filtered outside air intake connection.

3. Fan

The evaporator fan shall have three high performance, double inlet, forward curve sirocco fans driven by a single motor. The fans shall be statically and dynamically balanced and run on a motor with permanently lubricated bearings. The indoor fan shall consist of four (4) speeds: Low, M1, M2, and Hi.

4. Vane

There shall be a motorized horizontal vane to automatically direct air flow in a horizontal and downward direction for uniform air distribution. The horizontal vane shall provide a choice of five (5) vertical airflow patterns selected by remote

control: 100% horizontal flow, 80% horizontal flow (plus 20% downward airflow), 60% horizontal airflow (plus 40% downward airflow), 40% horizontal airflow (plus 60% downward airflow), and swing. The horizontal vane shall significantly decrease downward air resistance for lower noise levels, and shall close the outlet port when operation is stopped. There shall also be a set of vertical vanes to provide horizontal swing airflow movement selected by remote control.

5. Filter

Return air shall be filtered by means of an easily removable washable filter.

6. Coil

The evaporator coil shall be of nonferrous construction with pre-coated aluminum stake fins on copper tubing. The multi-angled heat exchanger shall have a modified fin shape that reduces air resistance for a smoother, quieter airflow. All tube joints shall be brazed with PhosCopper or silver alloy. The coils shall be pressure tested at the factory. A condensate pan and drain shall be provided under the coil.

7. Electrical

The electrical power of the unit shall be 208 volts or 230 volts, 1 phase, 60 hertz. The system shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The power to the indoor unit shall have an option of being supplied from the outdoor unit, using Mitsubishi Electric A-Control system or separate power source for indoor and outdoor units.

8. Control

- a. The control system shall consist of two (2) microprocessors, one on each indoor and outdoor unit, interconnected by a single non-polar two-wire cable. Field wiring shall run directly from the indoor unit to the wall mounted controller with no splices.
- b. For A-Control, a three (3) conductor 14 ga. AWG wire with ground shall provide power feed and bi-directional control transmission between the outdoor and indoor units.
- c. Where separate power is supplied to the indoor and outdoor units, a two (2) 20 ga. AWG wire shall be run between the units to provide bi-directional control communication.
- d. The system shall be capable of automatic restart when power is restored after power interruption. The system shall have self-diagnostics ability, including total hours of compressor run time. Diagnostics codes for indoor and outdoor units shall be displayed on the wired controller panel.
- e. The microprocessor located in the indoor unit shall have the capability of monitoring return air temperature and indoor coil temperature, receiving and processing commands from the wired controller, providing emergency operation and controlling the outdoor unit.
- f. The indoor unit shall be connected to a wall mounted wired controller to perform input functions necessary to operate the system. The wired controller shall have a large multi-language DOT liquid crystal display (LCD) presenting contents in eight (8) different languages, including English, French, Chinese, German, Japanese, Spanish, Russian, and Italian.

- g. There shall be a built-in weekly timer with up to eight pattern settings per day. The controller shall consist of an On/Off button, Increase/Decrease Set Temperature buttons, a Cool/Dry/Fan mode selector, a Timer Menu button, a Timer On/Off button, Set Time buttons, a Fan Speed selector, a Vane Position selector, a Louver Swing button, a Ventilation button, a Test Run button, and a Check Mode button. The controller shall have a built-in temperature sensor. Temperature shall be displayed in either Fahrenheit (°F) or Celsius (°C). Temperature changes shall be by increments of 1°F (1°C) with a range of 67°F to 87°F (19°C to 30°C).
- h. The wired controller shall display operating conditions such as set temperature, room temperature, pipe temperatures (i.e. liquid, discharge, indoor and outdoor), compressor operating conditions (including running current, frequency, input voltage, On/Off status and operating time), LEV opening pulses, sub cooling and discharge super heat.
- i. Normal operation of the wired controller shall provide individual system control in which one wired controller and one indoor unit are installed in the same room. The controller shall have the capability of controlling up to a maximum of sixteen systems at a maximum developed control cable distance of 1,500 feet (500 meters).
- j. The control voltage from the wired controller to the indoor unit shall be 12 volts, DC. The control signal between the indoor and outdoor unit shall be pulse signal 24 volts DC. Up to two wired controllers shall be able to be used to control one unit.
- k. Control system shall control the continued operation of the air sweep louvers, as well as provide On/Off and mode switching. The controller shall have the capability to provide sequential starting with up to fifty seconds delay.

G. Outdoor Unit

- 1. The outdoor unit shall be compatible with the three different types of indoor units (wall mounted, ceiling suspending, and four way ceiling cassette). The connected indoor unit must be of the same capacity as the outdoor unit.
- 2. The outdoor unit shall be equipped with a control board that interfaces with the indoor unit to perform all necessary operation functions.
- 3. The outdoor unit shall be capable of operating at 0°F (-18°C) ambient temperature without additional low ambient controls (optional wind baffle may be required).
- 4. The outdoor unit shall be able to operate with a maximum height difference of 100 feet (30 meters) between indoor and outdoor units.
- 5. System shall have a maximum refrigerant tubing length of 165 feet (50 meters) between indoor and outdoor units without the need for line size changes, traps or additional oil.
- 6. Cabinet

The casing shall be constructed from galvanized steel plate, coated with a finished with an electrostatically applied, thermally fused acrylic or polyester powder coating for corrosion protection and have a munsell 3Y 7.8/1.1 finish. The fan grille shall be of ABS plastic.

7. Fan

The fan motor shall be of aerodynamic design for quiet operation, and the fan motor bearings shall be permanently lubricated. The outdoor unit shall have horizontal discharge airflow. The fan shall be mounted in front of the coil, pulling air across it from the rear and dispelling it through the front. The fan shall be provided with a raised guard to prevent contact with moving parts.

8. Coil

The L shaped condenser coil shall be of copper tubing with flat aluminum fins to reduce debris build up. The coil shall be protected with an integral metal guard. Refrigerant flow from the condenser shall be controlled by means of linear expansion valve (LEV) metering orifice. The LEV shall be control by a microprocessor controlled step motor.

9. Compressor

The compressor shall be a DC rotary compressor with Variable Compressor Speed Inverter Technology. The compressor shall be driven by inverter circuit to control compressor speed. The compressor speed shall dynamically vary to match the room load for significantly increasing the efficiency of the system which results in vast energy savings. To prevent liquid from accumulating in the compressor during the off cycle, a minimal amount of current shall be intermittently applied to the compressor motor to maintain enough heat. The outdoor unit shall have an accumulator and high pressure safety switch. The compressor shall be mounted to avoid the transmission of vibration.

10. Electrical

The electrical power of the unit shall be 208volts or 230 volts, 1 phase, 60 hertz. The unit shall be capable of satisfactory operation within voltage limits of 198 volts to 253 volts. The outdoor unit shall be controlled by the microprocessor located in the indoor unit. The control signal between the indoor unit and the outdoor unit shall be pulse signal 24 volts DC. The unit shall have Pulse Amplitude Modulation circuit to utilize 98% of input power supply.

PART 3 – EXECUTION

3.1 INSTALLATION:

- A. Units shall be installed in accordance with manufacturer's recommendations.
- B. See details for mounting instructions and accessories.

END OF SECTION 15760

1.0 GENERAL:

1.1 SCOPE:

- A. Provisions of this Section shall apply to all HVAC work.

2.0 PRODUCTS:

2.1 HOT GAS REHEAT PACKAGED ROOF TOP AIR CONDITIONING UNITS (ELECTRIC HEATING)

- A. Unit(s) furnished and installed shall be cooling with hot gas reheat as scheduled on contract documents and these specifications. Unit(s) shall consist of insulated weather tight casing with compressor(s), hot gas reheat coil, modulating face and by-pass dampers for hot gas reheat control, air cooled condenser coil, condenser fans, evaporator coil, return air filters, supply motors and drives, and DDC microprocessor controls . The DDC controller must control and modulate Face and By-pass dampers for discharge air temperature, or space temperature, or space humidity control.
- B. Unit(s) shall be factory run tested and fully charged with R-454B.
- C. Unit(s) shall have labels, decals, and/or tags to aid in the service of the unit and indicate caution areas.
- D. Units shall be dedicated downflow, dedicated horizontal airflow or mixed horizontal / vertical as shown on plans. Provide roof curb as required. Provide horizontal discharge curbs as required.
- E. Wiring internal to the unit shall be colored and numbered for identification.
- F. Cabinet: Galvanized steel, phosphatized, and finished with an air-dry paint coating with removable access panels. Structural members shall be 18 gauge with access doors and removable panels of minimum 20 gauge. **Unit construction shall be Double-wall** with insulation sandwiched between inner and outer wall. No insulation shall be in the airstream. Double wall panels must be easily removable with separable panels to inspect the sandwiched fiberglass insulation.
- G. Units cabinet surface shall be tested 500 hours in salt spray test in compliance with ASTM B117.
- H. Cabinet construction shall allow for all service/ maintenance from one side of the unit. Insulation on the doors must not be exposed to the airstream. Unit must be double-wall construction.
- I. Cabinet top cover shall be one piece construction or where seams exist, it shall be double hemmed and gasket sealed.
- J. Access Panels: Water and air tight panels with handles shall provide access to filters, heating section, return air fan section, supply air fan section, evaporator coil section, and unit control section.
- K. Downflow unit's base pans shall have a raised 1 1/8 inch high lip around the supply and return

openings for water integrity.

- L. Insulation: Provide 1/2 inch thick coated fiberglass insulation sandwiched between outer and inner double walls on all exterior panels in contact with the return and conditioned air stream.
- M. The base of the unit shall have provisions for forklift and crane lifting.
- N. Air Filters: 30% efficient factory installed filters shall mount integral within the unit and shall be accessible thru access panels. Two inch thick pleated media glass fiber disposable media filters shall be provided.
- O. Provide evaporator fan section with forward curved, double width, double inlet, centrifugal type fan.
- P. Provide self-aligning, grease lubricated, ball or sleeve bearings with permanent lubrication fittings.
- Q. Outdoor and Indoor Fan motors shall be permanently lubricated and have internal thermal overload protection.
- R. Outdoor fans shall be direct drive, statically and dynamically balanced, draw through in the vertical discharge position.
- S. Provide shafts constructed of solid hot rolled steel, ground and polished, with key-way, and protectively coated with lubricating oil.
- T. Provide heavy duty nickel chromium heating elements internally wired. Heater shall have pilot duty or automatic reset line voltage limit controls and any circuit carrying more than 48 amps shall have fuse protection in compliance with N.E.C.
- U. Heater shall be factory supplied and field installed internal to unit cabinet.
- V. Heater shall be UL and CSA listed and approved and provide single point power connection.
- W. Provide configured aluminum fin surface mechanically bonded to copper tubing coil.
- X. Provide a thermal expansion valve for each refrigeration circuit. Factory pressure test at 450 psig and leak tested at 200 psig.
- Y. Provide drain pan for base of evaporator coil constructed of PVC or galvanized steel with external connections.
- Z. Provide a hot gas reheat coil mounted after the fan discharge with a modulating face and by-pass damper to modulate air thru or around reheat coil as needed to meet programmed air temperature or humidity setpoint. Hot gas reheat coil must be piped in series to condenser coil. Parallel piping is unacceptable.
- AA. **The Hot Gas Reheat Coil must be mounted at least 24" away from the DX coil to prevent radiated heat from evaporating moisture back into the air stream.**
- BB. The DX coil must be **intertwined**; horizontal split coils are not acceptable. The vendor will be responsible for changing the coil out in the field if a horizontal coil is substituted with or without approved submittals.
- CC. Provide internally finned 3/8 " seamless copper tube mechanically bonded to aluminum fins. Factory pressure tested to 450 psig.

- DD. Provide vertical discharge, direct drive fans with aluminum blades. Fans shall be statically balanced.
- Motors shall be permanently lubricated, with integral thermal overload protection in a weather tight casing.
- EE. Compressor(s): Provide scroll compressors with direct drive operating at 3600 rpm. Integral centrifugal oil pump, inlet dirt separator, rolling element bearings, crankcase heater, completely enclosed compression chamber with no leakage paths. Provide suction gas cooled motor with over temperature and over current protection.
- FF. Compressor(s) shall be manufactured by the HVAC unit manufacturer.
- GG. Units shall have cooling capabilities down to 60° F.
- HH. Provide with thermostatic temperature control in the compressor windings, to protect against excessive temperatures, high and low pressure conditions.
- II. Provide 100% outside air hood with birdscreen and multi position osa damper where required with economizer.
- JJ. Provide Differential Enthalpy controlled economizer and barometric relief damper.
- KK. Provide microprocessor unit mounted control (UCM) which when used with an electronic discharge air sensor mounted on the DX coil provides proportional, integral, and derivative supply air control. This UCM shall perform all unit functions by making all heating, cooling and ventilating decisions through resident software logic. The microprocessor shall include several temperature functions. A discharge air sensor mounted after the evaporator coil shall maintain the specified dehumidification temperature. The second temperature sensor shall modulate the hot gas reheat coil face and by pass damper to maintain the specified supply or space air temperature. The third temperature sensor shall monitor suction temperature and lockout compressors to keep the evaporator coil from freezing. The fourth temperature sensor shall monitor liquid line temperature to modulate condenser fans to maintain head pressure. The fifth sensor is a space adjustable temperature or humidity input. The last temperature sensor monitors outdoor air temperature and makes the decision on when to lock out the compressors. All functions of the microprocessor shall be fully programmable and have the capability to be monitored and adjusted thru a laptop computer and/or remote LCD keypad. The UCM shall be Bacnet compatible.
- LL. Units shall be Trane, Carrier, Daikin or approved equal.

3.0 EXECUTION:

3.1 INSTALLATION:

- A. Units shall be installed in accordance with manufacturer's recommendations.
- B. See details for mounting instructions and accessories.

END OF SECTION

1.0 - GENERAL

1.1 Scope

- A. Provisions of this Section shall apply to all HVAC work.

2.0 - PRODUCTS

2.1 Electric Wall Heaters:

- A. UL listed recessed convection heaters with finned sheathed heating elements, resiliently mounted direct driven propeller fan with motor heat shield, circuit breaker, concealed thermostat, concealed "On-Off" switch, high limit controls, and junction box for connecting power wiring.
- B. Cabinets: 16-gauge steel, with pencil proof welded steel bar grilles (bars 1/16" X 3/8" minimum). Equip cabinet with adjustable recessing frame. Finish: Baked enamel, over bonderizing. Architect will select the color from manufacturer's standard selections.
- C. Electric Wall Heaters: 2 KW and larger, Markel 3400 Series, less than 2 KW, Markel Series 3420, or approved equal.

3.0 - EXECUTION

3.1 Installation

- A. Units shall be installed in accordance with manufacturer's recommendations.
- B. See Details for mounting instructions and accessories.

END OF SECTION

1.0 - GENERAL

1.1 Scope

- A. Provisions of this Section shall apply to all HVAC work.

2.0 - PRODUCTS

2.1 Fans, Centrifugal – General

- A. Fan Rating: Certified in accordance with AMCA Standard 210 for capacity and sound. Provide fans of class required for service based on static pressures 20% greater than those scheduled. All fans are to be rated for continuous duty.
- B. Provide forward curved blade, radial blade, backward curved blade or air foil blade fans statically and dynamically balanced with L (10) 80,000 hour rated self-aligning, grease lubricated ball or roller bearings rigidly supported by bearing stands.
- C. For all fans furnish adjustable motor bases or rails.
- D. Size V-belt drives for 50% overload, and provide adjustable pitch motor pulleys for drives of 15 BHP and smaller.
- E. For all fans outside casings provide belt and drive guards.
- F. Provide scroll access doors with quick-operating latches for all exhaust fans.
- G. Equip all fans with flanged outlets and casing drains.
- H. Sound power levels shall not exceed those shown.
- I. Size fan motors to provide at least 5% drive loss, with motor service factors not exceeding 1.0. Provide premium efficiency motors as specified under "MOTORS".
- J. Vibration isolators: See "MATERIALS AND METHODS" Section 15050.

2.2 FANS, CENTRIFUGAL CEILING EXHAUST:

- A. AMCA rated direct drive centrifugal fans for ceiling mounting, complete with removable ceiling grille, disconnect, fan mounted solid state speed control, flexible duct connection, integral backdraft damper and discharge outlet.
- B. Fans shall be manufactured by Greenheck, Cook, Acme, Twin City, or approved equal.

3.00 INSTALLATION:

- A. Fans shall be installed in accordance with manufacturer's recommendations.
- B. See details for mounting instructions and accessories.

END OF SECTION

SECTION 15840 - Ductwork

PART 1 – GENERAL

1.1 SCOPE:

- A. Include Section 15010, "GENERAL PROVISIONS - HVAC", with this section.
- B. Provisions of this Section shall apply to all HVAC work.

1.2 SHOP DRAWINGS:

- A. Ductwork shop drawings shall include details of duct constructions: seams, joints, gauges, reinforcing and hanger details for each pressure class and size range together with details of turning vanes, branch connections, dampers and access doors and elevations of all ductwork.

PART 2 - PRODUCTS

2.1 DUCTWORK - GENERAL:

- A. Unless otherwise shown or specified construct ducts of galvanized steel sheet metal using gauges and recommended details as contained in the current edition of the SMACNA HVAC Duct Construction Standards. Ductwork shall include supply air, exhaust air, return air, and outdoor air ducts, together with all necessary fittings, splitters, dampers, quadrants, flexible connections, sleeves, hangers, support, braces, etc. Hang and install ducts in a neat and workmanlike manner from structural members (not roof deck) with adequate bracing and cross bracing to prevent breathing, rattling, and vibration.
- B. No flexible ductwork on return, exhaust or outside air.
- C. Install Duro-Dyne locking quadrants and Duro-Dyne end bearings on all splitters and manual volume dampers located above accessible ceiling and Young #1 regulator, C.P., and Duro-Dyne end bearings elsewhere.
- D. Duct dimensions shown are net inside dimension and do not include insulation thickness.
- E. Duct Turns: Wherever possible, duct turns shall have a centerline radius equal to 1.5 times the duct width in the plane of the turn. Vane other duct turns to provide a dynamic loss co-efficient ("C") not greater than 0.2. No reducing ells or tees to be used.
- F. Duct Sealing: Seal duct seams and joints as noted below. Seal entire circumference of all branch duct connections, tapping collars and spin-ins. Seal ducts using mastic sealant equal to United Duct Sealer.
 - 1. Class "A" Seal: Seal all joints and seams and leak test as specified.
 - 2. Class "B" Seal: Seal entire circumference of all transverse joints, seal all longitudinal joints.
 - 3. Class "C" Seal: Seal entire circumference of all transverse joints.
 - 4. Class "D" Seal: Seal corner of transverse joints.

2.2 DUCTWORK - LOW PRESSURE:

- A. Ductwork: Low Pressure, Pressure and Seal Class shall include: all supply, return, exhaust and outside air ductwork, 2" pressure class, "B" seal.
- B. Construct ducts in accordance with SMACNA Duct Construction Standards for pressure and seal classes noted.

2.3 DUCTWORK LOCATED OUTDOORS:

- A. Seal all seams weather tight using glass cloth tape and carbolastic or United Duct Sealer.

2.4 Ductwork, Plenum Casing:

- A. Include all plenum chambers and enclosures for air passage between air intakes, filters, heating and cooling coils and fans. Unless otherwise shown the floors under casings shall serve as the bottom and sides and tops shall be constructed of sheet metal. Provide concrete pads (4" min. height) under all casings. Any passage definitely shown above and clear of floor shall not be classed as a casing and shall be constructed as specified for ducts.
- B. Construct all exterior walls of casings, partitions between decks and fan discharge partitions of 4" thick factory furnished insulated panels having 20 gauge galvanized steel outer skin, 20 gauge perforated galvanized steel inner skin, fiberglass insulation (flame spread 10 20, fuel contributed 10 15, smoke developed 0 20) (and 0.002" thick mylar film between insulation and perforations). Assemble casing panels with joining members to provide structural rigidity to 10" WG pressure differential. Reinforce and support panels as recommended by panel manufacturer. Minimum "U" value (still air both sides) 0.06 Btu/hr sq. ft. F. Minimum NRC 0.95, minimum STC 37. Casing joints and seams shall be air tight under 8" WG pressure and casing joints will be fully insulated to prevent sweating.
- C. Construct portions of casings other than the panels specified above of 18 gauge galvanized steel with standing seams 42" on center. Locate 2" standing seams on casing perpendicular to direction of air flow. Seal seams with United Duct Sealer and fastened with bolts or tinnier's rivets 6" O.C., reinforce casings with members sized and spaced as follows: $I = 3 \times SP \times C \times L/1000 \times L/1000 \times L/1000$. Where I = moment of inertia of section, inches fourth, SP= static pressure, ins. WG, C = member spacing inches, L = member length, inches.
- D. Brace casings diagonally with 2 X 2 X 3/16 angles and stay as required.
- E. Calk casing floor angles to pads and secure with expansion bolts 12" O.C.
- F. Construct drain pans inside with double construction with insulation between pans and 16 gauge type 304 stainless steel inner pan with welded joints.
- G. Install coil racks of galvanized angle iron inside casings to permit removing coils without dismantling casings. Equip cooling coils with intermediate drip troughs and eliminators as shown. Pipe drip troughs to main drain pans.
- H. Provide access doors where shown and/or required for access to equipment and/or controls. Construct doors with 1" insulation between two (2) sheets 24 gauge galvanized steel. Set doors in frames arranged so that doors will be flush with exterior of casing. Equip each door with at least two (2) hinges and two (2) sets of double acting latches. Latches shall be made from non ferrous metal, with a lever handle on the outside and a lever handle on the inside of the casing. Lever handle on the outside of the casing shall cam over a door pull with a stop. Latches shall be Vent Fabrics #310 Ventlok latch, or equal. Doors shall be reinforced to prevent

wracking and warping. Provide 3" butt hinges and weld to doors and to door frames.

2.5 FLEXIBLE DUCTS:

- A. Flexible duct connectors: A two (2) element spiral construction composed of galvanized steel supporting spiral and coated woven textile fabric with metal or mineral base, UL listed as Class I Air Duct and Connector (UL 181) minimum R=6.0.
- B. Flexible connectors shall not exceed 5 feet in length.
- C. Make connections between flexible ducts and other equipment using galvanized steel draw bands with plated screws and buckles and United Duct seal for high and medium pressure ducts and nylon draw bands for low pressure ducts.
- D. Factory insulate cold flexible ducts using insulation equivalent to that specified for cold ducts.
- E. Flexible ducts: Thermoflex M-KC, Wiremold 57K, Technaflex 57K, or Flexmaster Type 4M. Submit sample for approval of any other manufacturer.

PART 3 – EXECUTION

3.1 INSTALLATION:

- A. Ductwork shall be installed in accordance with manufacturer's recommendations.
- B. See details for mounting instructions and accessories.

END OF SECTION 15840

SECTION 15860 – Duct Accessories

PART 1 – GENERAL

1.1 SCOPE:

- A. Provisions of this Section shall apply to all HVAC work.

PART 2 – PRODUCTS

2.1 SHEET METAL SPECIALTIES:

- A. Make rectangular take-offs in low pressure supply, return and exhaust ducts using 45 degrees entry tap (SMACNA Duct Construction Standards Figure #2-8) with manual damper with end bearings and locking quadrant in branch. End bearings and quadrants shall have air tight duct connections and shaft seals: Ruskin, Duro-Dyne, or approved equal.
- B. Manual balancing dampers: Comply with SMACNA Duct Construction Standards, Figure 2-14 and 2-15. Equip all dampers with locking quadrants and end bearings. End bearings and quadrants shall have air tight duct connections and shaft seal, Ruskin, Duro-Dyne, or approved equal.
- C. When damper quadrants are located other than above lay-in ceilings.
 - 1. Provide all necessary accessories for remote control of balancing dampers without requiring access doors. Substitute Young #1 regulators and an additional end bearing or Ventlock #688 regulators and an additional end bearing for the quadrant (regulators shall be chrome plated), or, Architect/Engineer option.
 - 2. Provide access door for access to the quadrant (See sub-section 2.5 "ACCESS DOORS", hereinafter).
- D. Provide "Stand-Offs" (hat sections) for damper quadrants, controls, etc., on externally insulated ducts.
- E. Branch duct connections for connecting round low pressure branches to rectangular low pressure trunks: spin-in fittings with integral dampers with end bearings, stand-off and beaded collars. Seal Class of components penetrating duct shall be consistent with duct pressure class. Spin-in shall be Flexmaster – FLD or equal. Submit sample for approval of other manufacturers for prior approval.

2.2 FIRE DAMPERS:

- A. Install UL labeled 1-1/2 hour fire dampers wherever sheet metal ducts pass through chase walls, floors, outside fire chases, and elsewhere as shown or required by local Code. Install dampers per SMACNA "Fire Damper Guide" and UL 555.
 - 1. Fire dampers shall be Type "B" "Venation Blind" dampers. Unless otherwise shown folded blades shall not obstruct duct. Dampers in floors shall be spring loaded.
 - 2. Provide factory fabricated steel integral wall sleeve 3" longer than wall thickness for each fire damper and install sleeve using bolts and angles as detailed in Figure #1 of SMACNA "Fire Damper Guide".
 - 3. Provide rectangular, round and/or flat-oval collars. See Drawings for sizes and

locations.

4. For aluminum ductwork provide stainless steel fire dampers.
- B. Install ceiling fire dampers in all fire rated ceiling as shown in Figure #11 of SMACNA "Fire Damper Guide" at ceiling penetrations as noted. Fire rated diffuser assembly to be approved for the specific UL Classification of the ceiling assembly used.
- C. Install access door in medium pressure ducts downstream from each fire damper. Install access door in low pressure ducts at each fire damper. Install wall or ceiling access door for access to fire dampers not accessible through lift-out ceilings. See sub-section 2.5 "ACCESS DOORS", below.
- D. Install three (3) hour fire dampers where sheet metal ducts pierce 4 hour fire walls. Three (3) hour fire damper shall consist of a three (3) hour UL labeled fire door pivoted in a 3" X 3" X 1/4" angle frame bolted through wall. Equip door frame with angle flange and latch. Install Fire Door as shown in Figure 25 and 26 of SMACNA "Fire Damper Guide".

2.3 AUTOMATIC DAMPERS:

- A. Factory fabricated dampers with extruded aluminum airfoil blades and frame with full gasket stops for blades ends. Equip blades with air tight plastic or butyl rubber seals and bronze or nylon bearings. Provide jamb seals. Damper widths from 12" to 60" wide shall not leak any greater than 8 cfm sq. ft. at 4" w.g. and a maximum of 3 CFM sq. ft. at 1" w.g. Ruskin CD50 or approved equal.
- B. Automatic dampers located near fan outlets or in ducts having maximum velocities exceeding 1500 FPM shall have extruded aluminum air-foil blades and all linkages shall be located outside of airstream. Such dampers shall have leakage rates not exceeding 1% maximum design flow at 4" WG pressure differential.

2.4 SMOKE DETECTORS:

- A. Smoke detectors will be furnished and wired under Electrical Work but shall be installed in ducts under this Section.
- B. Locate smoke detectors so that indicating lights are visible and so that they will not be affected by moisture from coils or humidifiers.
- C. Install access door in duct at each smoke detector. (See sub-section 2.5 "ACCESS DOORS", hereinafter).

2.5 ACCESS DOORS:

- A. Access doors in low pressure ducts: Galvanized steel frame with gasket permanently secured to duct with a removable gasket access port held in place with screw driver or thumb operated latches. Door in insulated ducts: Double thickness with insulation. Doors in non-insulated ducts: A single thickness. Weld door frames to kitchen exhaust ducts. Size doors to permit removal of equipment or maintenance. Minimum size 12" X 12".
- B. Access doors in high and medium pressure supply ducts: Combination access/vacuum relief doors consisting of a galvanized steel frame welded to duct with double wall inwardly-opening transparent plastic door. Latches shall secure plastic door to frame but release door into duct to act as a vacuum breaker. Attach a restraining chain to frame and door. Door size (minimum) 8" X 12" for round ducts up to 12" diameter, and oval or rectangular ducts up to 16" maximum side; 12" X 12" for round ducts 13" to 18" and oval or rectangular ducts 17" X 24" maximum side and 14" X 20" for larger ducts. Doors shall be tight under 10" WG pressure and shall pop open under 6" WG vacuum.

- C. Mark access points in lift-out ceilings with brass paper brads. Bend points of brads over top of ceiling.

2.6 FLEXIBLE DUCT CONNECTIONS:

- A. Install Neoprene coated glass cloth flexible connections at all duct connections to all fans and AC Units.
- B. Install flexible connections in all ducts at building expansion joints.

2.7 ELECTRICAL GROUNDING:

- A. Ground all fans.
- B. Install braided copper jumpers around all flexible connections, taking care that jumpers do not bind flexes.

PART 3 – EXECUTION

3.1 INSTALLATION:

- A. Duct shall be installed in accordance with SMACNA Standards.
- B. Equipment shall be installed in accordance with manufacturer's recommendations.
- C. See details for mounting instructions and accessories.

END OF SECTION 15860

SECTION 15870 - Outlets

PART 1 – GENERAL

1.1 SCOPE

- A. Include section 15010 "GENERAL PROVISIONS" with this section.
- B. Provisions of this Section shall apply to all HVAC work.

PART 2 – PRODUCTS

2.1 GRILLES, REGISTERS AND DIFFUSERS:

- A. General: Air devices may be Titus, Price, Metal Aire, Krueger, Tuttle & Bailey or approved equal. Where fire dampers are required at grilles, provide steel grilles, not aluminum.
- B. Architectural Supply Diffuser (S): The diffuser shall have a heavy gauge aluminum face panel, which shall be a one piece assembly, removable by means of four positive locking posts. The exposed surface of the face panel shall be smooth, flat, and free of visible fasteners. The face panel shall project 1/4" below the outside border of the diffuser back pan. The back of the face panel shall have an aerodynamically shaped, rolled edge to ensure a tight horizontal discharge pattern. The back pan shall be one piece precision die-stamped and shall include an integrally drawn inlet. The diffuser back pan shall be constructed of heavy gauge aluminum. The finish shall be #26 white. The pencil hardness must be HB to H. Directional blow clips shall be provided to restrict the discharge air in certain directions. The manufacturer shall provide published performance data for the square panel diffuser. The diffuser shall be tested in accordance with ANSI/ASHRAE Standard 70-1991. Diffuser shall be Titus "OMNI-AA".
- C. Supply Registers (SR): Adjustable vertical deflection, adjustable horizontal deflection, removable core, opposed blade damper and multi-blade scoop and baked aluminum enamel finish. Titus "272".
- D. Wall Return Grilles (WRG): Horizontal bars fixed at about 35° angle, close spacing and plaster frames. Baked aluminum, enamel finish. Titus "350".
- E. Bar Return Grille (BRG): All steel, heavy duty, 16 gauge border, 14 gauge blades, 1/2" spacing, 38° deflection. Provide all frames. Titus "33R". All BRG's are to appear as a one piece grille. BRG's are to be painted as selected by architect. Submit color chart to architect.
- F. Ceiling Return Grilles (R), Ceiling Exhaust Grilles (E) and Transfer Air Grilles (TAG): All aluminum, 1/2" X 1/2" X 1/2" cube core and plaster frames as needed. Off-white baked enamel finish. Provide 24 x 24 panel so grille will fit in 24 x 24 ceiling grid. Titus "50F".

2.2 Weather Louvers

- A. Louvers shall be 6" thick extruded aluminum louvers with 12 gauge blades with drainable head frame, drainable blades, water stop, and with angled sill. 57% F.A. minimum. Equip with 1/2" mesh aluminum birdscreen on inside of louver. Finishes: Kynar. Submit color sample to Architect (20 year warranty on finish). Ruskin ELF6375DX, Louvers & Dampers, Greenheck, Airolite, or approved equal.

PART 3 – EXECUTION

3.1 INSTALLATION:

- A. Equipment shall be installed in accordance with SMACNA Standards and manufacturer's recommendations.
- B. See details for mounting instructions and accessories.

END OF SECTION 15870

1.00 GENERAL:

1.01 SCOPE:

- A. Provisions of this section apply to all HVAC work.

2.00 PRODUCTS:

2.01 FILTERS - AIR:

- A. 30% Filters, 1" or 2" Thick (Maximum allowed by MFR): Throwaway deep pleated filters, maximum face velocity 350 fpm. Maximum initial pressure drop 0.1" WG, UL Class 1, 30% efficiency per ASHRAE Test Standard 52-76, minimum ratio of media area to face area 4.4:1. Turn system over to Owner with clean filters and provide one (1) set of spare filters. Farr 30/30 or approved equal.

3.00 EXECUTION:

3.01 INSTALLATION:

- A. Filters shall be installed in accordance with manufacturer's recommendations.
- B. See details for mounting instructions and accessories.

END OF SECTION

1.00 GENERAL:1.01 SCOPE:

- A. Include Section 15010 "GENERAL PROVISIONS", with this Section.
- B. Provisions of this Section shall apply to all HVAC work.

2.00 PRODUCTS:2.01 CONTROL SYSTEMS:

- A. Furnish and install complete and ready for operation a control system with control sequences specified below.
- B. Products of a manufacturer maintaining complete service and parts facilities in Alabama continuously for the last three (3) years: Trane, Carrier, or approved equal.
- C. Control equipment, except for items comprising an integral part of the water or refrigeration piping, shall be installed by trained mechanics employed by the Control Manufacturer.
- D. Include the services of a full time control technician for calibrating and adjusting controls for the first 3 working days after Owner has occupied building.
- E. Before installation, submit for approval five (5) copies of complete power and control wiring and piping diagrams. Hang a photostatic copy of the approved diagram, framed behind glass, in each equipment room. Provide one (1) set of reproducible sepias of "As-Built" control diagrams at completion of project for the Owner's use.
- F. Provide permanent nameplates for control switches and motor starters. Nameplates: engraved laminated plastic with letters legible under normal operating conditions. (White on black).
- G. Permanently identify control devices other than room thermostats, so they may be identified on control diagrams. Provide engraved plastic nameplates for items mounted outside of or on faces of panels. Mark other instruments with indelible ink.

2.02 CONTROL WIRING:

- A. Include control and interlock wiring and power wiring for control panel in this Section. Install in conduit in accordance with provisions of Electrical Work where exposed, concealed in walls or above ceilings other than lay-in type. Provide plenum rated cable above lay-in ceilings (for plenum or non-plenum).
- B. Waterproof and firestop all conduit floor penetrations. Firestop conduit penetrations of fire rated walls partitions.
- C. Wire all devices individually to terminal strips in control panels.
- D. Furnish necessary relays and auxiliary contactors and other accessories required. Provide interlock relays per NEC. Coordinate start-stop stations, auxiliary contacts, etc., with supplier of Starters, Variable Frequency Drive (VFD) and Motors Control Centers specified in Electrical Work.

2.03 CONTROL DEVICES:

- A. Room Thermostats: (Provide seven (7) day occupied/unoccupied, 24 hour, multi-stage programmable thermostats, with 3-hour override, and battery back-up. Thermostats to be provided with local control. Thermostat covers: lockable high impact plastic. Mount room thermostats with tops 4 feet above floors. Provide switches and Hand – Off – Auto switches (H-O-A) as required.
- B. Remote Bulb Thermostats and Temperature Transmitters: Unless otherwise shown use averaging elements not less than 12 feet long for duct or casing cross sections for each 24 square feet of face

area.

- C. Thermometers: Pipe line thermometers are specified in another Section. Install digital readout thermometers in ducts where shown on control diagrams, providing averaging bulbs where shown and/or required.
- D. Freezestats: Manual reset, pneumatic not permitted. Locate freezestat bulbs between preheat and chilled water coils in units with chilled water coils and downstream from DX coils in units with DX coils. Provide coverage for each 3' X 3' coil face area section.
- E. Firestats: Single pole double throw, electric, manual reset, pneumatic not permitted. Firestats shown to be connected to the fire alarm system: compatible with fire alarm system, furnished and installed under Controls, wired under Electrical Work. Firestats to be installed in all fans where smoke detectors are not furnished.
- F. Program Clocks / Timers:
Provide digital time clock with 365 day holiday capabilities with 24 single dates, 99 setpoints, separate scheduling for each day of the week, AM/PM format, one minute programming resolution, portable memory module, optional programmer for integration into a Windows based PC for program duplication and modifications, LCD display, daylight savings or standard time, automatic leap year correction, permanent schedule retention, 100 hours of backup, manual override, Nema 3 indoor/outdoor enclosure. Clock/Timer to be Tork or approved equal.
- G. Valve and Damper Operators: Of sufficient power to close/open valves and dampers under operating conditions. Electric valve and damper motors shall have oil immersed gear trains and spring return to normal position. Valves and damper operators to have DDC Controls.
- H. Wells: Install pipe line mounted control and indicating devices in stainless steel or brass thermometer wells.
- I. Capillary Supports: Securely support all duct-mounted and casing- mounting thermostat capillaries using factory fabricated copper bulb supports.
- J. Provide stand-offs for control devices mounted on externally insulated ducts and equipment.
- K. Anchor all items mounted on gypsum board (dry-wall) using toggle bolts or moly bolts, not expansion shields.
- L. Air flow Measuring Station (AFMS): Provide AFMS with probe, transmitter and cable. Unit to average velocity profile thru multiple probes and provide average readout in CFM on transmitters LED screen. Provide 0-10VDC and 4-20MA output (field selectable) to BMCS. Sensor accuracy to be 2%, installed accuracy to be 3%. ARMS to be Ebtron model GTX116.
- M. Hand-Off-Auto switches (H-O-A): Provide 3 position dial switches (one for each exhaust/supply fan as scheduled). Switches for fans shall be grouped together in panels by building section. Locate panels in nearest Mechanical / Electrical room or where shown (coordinate location with G.C. & owner).

2.04 CONTROL POWER:

- A. All 120 Volt wiring shall be the responsibility of the Control Sub-Contractor from circuit furnished under Electrical Section. Coordinate circuit locations with General and Electrical Contractors.
- B. Power wiring to all automatic dampers shall be included under this section.
- C. Wiring and relays between light and fans for interlock shall be included under this section.

2.05 CONTROL PANELS:

- A. Local Control Panels: Construct of galvanized steel with baked enamel finish or aluminum-plywood-aluminum fronts and backs and extruded tops, bottoms, and ends. All panels

shall have piano hinges and key locking latches (key panels alike). Permanently label instruments located in panels consistent with labeling on control diagram. Cement photostat of approved diagram inside each panel cover. (Include Local-Remote switching for control point adjusters on face of each panel).

2.06 CONTROL SEQUENCES:

- A. As shown on drawings.

3.00 EXECUTION:

3.01 INSTALLATION:

- A. Control diagrams on drawings and/or Control Sequences are intended to indicate, in general, control arrangements. Provide all instruments, relays, operators, switches, etc. required to accomplish control sequences whether or not such devices are actually shown.

END OF SECTION 15900

PLUMBING IDENTIFICATION – SECTION 15405

PART 1 - GENERAL

1.01 SUMMARY

- A. This Section includes the following plumbing identification materials and their installation:

1. Pipe markers.
2. Valve tags.
3. Valve schedules.
4. Equipment labels.
5. Warning signs and labels.

1.02 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Valve numbering scheme.
- C. Valve Schedules: For each piping system. Furnish extra copies (in addition to mounted copies) to include in maintenance manuals.

1.03 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.04 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.01 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Pre-tensioned Pipe Markers: Pre-coiled semi-rigid plastic formed to cover full circumference of pipe and to attach to pipe without adhesive.
- C. Self-Adhesive Pipe Markers: Are not allowed

2.02 VALVE TAGS

- A. Valve Tags: Stamped or engraved with 1/4-inch letters for piping system abbreviation and 1/2-inch numbers, with numbering scheme approved by Architect. Provide 5/32-inch hole for fastener.
1. Material: 3/32-inch thick laminated plastic with 2 black surfaces and white inner layer.
 2. Valve-Tag Fasteners: Brass wire-link chain, beaded chain or S-hook.

2.03 VALVE SCHEDULES

- A. Valve Schedules: For each piping system, on standard-size bond paper. Tabulate valve number, piping system, system abbreviation (as shown on valve tag), location of valve (room or space), normal-operating position (open, closed, or modulating), and variations for identification. Mark valves for emergency shutoff and similar special uses.
1. Valve-Schedule Frames: Glazed display frame for removable mounting on masonry walls for each page of valve schedule. Include mounting screws.
 2. Frame: Extruded aluminum.
 3. Glazing: ASTM C 1036, Type I, Class 1, Glazing Quality B, 2.5-mm, single-thickness glass.

2.04 EQUIPMENT LABELS

- A. Plastic Labels for Equipment:

1. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
2. Color Coding:

<u>System</u>	<u>Background Color</u>	<u>Letters</u>
Other equipment	Black	White

3. Temperatures up to 160 deg F.
4. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
5. Letter shall be a minimum of 1/2" high. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
6. Fasteners: Stainless-steel self-tapping screws.
7. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.

- B. Label Content: Include equipment's Drawing designation or unique equipment number.

2.05 WARNING SIGNS AND LABELS

- A. Material and Thickness: Multilayer, multicolor, plastic labels for mechanical engraving, 1/16 inch thick, and having predrilled holes for attachment hardware.
- B. Letter Color: White.
- C. Background Color: Yellow.
- D. Maximum Temperature: Able to withstand temperatures up to 160 deg F.
- E. Minimum Label Size: Length and width vary for required label content, but not less than 2-1/2 by 3/4 inch.
- F. Minimum Letter Size: Minimum 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
- G. Fasteners: Stainless-steel self-tapping screws.
- H. Adhesive: Contact-type permanent adhesive, compatible with label and with substrate.
- I. Label Content: Include caution and warning information as indicated elsewhere in the specifications and on the Drawings.

PART 3 - EXECUTION

3.01 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 15 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.02 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
1. Pipes with OD, Including Insulation, Less Than 6 Inches: Pre-tensioned pipe markers. Use size to ensure a tight fit.
 2. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, [at least 3/4 inch] [1-1/2 inches] wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 3. Pipes with OD, Including Insulation, 6 Inches and Larger: Shaped pipe markers. Use size to match pipe and secure with fasteners.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.
- B. Locate pipe markers and color bands where piping is exposed or above accessible ceilings in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior non-concealed locations as follows:
1. Near each valve and control device.
 2. Near each branch connection, excluding short takeoffs for fixtures. Where flow pattern is not obvious, mark each pipe at branch.
 3. Near penetrations through walls, floors, ceilings, and non-accessible enclosures.
 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 5. Near major equipment items and other points of origination and termination.
 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 7. Label 2 psi gas piping at 6 foot intervals.

3.03 VALVE-TAG INSTALLATION

- A. Install tags on valves and control devices in piping systems, except check valves; valves within factory-fabricated equipment units; plumbing fixture supply stops; shutoff valves; faucets; convenience and lawn-watering hose connections; and HVAC terminal devices and similar roughing-in connections of end-use fixtures and units. List tagged valves in a valve schedule.
- B. Valve-Tag Application Schedule: Tag valves according to size, shape, and color scheme and with captions similar to those indicated in the following:
1. Valve-Tag Size and Shape:
 - a. Cold Water: **2 inches square.**
 - b. Hot /HWR Water: **2 inches square.**
 - c. Fire Protection: **2 inches square.**
 2. Valve-Tag Color:
 - a. Cold Water: **Natural.**
 - b. Hot Water: **Blue.**

c. Fire Protection: **Red.**

3. Letter Color:

a. Cold Water: **White**

b. Hot Water: **White.**

c. Fire Protection: **White.**

3.04 VALVE-SCHEDULE INSTALLATION

A. Mount valve schedule on wall in accessible location in each major equipment room.

END OF SECTION 15405

1.00 GENERAL:

1.01 SCOPE:

- A. Provisions of this Section apply to all Plumbing and Fire Protection work.
- B. Include the provisions of General, Supplementary and Special Conditions and provisions of the Specifications shall apply to and form a part of this Section.
- C. Provide all labor, materials, equipment, and services necessary for the completion of all work shown or specified, except work specifically specified to be done or furnished under other sections of the Specifications. Include performing all operations in connection with the complete installation in strict accordance with the specification and applicable drawings subject to the terms and conditions of the Contract, for the following system:
 - 1. A system of sanitary waste and vent piping.
 - 2. A system of domestic water piping.
 - 3. A system of fire protection piping.
- D. Give required notices, file drawings obtain and pay for permits, deposits and fees necessary for the installation of the work. Obtain and pay for inspections required by laws, ordinances, rules, regulations or public authority having jurisdiction. Obtain and pay for certificates of such inspections, and file such certificates with Owner.
- E. "Provide" means to furnish and install, complete and ready for operation.

1.02 DRAWINGS:

- A. Drawings are diagrammatic and subject to requirements of Architectural Drawings. Drawings indicate generally the location of components and are not intended to show all fittings or all details of the work. Coordinate with Architectural, Structural, Electrical, HVAC and other Building Drawings.
- B. Follow the Drawings closely, check dimensions with Architectural Drawings and field conditions. DO NOT scale Drawings for location of system components.
- C. Make no changes without Architect's written permission. In case of doubt, obtain Architect's decision before proceeding with work. Failure to follow this instruction shall make the Contractor liable for damage to other work and responsible for removing and repairing defective or mis-located work.
- D. Do not scale Drawings to locate sprinkler heads. Coordinate with lighting, ceiling grids, ceiling diffusers and/or reflected ceiling plans. Install Sprinkler Heads in center of ceiling tiles.

1.03 APPLICABLE CODES AND STANDARDS:

- A. Comply with the current editions of the following Codes and Standards:
 - 1. ANSI/ASHRAE 15 - Code for Building Services Piping.
 - 2. NFPA 70 - National Electrical Code.
 - 3. NFPA 101 – National Life Safety Code.
 - 4. Other Standards as referenced in other Sections of Division 15.

5. Local Building Code (International Building Code if no local Building Code in effect).
6. Local Plumbing Code (International Plumbing Code if no local Plumbing Code is in effect).
7. Local gas code (International Gas Code if no local code is in effect).
8. NFPA 13 - Sprinkler System installation.
9. NFPA 24 – Installation of Private Fire Service Mains.
10. NFPA 110 - Emergency and standby power.
12. NFPA 72 - National Fire Alarm and Signaling Code.
13. 13. NFPA 20 - Installation of Fire Pump

1.04 QUALIFICATIONS OF SUBCONTRACTOR:

A. The Plumbing Contractor shall meet the following qualifications:

1. The Plumbing Contractor must be approved by the Architect.
2. The Plumbing Contractor shall have been in business as a Plumbing Contractor for at least three (3) years prior to Bid Date. He shall have a current Master's Plumber's Certificate and Gas Certificate of competency issued by the State of Alabama and the city and county in which work occurs.
3. The Plumbing Contractor shall have a satisfactory experience record with Plumbing installations of character and scope comparable with this project, and for at least three (3) years prior to the Bid Date and shall have had an established service department capable of providing service inspection or full maintenance contracts.

B. The Fire Protection Sub-Contractor shall meet the following qualifications:

1. The Fire Protection Contractor shall be approved by the Architect,
2. The Fire Protection Contractor shall have been in business as a Fire Protection Contractor for at least three (3) years prior to the Bid date and shall be licensed by the State, County and City in which the work will be performed.
3. The Fire Protection Contractor shall have a satisfactory experience record with Fire Protection installations of character and scope comparable with this project and shall have completed three (3) such installations in the past three (3) years.
4. The Fire Protection Contractor shall be a Registered Engineer in the State in which the work occurs or be a Nicet Level 3.
5. The Fire Protection Contractor shall be the employer of the NICET Level 3 Designer. The NICET Level 3 designer will oversee installation and provide in closeout documentation.

1.05 CONFLICTS AND INTERFERENCES:

- A. If systems interfere or conflicts, the Architect shall decide which equipment to relocate regardless of which was first installed.

1.06 WORKMANSHIP:

- A. Do all work in a neat and first-class manner. Remove and replace work not done in such manner as directed by the Architect.

1.07 COOPERATION:

- A. Cooperate with all other crafts. Perform work in a timely manner. Do not delay the execution of other work.

1.08 VISITING SITE:

- A. Visit site and become familiar with location and various conditions affecting work. No additional allowance will be granted because of lack of knowledge of such conditions.

2.00 PRODUCTS:

2.01 MATERIALS, SUBSTITUTIONS AND SUBMITTALS:

- A. Unless otherwise noted, provide new, standard, first-grade materials throughout. Equipment and materials furnished shall be fabricated by manufacturers regularly engaged in their production and shall be the standard and current model for which replacement parts are available. Equipment shall be substantially the same equipment of a given manufacturer which has been in successful commercial use and operation for at least three (3) years.
- B. Where materials or products are specified by manufacturer's name, brand, trade name, or catalog reference, such named materials or products shall be the basis of the Bid, without substitution, and shall be furnished under the Contract unless requests for substitutions are approved as noted below. Where two or more brands are named the choice of these shall be optional with the Contractor.
- C. Substitutions will be considered only if written request for approval has been received by the Architect TEN (10) DAYS prior to the date established for receipt of Proposals. Each request shall include the name of the material or equipment for which substitution is proposed and a complete description of the proposed substitute including drawings, cuts, performance and test data, samples and any other information necessary for evaluation. A statement setting forth any changes in other materials, equipment or other Work that incorporation of the substitute may require shall be included. The burden of proof of the merit of the proposed substitute is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution is final.
- D. If the Architect approves any proposed substitution prior to receipt of Proposals, approval will be set forth in an Addendum. DO NOT rely upon approvals made in any other manner.
- E. No substitutions will be considered after the Contract has been executed, except as described in the General Conditions.
- F. Submittal data and shop drawings shall be submitted at one time, partial submittals will not be considered. Within 30 days of execution of Contract and before ordering materials and equipment, submit to Architect and obtain his approval of a detailed list showing each item which is to be furnished by make, trade name, catalog number, or the like; together with manufacturer's specifications, certified prints, and other data sufficient for making comparisons with items specified. When approved, such schedule shall be of equal force with these specifications in that no variation there from shall be allowed except with Architect's written approval. Number of Shop Drawings and procedure shall be as directed by the Architect.
- G. All pressure vessels shall be constructed and tested in accordance with applicable ASME Codes and shall bear ASME stamps. Certificates of inspection and approval shall be submitted to Architect.
- H. Similar items of equipment shall be the product of the same Manufacturer.
- I. See section, "ALTERNATES" in other sections of the Specifications and Bid accordingly.

2.02 SHOP DRAWINGS:

- A. Before starting work, submit and obtain approval of the following:

1. Equipment piping.
 2. Plumbing Equipment, Products and Fixtures.
- B. Thirty (30) days before starting work, submit Fire Protection Shop Drawings bearing the Seals of the Owner's underwriters and all governmental agencies having jurisdiction. Shop Drawings will not be considered without these seals. Complete shop drawings are required to be submitted at one (1) time.
1. Piping routing showing sizes, dimensions, elevations, and head locations (coordinate with reflected ceiling plan). Provide minimum six (6) sets of blue line drawings.
 2. Provide a sprinkler head layout on a reflected ceiling plan. Indicate on plan all lights, HVAC ceiling air devices, smoke detectors, exit lights and any other ceiling attachments. Adjust locations of heads after Architectural review.

2.03 RECORD DRAWINGS:

- A. When work starts obtain from Architect two (2) complete sets of white prints of the **Plumbing**. All corrections, variations, and deviations, including those required by change orders, if any, must be recorded in colored ink or colored pencil at the end of each working day on these drawings. The marked prints shall be available at all times for the Architect's inspection.
- B. Prior to examining the request for final payment or making any response thereto, the Architect shall receive from the Contractor one (1) complete set of the white prints, marked as stated above, indicating the actual completed installation of the work included under this Contract.
- C. The Architect will forward the marked white prints to the Consulting Engineers for review. They will then be returned by the Architect to the Contractor for use in preparing record drawings.
- D. When work is completed Contractor shall purchase from the Architect (At Architects' printing cost) one (1) set of reproducible electronic files and prints of Plumbing Drawings for use in preparing record drawings. Contractor shall transfer the information from the marked white prints to the dwg record drawings, removing all superseded data in order to show the actual completed conditions.
 1. Accurately show location, size and elevation of new exterior piping work and its relationship to any existing piping and utilities, obstructions, etc., contiguous to the area of work.
 2. Block out areas modified by change-order and identify them by change-order number.

2.04 ELECTRICAL EQUIPMENT:

- A. Provide electrical equipment compatible with the current shown on electrical drawings.
Verify current characteristics before ordering equipment.
- B. Should the Contractor with the Architect's/Engineer's approval make changes in electrical equipment from those shown on the Electrical Drawings, he shall be responsible for the coordination and cost of required changes.
- C. Provide factory installed fuses in all equipment requiring fusing for branch circuit protection.
- D. Verify electrical characteristics of all equipment and voltages available with Electrical Section prior to ordering any electrical equipment.

2.05 SLEEVES:

- A. Refer to the Architectural Life Safety Drawings for wall ratings and close all openings to match rating of wall.
- B. Submit details of all pipe penetrations thru rated walls indicating wall construction, penetrating

material and method of closing penetration including materials and listing of detail.

- C. All Penetrations thru walls are to be closed. If the wall is not rated, sheet rock joint compound may be used to close space around piping. For walls with ratings opening shall be closed with a U.L. Listed rating system compatible with wall rating. Insulation is to be continuous thru all openings.
- D. For pipe through floors inside rated chases or through non-fire-rated walls: 20 gauge galvanized steel sleeve 1/2" larger than pipe or pipe covering. Pipe insulation to be continuous thru sleeve. Seal opening between sleeve and pipe or pipe covering
- E. For uninsulated pipe through 2 hour fire rated walls, partitions or floors outside chases: Hilti FS605 with sleeve, U.L. Listing #WL1056.
- F. For insulated pipe passing through fire rated partitions or walls or floors outside chases: Hilti #FS611A with no sleeve, U.L. Listing #WL5029. Insulation: 1" thick fiberglass continuous thru wall.
- G. For pipe passing thru concrete floor, concrete walls, and concrete block walls:
 - 1. Uninsulated Schedule 40 steel and copper: Hilti #FS605 with sleeve, U.L. #CAT1155.
 - 2. Insulated Schedule 40 steel and copper: Hilti #FS611A, U.L. #CAT5045.
- H. For 4" and smaller acid waste or PVC pipe passing thru 3 hour concrete floor, wall or concrete block wall - Hilti #FS611A with collar, UL System #CAJ095.
- I. For 2" and smaller acid waste or Schedule 40 PVC pipe penetrating a 1H12 concrete floor or wall - Hilti #FS611A sealant, UL #CAT2062 or UL #CAJ2066.
- J. Under this Section, the Contractor shall be responsible for closing and making fire safe all openings exposed during construction (both new and existing) in the floor and deck above. Closing of opening shall be compatible with rating and shall not compromise the rating of the wall or floor being sealed.
- K. Set sleeves before concrete is poured or masonry is erected. In existing construction, grout sleeves firmly in place.
- L. In Mechanical Rooms extend sleeves 1-1/2" above finish floor and waterproof.
- M. Where exposed pipes pass through walls and partitions in finished or exposed spaces, provide chrome plated F & C plates or escutcheons. Seal wall penetration and case work penetration with silicone prior to installing escutcheon.
- N. All wall floor penetrations shall be closed in a neat manner. The method used to the close penetrations shall be compatible with the rating of the wall and shall in no way compromise the integrity of the partition or floor.

2.06 ACCESS DOORS:

- A. Provide access doors for valves, and other items requiring maintenance located above hard ceilings or behind partitions or walls. Doors in fire rated walls and ceilings: UL labeled with fire rating equal to fire rating of wall or ceiling. Provide door styles, sizes and colors as specified under the Architectural section.
- B. Mark lay-in ceilings with paper brads at valve locations and maintenance access points. Bend ends of brads over above ceiling tile.

3.00 EXECUTION:

3.01 PROTECTION OF EQUIPMENT:

- A. During construction all fixtures and equipment shall be protected from damage caused by weather,

masonry, plaster, paint and job accidents.

- B. When installation is complete, clean equipment and make ready for painting. Adjust all flush valves.

3.02 INSTALLATION OF FIXTURES AND EQUIPMENT:

- A. Install fixtures and equipment to provide normal service access to all components.
- B. Provide sufficient space for removing components, install fixtures and equipment to provide such clearance.
- C. Install fixtures and equipment in accordance with manufacturer's instructions. If manufacture's instructions conflict with contract documents, obtain Architect's decision before proceeding.
- D. All fixtures and equipment shall be firmly fastened in place:
 - 1. All wall hung fixtures shall be installed on a floor mounted fixture support with anchoring bolts in all holes of each leg. Bolts shall be sized as per manufacturer's recommendation.

3.03 CUTTING AND PATCHING:

- A. Set sleeves and inserts and lay-out and form openings in walls, beams, girders and structural floors in this Section.
- B. Cut, patch and repair as required to accomplish work and finish to match adjacent work. Architect's approval required before cutting any part where strength or appearance of finished work is involved.
- C. Cutting, patching and repairing of walls, floors, etc., where noted in paragraph "A" above, have been located or sized incorrectly are included in this Section.

3.04 INCIDENTAL WORK:

- A. All power wiring is included in Electrical Section.
- B. Permanent drain and relief connections for **Plumbing Equipment** to nearest floor drain or to grade are included in this Section whether shown or not.
- C. Items obviously omitted from drawings and/or specifications shall be called to attention of the Architect prior to submitting Bid, after award of Contract any changes or rearrangements necessary to complete Contract shall be at no additional cost to Owner.

3.05 FLASHING:

- A. Vent Pipe and Roof Drain Flashing: Specified in "Architectural Roofing Section".
- B. Coordinate all roofing penetrations with Roofing Section.

3.06 EXCAVATION AND BACKFILLING:

- A. Include all excavation and backfilling required to bring the work to line and grade shown, including excavation of rock and all other materials which may be encountered.
- B. Excavate trenches wide enough for proper installation of work. Grade trench bottoms evenly. Provide bell holes as necessary to insure uniform bearing for pipes. Excavate minimum 6" below pipe. Refill cuts below required pipe grade with sand or compacted gravel. Support pipe continuously along its entire length. Do not use piers to support piping.
- C. Backfill after inspection by Architect and authorities having jurisdiction. Backfill compacted areas with "Engineered Fill", sand or fine gravel in accordance with requirements of "Sitework". Backfill paved areas with sand or fine gravel compacted to meet requirements of Paving Section. Backfill

shall be free of rock, wood, steel, brick, etc. Do not disturb pipe. Restore or repair pavements and the like after backfilling, to meet the requirements of the authority having jurisdiction.

3.07 PAINTING:

- A. Refinish equipment damaged during construction to new condition.
- B. Paint all non-potable water pipe and insulation with two (2) coats of bright yellow paint in compliance with the Local Plumbing Code and these specifications. Paint piping prior to installing insulation. Paint type to be equal to Paint Specified in Painting Section of the Specifications.
- C. Other painting is specified in "PAINTING SECTION, Finishes Division".

3.08 PIPE IDENTIFICATIONS:

- A. Identify all piping exposed to view or accessible through removable ceilings or access panels with plastic snap-on pipe line markers. Color code markers in accordance with ANSI A13.1. Show pipe contents and direction of flow. Markers on lines 8" OD and smaller shall be taped in place; on lines over 8" OD secure with spring clips.
- B. Submit samples of all nameplates, tags, chains and etc., for approval.
- C. Protect all factory identification tags, nameplates, model and serial numbers, stenciling, etc., during construction and replace if damaged.
- D. Label Spacing and Extent:
 - 1. On straight run of pipes; Above suspended ceilings space labels approximately 10 feet on center; elsewhere, 20 feet on center.
 - 2. Wherever a pipe enters or leaves a room or building.
 - 3. At change of direction.
 - 4. At main valves and control valves (not equipment valves).
 - 5. On risers, just above and below floors.

3.09 VALVE TAGS:

- A. 2" X 3" laminated plastic with 1/2" numbers engraved at top, leaving space for further engraving by others. Secure tags with chains to valve yoke or stem, not handles.
- B. Valve tags colors:
 - 1. Plumbing: Red tags with white numbers.
- C. Valve tag locations: At all valves on mains, risers and branches.
- D. Valve tag numbers: Starting with Number 1, number tags in sequence from the lowest point to the highest point in the building. In existing building extend existing sequences.
- E. Starting with Number 1, number valve tags on this floor extending existing sequence. If there are no valve tags on existing valve, provide tags for all existing valves and new valves beginning floor sequence with Number 1.

3.10 VALVE CHARTS:

- A. In all mechanical rooms, provide charts showing number and locations of all valves, type of service, etc. Frame with aluminum, under glass.

- B. In existing buildings include existing valves in the charts of new valves.

3.11 WARRANTY AND INSTRUCTIONS:

- A. See General Conditions - One-Year Warranty.
- B. Contractor shall and hereby does warrant all materials, workmanship and equipment furnished and installed by him to be free from defects for a period of one (1) year after date of substantial completion of the Contract. Should any defects in materials, workmanship, or equipment be made know to Contractor within the one (1) year warranty period, Contractor shall replace such materials, workmanship, or equipment without charge.
- C. After completion of the work, Contractor shall operate the equipment which he installs for a period of ten (10) working days, as a test of satisfactory operating conditions. During this time, Contractor shall instruct the Owner's operating personnel in the correct operation of the equipment. Furnish necessary oral and written operating instructions to the Owner's representative.
- D. Provide three (3) sets of manufacturer's operating and maintenance manuals and parts lists including nearest manufacturer's sales and service representative by name, address and phone for all equipment and materials furnished. Provide a maintenance schedule listing routine maintenance operations and suggested frequency there of. Include all warranty dates on equipment and guarantees. Include names, address and phone of any subcontractor and work performed. Bind above items in loose leaf three (3) ring binders with tab for each class of equipment.
- E. During the period of tests, adjust all controls, regulators, etc., to comply with these Specifications.
- F. Make available to the Owner, without additional cost, service and adjustment of the equipment for the guarantee period.

3.12 PROJECT CLOSE-OUT DOCUMENTS:

- A. Prior to the issuance of a certificate for final payment, submit to Architect and obtain his approval of the following:
 - 1. Record drawings – Plumbing & Fire Protection (reproducible). Electronic drawings dwg format and pdf format.
 - 2. Equipment and Fixture Submittal Data: List of manufacturers representative including name, address and telephone number that supplied requirement (3).
 - 3. Equipment operating and maintenance manuals including: Spare parts required (3).
 - 4. Maintenance schedule (3).
 - 5. Equipment warranty dates and guarantees (3).
 - 6. List of Owner's Personnel who have received maintenance instructions.
 - 7. Record of inspections indicating what system was tested, type of tests, date of tests and those parties witnessing tests.
 - 8. Valve Tag Chart.
 - 9. Current flow test.

1.00 GENERAL:

1.01 SCOPE:

- A. Provisions of this section apply to all Plumbing and Fire Protection work.
- B. Include Section 15410, "GENERAL PROVISIONS - PLUMBING AND FIRE PROTECTION", with this Section.
- C. All tests shall be witnessed by the Architect in addition to authorities having jurisdiction. A minimum of 48 hour notice is required prior to performance of test.

2.00 PRODUCTS:

2.01 NOT APPLICABLE

3.00 EXECUTION:

3.01 GENERAL REQUIREMENTS:

- A. After system have been installed, Test, Balance and Adjust System for proper operation, flow rates, pressures and temperatures. Correct any noise and/or vibration conditions.
- B. Perform all tests as required by local codes. Contractor shall furnish testing equipment. Keep a record of all tests indicating dates of tests, those persons witnessing tests and results of tests.
- C. Provide with the Close-Out Documents a Testing Record.
- D. If local Codes are more stringent, local Codes shall govern.

3.02 SANITARY WASTE AND VENT SYSTEMS:

- A. Test piping by stopping lower outlets and filling with water to 10' hydrostatic head. Stop leaks and repeat test until watertight. All joints shall be exposed throughout test.
- B. Provide "Ball Test" on all piping 3" and larger with ball 1/2" smaller than pipe diameter.
- C. Provide visual inspection of all building drain piping below grade. Visual inspection shall be by means of a video camera routed through the drain system. Where the drain piping is connected to existing drain piping, the visual inspection shall include the existing drain piping from the point of connection, downstream to the point of connection to the public utility. A video tape and written report, noting any defects, on the findings of the visual inspection shall be provided to the owner with the close-out documents. The Plumbing Contractor shall provide personnel and equipment required for the visual inspection.

3.03 DOMESTIC WATER PIPING:

- A. On completion of roughing-in, cap all outlets, make connections with house supply line, and put under full water pressure. Test by applying additional pressure (by temporary pump or compressed air connection) to total hydrostatic pressure 1-1/2 times street pressure but not less than 150 psig for not less than 4 hours.
- B. Immediately and completely stop all leaks and retest until system is watertight. After testing, leave general pressure on until ready to install fixture (except when necessary to drain to avoid freezing during construction). After completion of all tests, repairs and installation of fixtures, flush all domestic hot and cold water piping with water to remove all sediment scale and until water runs clear, then disinfect.

- C. Disinfect piping with hypochlorite solution of chlorine or compressed chlorine gas applied through on approved chlorinator. Operate all valves and faucets several times to insure the chlorine reaches all parts of the system. Feed water and chlorination agent into the system at rates that will provide a residual chlorine content of not less than 50 ppm after a retention period of 6 hours and 10 ppm after a retention period of 24 hours. Upon completion of treatment, flush treated water from each system until the water supply is satisfactory to the public health authority having jurisdiction. Provide Architect a certificate of compliance from the local Health Department.
 - D. Clean air aerators, hose sprays, flush valves, etc. and adjust to proper flow rates.
- 3.04 FIRE PROTECTION PIPING TEST:
- A. Test in accordance with NFPA Pamphlets 13 and 20. Architects, Owner's, Underwriters and local Fire Marshall shall witness test. Provide certificate of inspection to the Architect/Engineer including the name of those witnessing the test.
 - B. On completion of roughing-in and before connection to existing piping, cap all outlets, make connections with house supply line, and put under full water pressure. Test by applying additional pressure, by temporary pump or compressed air connection, to total hydrostatic pressure 1 1/2 times street pressure, but not less than 200 psig for a period of not less than four (4) hours. Immediately and completely stop all leaks. Retest when system is watertight.
 - C. After testing, leave general pressure on until ready to install sprinkler heads and fire department valves, etc. except when necessary to drain to avoid freezing during construction.
- 3.05 COMPLETION OF TEST:
- A. Upon completion of all testing, Contractor shall provide to the Architect copies of test results and include a listing of all personnel witness to the tests.

1.00 GENERAL:

1.01 SCOPE:

- A. Include Section 15410, "GENERAL PROVISIONS – PLUMBING AND FIRE PROTECTION", with this Section.

2.00 PRODUCTS:

2.01 MATERIALS:

- A. Pipe and fittings to be the same manufacturer.

2.02 SANITARY - WASTE AND VENT PIPING:

- A. PVC plastic pipe: PVC-DWW, ASTM D-2665 to be installed above and below a slab, except in return air plenums. "Foam Core" piping is not acceptable.
- B. Cast iron soil pipe: Cast iron non-hub pipe and fittings. CISPI Standard 301 shall be installed in all plenum return areas.
- C. Joints for PVC plastic pipe: Solvent welded, ASTM B-2564
- D. Joints for hubless cast iron pipe and fittings: Hubless pipe and fittings shall be joined by a heavy-duty coupling. Approved manufacturers: Husky SD 4000, Clamp All 125 or MG Couplings.
- E. Joints in galvanized pipe: Screwed with Teflon tape applied in male threads.
- F. Install vent stacks through roof. Terminate 12" above finish roof. Flashing is specified under Roofing Section.
- G. Connect to site sanitary 5'-0" from Building. Verify with Civil Site Drawings exact size, location and invert of site sewer prior to beginning work.

2.03 DOMESTIC WATER PIPING:

- A. Domestic Water Piping: Copper tube.
- B. Copper Tube: ASTM B-88, copper water tube, Type "L" hard temper inside building, Type "K" outside building and below slab on grade. Fittings, cast brass or wrought copper water tube fittings, ANSI B-16.18 or B-16.22.
- C. Joints on copper tube:
 - 1. Inside Building: Properly cleaned fluxed and soldered as recommended by manufacturer, using 95-5 solder and 100% lead free flux.
 - 2. Outside Building and below slab on grade: "Sil-Fos".
- D. Provide temporary construction water at site as required.
- E. Connect to water service 5'-0" from building, provided and installed under Civil Section. Verify exact location with Civil Drawings.
- F. All water piping installed below slab on grade to be type "K" soft copper bent up on both ends with no joints below slab.

2.04 VALVES:

A. Domestic Water Piping Valves:

1. Ball Valves: All bronze, 150 psig WP, chrome plated bar stock ball, full port Teflon seats, stem packing seal and thrust washer, Watts B-6080 or B-6081, Apollo 20-100, Red White 5044F or 5094F, Kitz 56 or 57. Provide valve handle extension to (minimum 1") clear insulation.
2. Check valves 2" and smaller: All bronze, 125 psig WP, bronze disc, swing check, Stockham B-309, Crane 1342, Nibco S-413-B, Milwaukee 1509, Red White 237, Kitz 14.
3. Check valves 2-1/2" and larger: Iron body, bronze trim, switch check, 125 psig WP, Stockham G-931, Crane 373, Nibco F-918-B, Milwaukee F2974, Red White 435, Kitz 78.

B. Water pressure reducing valves: Watts, Wilkins, or Cash Acme, complete with inlet strainer, unions, inlet and outlet pressure gages and shut-off valve up stream of strainer.

2.05 PIPE HANGERS:

A. General: Pipe hangers, Grinnell, PHD, Michigan Hanger, or Elcen. Grinnell figure numbers are given for reference. Provide copper clad hangers on bare copper lines.

B. Pipe hangers for lines 3" and smaller, adjustable wrought ring hangers, Grinnell Fig. 97 or wrought clevis hangers, Grinnell Fig. 260.

C. Pipe hangers for lines 4" and larger, adjustable wrought clevis hangers, Grinnell Fig. 260.

D. Parallel piping graded in same direction may be grouped on trapezes. Trapezes for line 4" and smaller, Unistrut P2000 channel, or equal, with rods sized as specified below for largest pipe on trapeze. Guide lines on (but not anchor to) trapezes using Unistrut Series P1100 clamps. Trapezes shall not exceed 3' in length. Space lines to allow at least 3" clear between adjacent pipe or pipe covering and between pipes or pipe covering and rods. Space trapezes as specified for pipe hangers based upon smallest size of pipe on trapeze.

E. Provide riser clamps on pipe risers on each floor. Clamps in contact with copper or plastic pipe, plastic coated.

F. Beam Clamps: Grinnell Fig. 229.

G. Inserts for hangers in concrete structures: Underwriter's listed cast iron inserts. Grinnell Fig. 282.

H. For fasteners in existing concrete structures use drilled in expansion anchors with load rating at least 150% of pipe hanger rating (power driven anchors are not acceptable).

I. Size rods for pipe hangers not smaller than the following: 3/8" rods for pipe up to 2", 1/2" for 2-1/2" and 3" pipe, 5/8" rods for 4" and 5" pipe, 3/4" rods for 6" pipe, and 7/8" rods for 8" and 10" and 12" pipe, 1" rods for 14" and 16" pipe and 1-1/8" rods for 18" pipe.

J. Space pipe hangers at maximum: 5' intervals for cast iron pipe with additional hanger at each fittings. Pipe hanger spacing for screwed, solder joint and welded piping: 1/2", 6 ft.; 3/4" to 1-1/4", 8 ft.; 1-1/2" to 2-1/2", 10 ft.; 3", 12 ft.; 4" to 6", 14 ft.; 8" and over, 16 ft. Polypropylene and PVC plastic pipe 4 ft. horizontally maximum or as directed by manufacturer if closer, and 10 ft. vertically. Install additional hangers at change of direction and valve clusters.

K. Install pipe hangers on insulated pipe over pipe covering. Provide sheet metal saddle under hanger length to be 1-1/2 times the pipe diameter, minimum 12" long.

L. On sanitary piping requiring insulation, hanger may be installed directly on pipe and insulation installed over hanger.

3.00 EXECUTION:

3.01 PIPE INSTALLATION:

- A. All piping shall be securely anchored in place to the Building Structure.
- B. Cut pipe square and ream full size after cutting. Clean pipe. Make threaded joints with Teflon tape. Do not spring pipe into place.
- C. Provide welding material and labor in accordance with the welding procedures of the Heating, Piping, and Air Conditioning Contractor's National Association or other approved procedure conforming to the requirements of ANSI B-31.9 "Building Service Piping". Employ only welders fully qualified in the above specified procedure and currently certified by recognized testing authority. Use either electric arc or oxyacetylene welding. Provide full perimeter welds at both face end and collar end of each slip-on flange.
- D. Install piping to allow for expansion. Make connections to all equipment to eliminate undue strains in piping and equipment. Furnish necessary fittings and bends to avoid spring of pipes during assembly.
- E. Install chrome plated floor and ceiling plates on pipe passing through finished surfaces in finished spaces.
- F. Make pipe size reductions using reducing fittings. Bushings are prohibited.
- G. Install 3/4" ball or gate valve drains with hose adapters at low points of water piping and at bases of all risers or where shown provide large drains.
- H. Make connections to equipment using screwed unions in sizes 2" and smaller and flanged unions in sizes 2-1/2" and larger. Install unions in all piping connections to each piece of equipment.
- I. Wherever ferrous pipes or tanks and copper tubing connect, provide dielectric insulation unions or couplings, equal to EPCO.
- J. Run piping concealed, except where specifically shown or specified exposed. Plumb all vertical lines and run mains parallel to building walls unless specifically shown otherwise.
- K. Lay underground pressure piping so top of pipe is at least 18" below finished grade. Provide deeper bury if required by local regulations. Support all underground piping solidly along body of pipe. Strongly suspend other piping from building construction.
- L. Run no piping or tubing in direct contact with slag fill. Where necessary to pass through slag, protect piping with not less than two (2) wrappings of polyvinyl chloride tape or equivalent protection approved by Architect.
- M. Install shock arrestors as manufactured by J. R. Smith, Josam, Zurn or Wade as required by the IPC Plumbing Code and where indicated on drawings. Size in accordance with manufacturer requirements.

3.02 INSTALLATION OF VALVES:

- A. Provide shut-off valves where shown and detailed on Drawings. Locate valves to isolate each item to facilitate maintenance and/or removal.
- B. Locate valves in piping connections to water heaters, etc., so heads and tube bundles can be removed without disconnecting equipment or piping other than union or flange connections immediately adjacent to heat exchangers.
- C. Provide sweat to screw adapters where required.

- D. In Buildings with water pressure exceeding 80 psig, provide and install a water pressure reducing valve(s) immediately upon entering building or as shown on Drawings. The P.R.V. shall be line size and have an integral strainer or separate WYE strainer up stream of P.R.V. Provide a ball or gate valve immediately upstream of P.R.V. and strainer.

SECTION 15451 - GENERAL FIRE PROTECTION REQUIREMENTS

1.00 GENERAL:

1.01 RELATED DOCUMENTS

- A. Division 1 – Section "ALTERNATES": Coordinate related Division 15 work and modify surrounding work to integrate the Work of each Alternate.

1.02 SUMMARY

- A. Description of General Fire Protection Requirements. Applies to all Division 15, Section 15450's (Fire Protection).

1.03 DEFINITIONS

- A. "Provide" means to furnish and install, complete and ready for operation.

1.04 REFERENCES

- A. ASME: American Society for Mechanical Engineers.
- B. ASTM: American Society of Testing and Materials.
- C. AWWA: American Water Work Association.
- D. FM: Factory Mutual.
- E. NEMA: National Electrical Manufacturer's Association.
- F. NFPA: National Fire Protection Association.
- G. MSS: Manufacturer's Standardization Society of the Valve and Fitting Industry.
- H. UL: Underwriters Laboratories, Inc.

1.05 REGULATORY REQUIREMENTS

- A. Comply with current edition, unless otherwise noted, of the following codes and standards.
 - 1. ANSI B31.9 - Building Services Piping.
 - 2. ADA - American's with Disabilities Act.
 - 3. NFPA 13 – Installation of Sprinkler System.
 - 4. NFPA 24 – Installation of Private Fire Service Mains.
 - 5. NFPA 30 – Flammable and Combustible Liquids Code.
 - 6. NFPA 31 – Installation of Oil-Burning Equipment.
 - 7. NFPA 45 – Fire Protection for Laboratories Code.
 - 8. NFPA 54 – National Fuel Gas Code.
 - 9. NFPA 70 - National Electrical Code.
 - 10. NFPA 101 - Life Safety Code.
 - 11. IBC - International Building Code with Fire, Mechanical, Plumbing and Gas Codes; 2015 Edition.
 - 12. NFPA 20 - Installation of Fire Pump

- B. Permits, Licenses, Inspections and Fees.
 - 1. Obtain and pay for all permits, licenses, inspections and fees, and comply with all rules, laws and ordinances pertaining to the Contractor's portion of the Work.
 - 2. Obtain and pay for certificates of required inspections, and file certificates with Owner.

1.06 PRODUCT REQUIREMENTS

- A. Provide new standard, materials throughout.
- B. Multiple items of similar equipment shall be the product of the same manufacturer.
- C. Substitutions:
 - 1. Comply with the provisions of Division 1, Section "Product Requirements" and the following:
 - 2. When several manufacturers are named in the specifications, the corresponding products and models made by the specified manufacturers will be accepted and Contractor may base his bid on any one of those products. However, if the Contractor's bid is based on products other than the scheduled or specified basis of design, it shall be understood that there will be no extra cost involved whatsoever, and the effect on other trades has been included in the Contractor's proposal. Coordination with other trades for substituted equipment or use of products other than the named basis of design shall be the responsibility of the Contractor furnishing the equipment.
 - 3. The basis of design manufacturer's equipment has been used to determine space requirements. Should another approved manufacturer's equipment be used in preparing proposals, Contractor shall be responsible for determining that said equipment will fit space allocated. Submission of shop drawings or product data on such equipment shall be considered as indicating that the Contractor has reviewed the space requirements and the submitted equipment will fit the space allocated with due consideration given to access required for maintenance and code purposes.
 - 4. The basis of design manufacturer's equipment and scheduled Fire Protection equipment electrical requirements have been used to coordinate the electrical requirements of the plumbing equipment with the electrical systems serving that equipment.
 - a. Contractor shall coordinate the electrical requirements of the equipment actually furnished on this project and provide the electrical systems required by that equipment at no additional cost to the Owner.
 - b. Equipment of higher or lower electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified at no additional cost to the Owner.
 - c. Prior to approval of submittals of Fire Protection equipment with electrical requirements that are greater or lower than those shown on the Drawings, Contractor shall submit letter verifying that required changes to the electrical system, serving the specific piece of equipment in question, have been coordinated with the electrical contractor. Letter to be included with the associated equipment submittal, addressed to the Architect with a copy to the electrical engineer.
 - 5. Each bidder may submit to the Architect a list of any substitutes which he proposes to use in lieu of the equipment or material named in the specifications with a request for the approval of proposed substitutes. To be considered, such requests must be delivered to the office of the Architect not later than 10 days prior to bid due date. The submittal shall include the following:
 - a. Specific equipment or material proposed for substitution giving

- manufacturer, catalog and model number.
 - b. All performance and dimensional data necessary for comparison of the proposed substitute with the equipment or material specified.
 - c. A statement setting forth any changes in other materials, equipment or other Work that incorporation of the substitute may require.
6. The burden of proof of the merit of the proposed substitute is upon the proposer. The Architect's decision of approval or disapproval of a proposed substitution is final.

1.07 SUBMITTALS

- A. Submit under provisions of Division 1, Section "Submittal Procedures" and the following:
- B. Product Data: Submit to the Architect and obtain his approval of a complete list of materials and equipment which are to be provided under the 15450 Sections of Division 15.
 - 1. List shall be complete with manufacturer's names, catalog number, dimensions, specifications, rating data and options utilized. Capacities shall be in the terms specified.
 - 2. Call attention to deviations from specified items as to operation and physical dimensions.
 - 3. Performance curves for pumps shall be included.
 - 4. Final equipment orders shall not be placed until submittals have been returned marked "No Exceptions Noted" or "Make Corrections Noted".
 - 5. Bind all equipment submittals and provide index tab for each type of equipment. Submit all at one time. Reserve two sets for project close-out documents.
- C. Shop Drawings: Before starting work, submit and obtain approval from Architect of detailed drawings of the following, fully dimensioned and drawn to 1/8" to 1'-0" scale. Submit six (6) prints of each drawing. Engineer will return five (5) of the prints with comments noted. Failure to submit shop drawings will make the Contractor responsible for changes required to facilitate installation.
 - 1. Fire Protection Systems. See Division 15, Section "Fire Protection System."
 - 2. For multi-story buildings, submit detailed floor penetration sleeve layout drawings. See Division 15, Section "Plumbing Basic Materials and Methods," Article "Informational Submittals."

1.08 COORDINATION DRAWINGS

- A. General:
 - 1. Within 60 days of Notice to Proceed provide Coordination Drawings for the following areas of the building:
 - a. Auditorium (Include all Rigging)
 - 2. Do not base Coordination Drawings on reproduction of Contract Documents or standard printed data.
 - 3. Submitted Coordination Drawings are for information only and typically will not be returned to the Contractor. Architect will not take any action, but may define coordination conflicts or problems and inform the Contractor of such conflicts or problems.
- B. Content:
 - 1. Project specific information, drawn accurately to scale.
 - 2. Show sequencing and spatial relationship of separate units of work that must function in a restricted manner to fit in the space provided, or function as indicated.
 - 3. Indicate dimensions shown on Contract Drawings and make specific note of

dimensions that appear to be in conflict with submitted equipment and minimum clearance requirements. Provide alternate sketches to Architect for resolution of such conflicts. Minor dimension changes and difficult installations will not be considered changes to the Contract.

- C. Format:
 - 1. Coordination shop drawings shall be drawn to a scale of not smaller than $\frac{1}{4}" = 1'-0"$.
 - 2. Provide drawings on electronic media in AutoCad .dwg format.
 - 3. Provide layering system separate from wall outline and unique to each discipline.
 - 4. In addition to plan view, provide sections as required to clarify congested situations and verify vertical clearances.
 - 5. Base drawings and building sections in .dwg format will be provided by Architect.
- D. Fire Protection Shop Drawings: Fire Protection subcontractor shall add all fire protection equipment, piping, sprinkler heads and other elements to database.
 - 1. Upon completion of Fire Protection shop drawings, transmit electronic database to Electrical subcontractor.
- E. General Contractor's Final Coordination: General Contractor shall thoroughly review shop drawings, adding additional building elements where appropriate, and shall resolve conflicts, coordinating with the Architect, and the various subcontractors.
- F. Submit Coordination Shop Drawings: Upon completion of final coordination, General Contractor shall approve coordination shop drawings and transmit 3 sets of hard copies and electronic files on CD's to Architect.
- G. The Architect will not process fire protection shop drawings until such time as the coordination drawings have been sufficiently completed and conflicts resolved.

1.09 QUALITY ASSURANCE

- A. Installer's Qualifications: Firm experienced in installation of systems similar in size and complexity to those required for this project, plus the following:
 - 1. Acceptable to, or licensed by, manufacturer.
 - 2. Not less than 3 years experience with systems.
 - 3. Successfully completed not less than 5 comparable scale projects using systems similar to those for this project.
 - 4. Professional Engineer licensed in the State in which the work occurs; or NICET Level 3 and licensed by the State Fire Marshall in the State in which the work occurs. NICET Level 3 designer must be an employee of the Fire Protection Contractor. NICET Level 3 designer must oversee installation of shop drawings.

1.10 SUMMARY OF WORK

- A. Scope: Provide all labor, materials, equipment and services necessary for the completion of all fire protection work shown or specified, except work specified to be done or furnished by others, complete and ready for operation.

1.11 DRAWING INTERPRETATION AND COORDINATION

- A. Drawings are intended to show size, capacity, approximate location, direction and general relationship of one phase to another, but not exact detail or arrangement.
- B. Do not scale drawings for location of system components. Check all measurements, location of pipe, ducts, and equipment with the detail architectural, structural, and

electrical drawings and conditions existing in the field and lay out work so as to fit in with ceiling grids, lighting and other parts.

- C. Make minor adjustments in the field as required to provide the optimum result to facilitate ease of service, efficient operation and best appearance.
- D. Where doubt arises as to the meaning of the Drawings and Specifications, obtain the Architect's written decision before proceeding with parts affected; otherwise assume liability for damage to other work and for making necessary corrections to work in question.
- E. Refer to Architectural Drawings for all dimensions and location of lights, ceiling diffusers and sprinkler heads.

1.12 PROJECT/SITE CONDITIONS

- A. Visiting Site: Visit site and become familiar with location and various conditions affecting work. No additional allowance will be granted because of lack of knowledge of such conditions.
- B. Determine sizes and locations, and inverts of existing and new utilities near site.
- C. Cause as little interference or interruption of existing utilities and services as possible. Schedule work which will cause interference or interruption in advance with Owner, authorities having jurisdiction, and all affected trades.

1.13 SUBMITTALS FOR PROJECT CLOSEOUT

- A. Submit under provisions of Division 1 Sections - "Closeout Procedures" and "Project Record Documents" and the following.
- B. Record Drawings:
 - 1. Keep accurate record of corrections, variations, and deviations, including those required by change orders to the Fire Protection drawings.
 - 2. Accurately show location, size and elevation of new exterior work dimensioned from permanent structure.
 - 3. Record changes daily on a set of prints kept at the job site.
 - 4. Submit prints marked as noted above to Architect for review prior to request for final payment.
 - 5. Marked prints will be returned to Contractor for use in preparing Record Drawings.
 - 6. The Fire Protection Contractor shall use marked up drawing showing as-built conditions provided by Contractor to prepare Record Drawings. Asbuilt drawings shall be incorporated on electronic files.
- C. Prior to the issuance of a certificate for final payment, submit to Architect and obtain his approval of the following:
 - 1. Record drawings – fire protection piping/shop drawings, bond and electronic files in AutoCAD *.dwg & PDF format.
 - 2. Equipment Submittal Data (2).
 - 3. Equipment operating and maintenance manuals (2).
 - 4. Equipment warranty dates and guarantees (2).
 - 5. List of Owner's Personnel who have received operating and maintenance instructions.
 - 6. Install valve charts and valve location plans in main mechanical room. (See Division 15, Section "Plumbing Identification.")

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- 7. Submit factory start-up/field reports for:
 - a. Pressure Reducing Valve
- D. Contractor's Material and Test Certificate for above ground piping.
- E. Contractor's Material and Test Certificate for underground piping.

END OF SECTION 15451

SECTION 15453 - BASIC FIRE PROTECTION MATERIALS AND METHODS

PART 1 - GENERAL

1.01 SUMMARY

- A. Description of common piping, equipment, materials and installation for Fire Protection systems.
- B. This Section includes the following:
 - 1. Piping materials and installation instructions common to most Fire Protection piping systems.
 - 2. Sleeves.
 - 3. Concrete.
 - 4. Grout.
 - 5. Escutcheons.
 - 6. Access doors - Building.
 - 7. Flashing
 - 8. Workmanship.
 - 9. Cutting and patching.
 - 10. Excavation, trenching and backfilling.
 - 11. Piping systems installation - Common Requirements.
 - 12. Equipment installation - Common Requirements.
 - 13. Painting and finishing.
 - 14. Concrete bases.
 - 15. Supports and anchorages.
 - 16. Protection and cleaning of equipment and materials.

1.02 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct chases, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and chases.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.03 SUBMITTALS

- A. Product Data: For the following:
 - 1. Transition fittings.
 - 2. Escutcheons.
 - 3. Access doors - building.

1.04 INFORMATIONAL SUBMITTALS

- A. Shop Drawings: For multi-story buildings, submit detailed drawings of the floor penetration sleeve sizes and locations, including the following information:
 - 1. Fully dimensioned off column lines with location respective to adjacent walls shown.
 - 2. Sleeve size.
 - 3. Pipe size.
 - 4. Pipe service.

1.05 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture. If pipes do not ship with end caps, cover ends of pipe stored on site with 6 mil plastic.
- B. Store plastic pipes protected from direct sunlight. Support to prevent sagging and bending.

1.06 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for Plumbing installations.
- B. Coordinate installation of required supporting devices and set sleeves and inserts in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate installation of building access doors for fire protection items requiring access that are concealed behind finished surfaces.
- D. Electrical Characteristics for Fire Protection Equipment:
 - 1. Coordinate electrical system installation to match requirements of equipment actually furnished on this project.
 - 2. Include a letter with the respective equipment submittal from the electrical contractor and approved by electrical design consultant, detailing changes to the electrical system required to accommodate changes in the power distribution system to accommodate Fire Protection equipment that has different electrical power requirements from that equipment used as basis of design, or power provisions, as shown on the electrical drawings.

PART 2 - PRODUCTS

2.01 MANUFACTURERS

- A. In other Part 2 articles where subparagraph titles below introduce lists, the following requirements apply for product selection:
 - 1. Manufacturers: Subject to compliance with requirements. Provide products by one of the following:

2.02 PIPE, TUBE AND FITTINGS

- A. Refer to individual Division 15 Fire Protection Piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

- C. All piping and fittings prior to PRV shall be rated for 250psi.

2.03 JOINING MATERIALS

- A. Refer to individual Division 15 Fire Protection Piping Sections for special joining materials not listed below.
- B. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.
- C. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- D. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated.

2.04 SLEEVES

- A. Galvanized-Steel Sheet: 20 gauge minimum thickness; round tube closed with longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Firestopping Sealant: See Division 7 Sections "Through-Penetration Firestop Systems" and "Fire Resistive Joint Systems" for firestopping sealant requirements.
- D. Stuffing Insulation: Glass fiber type, non-combustible.

2.05 CONCRETE

- A. Nominal weight concrete (145 PCF) using Type I Portland Cement, 1-inch maximum size coarse aggregate to provide a minimum 28 day compressive strength of 3000 psi.

2.06 GROUT

- A. Description: ASTM C 1107, Grade B, non-shrink and nonmetallic, dry hydraulic-cement grout.
 - 1. Characteristics: Post-hardening, volume-adjusting, non-staining, noncorrosive, nongaseous, and recommended for interior and exterior applications.
 - 2. Design Mix: 5000-psi 28-day compressive strength.
 - 3. Packaging: Premixed and factory packaged.

2.07 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
 - 1. Finish: Polished chrome-plated.

2.08 ACCESS DOORS – BUILDING

- A. Manufacturers:
 - 1. Bilco.
 - 2. Milcor.
 - 3. Nystrom.

- B. Construction:
 - 1. Door: 14-gauge, cold rolled steel.
 - 2. Frame: 16-gauge, cold rolled steel of configuration to suit material application.
 - 3. Hinge: Concealed spring hinge.
 - 4. Latch: Screwdriver cam latch.
 - 5. Finish: Phosphate dipped and prime coated.
 - 6. UL labeled when in fire-rated construction with rating to match construction.
 - 7. Stainless steel (Type 304) shall be used in ceramic tile or glazed structural tile.
- C. Size: 18 inch x 18 inch minimum, as indicated on drawings, or as required to allow inspection, service, and removal of concealed items.

2.09 FLASHING

- A. Flexible Flashing: 47 mil thick sheet butyl compatible with roofing.
- B. Lead Flashing: Waterproofing, 5 lb/SF sheet lead.
- C. Pitch Cups: 20 gauge galvanized steel, minimum 8 inches deep, bases mitered and soldered and extending at least 4 inches horizontally.

PART 3 - EXECUTION

3.01 WORKMANSHIP

- A. First class and in accordance with best practice. Work to be orderly, neat, workman-like in appearance and performed by skilled craftsman.
- B. Poor or improper workmanship shall be removed and replaced as directed by the Architect without additional cost to the Owner or design professionals.

3.02 CUTTING AND PATCHING

- A. Comply with the requirements of other Divisions for the cutting and patching required to accommodate the installation of Fire Protection work. Repair and finish to match surrounding.
- B. Architect's approval required before cutting any part where strength, or appearance of finished work is involved.
- C. Openings are to be laid out and built-in, set sleeves and inserts and furnish detailed layout drawings to other trades in advance of their work.
- D. Core drill or saw cut openings in existing masonry construction.

3.03 EXCAVATION, TRENCHING AND BACKFILLING

- A. Provide trenching, excavation, backfilling necessary for performance of work, including excavation of rock and all other materials which may be encountered.
- B. Grade bottom of trenches evenly and excavate bell holes to insure uniform bearing for the full pipe length. Excavate minimum 6 inches below pipe. Refill cuts below grade with sand.

- C. Backfill after inspection by Architect and authorities having jurisdiction. Backfill compacted areas (engineered fill) with sand or fine gravel in accordance with requirements in Division 2. Section "Earthwork" no less than 95% compactancy. Backfill paved areas with sand or fine gravel compacted to meet requirements of Paving Section. Backfill shall be free of rock, wood, steel, brick, etc. Do not disturb pipe.
- D. Refer to Division 15, Fire Protection Piping Sections for specific bedding and backfill requirements.
- E. Restore existing pavement, curbs, sidewalks, sodding, bushes, etc., matching surroundings.
- F. Restore all pavement cuts to meet the requirements of the cuts of the local authority.

3.04 PIPING SYSTEMS INSTALLATION - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 15 Fire Protection Piping Sections specifying piping systems.
- B. Drawings, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Shop Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas and stairwells.
- D. Install piping indicated to be exposed and in service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections. No mitering or notching for fittings permitted.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install escutcheons where exposed piping penetrates walls, ceilings, and floors in finished spaces.

3.05 SLEEVES

- A. Sleeves are not required for core-drilled holes.
 - 1. In mechanical room floors and other potentially wet areas, provide 1-1/2 inch angle ring or square set in silicone adhesive around penetration.
- B. Install sleeves for pipes passing through concrete and masonry walls, gypsum-board partitions, and concrete floor and roof slabs.
 - 1. Cut sleeves to length so that sleeve extends out ½ inch from both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas, or other potentially wet areas, 1-1/2 inches above finished floor level. Caulk space outside of sleeves water tight.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Use the following sleeve materials:

- a. Sleeves for Piping Through Concrete Beams, Concrete Walls, Footings, and Potentially Wet Floors: Steel pipe.
 - b. Sleeves for Piping through Masonry Walls and Gypsum Board Partitions: Steel sheet sleeves 1/2 inch larger than pipe or pipe covering.
 - 4. Where piping penetrates non-rated equipment room wall, floors or roofs outside of a shaft, close off space between pipe or duct and adjacent work with stuffing insulation and caulk air tight.
 - 5. Above ground, non-rated, exterior wall penetrations: Seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
 - 6. Provide for continuous insulation wrapping thru sleeve.
 - 7. Seal space around the outside of sleeves with grout at masonry walls and floors and dry wall mud at gypsum board partitions.
- C. Fire-Rated Penetrations: Where pipes pass through fire-rated and fire-resistive floors, walls, and partitions, install appropriately rated sleeves and firestopping sealant. Firestopping materials and installation methods are specified in Division 7 Sections "Through Penetration Firestop Systems" and "Fire Resistive Joint Systems".

3.06 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 15 Fire Protection Piping Sections specifying piping systems.
- B. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- C. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Cut threads full and clean using sharp dies. Ream threaded pipe ends to remove burrs and restore full ID. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
- D. Flanged Joints:
 - 1. 125 Pound Cast Iron Flange (Plain Face): Mating flange shall have raised face, if any, removed to avoid overstressing the cast iron flange.
 - 2. Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.07 PIPE CLEANING

- A. Keep pipe clean and free of dirt. Keep caps on ends of pipe when it is stored on site and reinstall caps on ends of installed piping at the end of each day.

3.08 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations.

- D. Install equipment in accordance with manufacturer's instructions. If manufacturer's instructions conflict with Contract Documents, obtain Architect's decision before proceeding.
- E. Install equipment to allow right of way for piping installed at a required slope.
- F. All equipment shall be firmly fastened in place:
 - 1. Pad mounted equipment shall be secured to pads using poured in place anchor bolts or cinch anchors.
 - 2. Vibration isolators shall be secured to floors or pads and equipment shall be bolted to the isolators.

3.09 PAINING AND FINISHING

- A. Except as specified below or noted on the Drawing, requirements for painting of Fire Protection systems, equipment, and components are specified in Division 9 Sections "Interior Painting" and "Exterior Painting."
- B. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.
- C. Painting of fire piping:
 - 1. The following piping within boiler and chiller room shall be painted in its entirety under Division 9: Painting. Color codes are listed here for information only.
 - a. Fire Protection Piping: Red Metaltex B47R3.
 - 2. Should there be a conflict of colors in existing installations, contact the Architect.

3.10 CONCRETE BASES

- A. Provide concrete foundations with nominal dimensions conforming to the following schedule for floor-mounted equipment:

<u>Equipment</u>	<u>Foundation</u>
Equipment and piping stands and supports	4" high pad
Equipment located in equipment rooms, not listed above	4" high pad or as indicated on the Drawings
- B. Concrete bases shall be continuous and shall have beveled edges and smooth float finish. Concrete bases shall be reinforced with No. 3 bars a maximum of 12" on center each way, and held in place with dowel rods at each corner anchored in the slab. Dowel rods shall not penetrate through the slab.
- C. Roughen and clean exposed slabs before pouring foundations. Apply bonding agent to surfaces in contact.
- D. Concrete pads shall extend a minimum of 4" beyond the equipment footprint in all directions, including appurtenances, vibration isolators, base elbow supports, and motors.
- E. Equipment attached directly to foundations or inertia bases; bases provided with grout holes; and bases consisting of a structural frame shall have voids filled with grout after attachment to foundation.
- F. Fill voids between baseplates and foundations, and level equipment, with grout.

3.11 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" requirements.

- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor plumbing and fire protection materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.12 GROUTING

- A. Mix and install grout for Fire Protection equipment base bearing surfaces, pump and other equipment base plates, and anchors.
- B. Clean surfaces that will come into contact with grout.
- C. Provide forms as required for placement of grout.
- D. Avoid air entrapment during placement of grout.
- E. Place grout, completely filling equipment bases.
- F. Place grout on concrete bases and provide smooth bearing surface for equipment.
- G. Place grout around anchors.
- H. Cure placed grout.

3.13 ACCESS DOORS – BUILDING

- A. Provide access doors in wall and inaccessible ceilings to allow access to service and maintain concealed Plumbing equipment, valves, etc.
- B. Coordinate installation of access doors with Divisions responsible for Building System in which panels are being installed.

3.14 PROTECTION AND CLEANING OF EQUIPMENT, FIXTURES, AND MATERIALS

- A. Equipment and materials shall be carefully handled, properly stored, and protected from weather, dust-producing procedures, or damage during construction.
- B. At completion of all work, thoroughly clean exposed materials (pipe, etc.) and equipment and make ready for painting.

END SECTION 15453

SECTION 15455 - FIRE PROTECTION SYSTEM

PART 1 - GENERAL

1.01 SECTION INCLUDES

- A. Pipe, Fittings, Valves for:
 - 1. Service from the water main to the building.
 - 2. Fire Booster Pump.
 - 3. Wet sprinkler system.
- B. System design and installation. Base system design hydraulic calculations using the area/density method on the following criteria and in accordance with NFPA 13 latest edition.
 - 1. Sprinkler Protection:
 - a. Offices, gymnasiums, classrooms, lobbies, waiting areas, educational areas, dining areas, and corridors: Light hazard, 0.10 gpm/sq. ft. over the hydraulically most remote 1500 sq. ft.
 - b. Kitchen, Mechanical Equipment Rooms, Transformer Rooms, Electrical Switchgear Rooms, Electric Closets, Elevator Shafts, Elevator Machine Rooms, Refrigeration Service Rooms, and storage between 100 and 250 sq. ft.: Ordinary Hazard, Group 1, 0.15 gpm/sq. ft. over the hydraulically most remote 1500 sq. ft.
 - c. Utility and Maintenance rooms, laundry, laboratory and storage rooms, storage rooms over 250 sq. ft., loading docks, energy centers areas: Ordinary Group 2, 0.20 gpm/sq. ft. over the hydraulically most remote 1500 sq. ft.
 - d. Provide sprinklers in accessible shafts per NFPA 13 latest edition.
 - 2. Add water allowance of 250 gpm for inside and outside hose streams to the sprinkler requirements at the connection to the distribution main.
 - 3. Hydraulic Calculations: The calculated demand including hose stream requirements shall fall no less than 10 percent below the available supply curve.
 - 4. Comply with IBC (2009 Edition), NFPA 13 (2009 Edition), NFPA 30, Flammable and Combustible Liquid Code, NFPA 45, Standard on Fire Protection for Laboratory Using Chemicals, NFPA 54, National Fuel Gas Code, NFPA 58, Liquefied Petroleum Gas Code, NFPA 70, National Electric Code, NFPA 72, National Alarm and Signaling Code, and NFPA 101, Life Safety Code (2009 Edition).

1.02 RELATED SECTIONS

- A. Section 15405 – Plumbing Identification.
- B. Section 15451 – General Fire Protection Requirements.
- C. Section 15453 – Basic Fire Protection Materials and Methods.

1.03 SYSTEM

- A. A wet sprinkler system providing coverage for the entire building.
- B. A fire booster pump.
- C. Fire service from approximately 5ft outside the building to inside the building.

1.04 SUBMITTALS FOR REVIEW

- A. Submit under provisions of Division 1, Section "Submittal Procedures" and the following:
- B. Product Data: Submit to the Architect and obtain his approval of a complete list of materials and equipment which are to be furnished under Division 15.
 - 1. List shall be complete with manufacturer's names, catalog number, dimensions, specifications, rating data and options utilized. Capacities shall be in the terms specified.
 - 2. Call attention to deviations from specified items as to operation and physical dimensions.
 - 3. Performance curves for equipment such as pumps shall be included.
 - 4. Final equipment orders shall not be placed until submittals have been returned marked "No Exceptions Noted" or "Make Corrections Noted".
 - 5. Bind all equipment submittals and provide index tab for each type of equipment. Submit all at one time. Reserve two sets for project close-out documents.
- C. Shop Drawings:
 - 1. A reflected ceiling plan indicating locations of sprinkler heads, lights, HVAC devices, smoke detectors, exit lights and any additional items attached to ceiling. In lift out ceilings, sprinkler heads are to be centered in ceiling tiles. In hard ceilings, sprinkler heads to follow the general arrangement of the ceiling. After review by the Architect, revise layout as required.
 - 2. Prepare a working pipe shop drawing based on hydraulic calculations. The piping shop drawing shall indicate routing and configuration of piping, size of pipe, piping support, elevation of piping and coordination of piping with ductwork. Shop drawings shall include low point drain downs.
 - 3. Hydraulic calculations are to be prepared utilizing a current water flow test (maximum 90 days old). If current flow test is not available, obtain a current flow test and pay for all fees required.
 - 4. If water flow information is not available due to new main extension or other construction which prohibits the availability of flow information at the start of construction, the contractor shall estimate probable flow information based on information available. Once permanent water is available at the site, the Contractor shall perform a flow test, incorporate the information into the calculation and make any modifications to the system as may be required.
 - 5. When drawings and hydraulic calculations are submitted to the Engineer for review, they shall bear the seals of review and approval of the Architect, General Contractor, the Owners Insurance Underwriter, and the Nicet Level 3 Designer. The Nicet registered designer shall be an employee of the Fire Protection Installing Contractor and shall oversee installation of Project. Nicet registration seal shall be included on shop drawings.
 - 6. Contractor to provide to the State reviewing Agency a set of shop drawings reviewed and approved by Engineer of Record as required by the State of Alabama.
 - 7. The Contractor shall incorporate all comments for approval by local Fire Marshall's Office and any State of Alabama Reviewing Agency. Contractor shall provide signed, and approved set of plans to Engineer upon approval by state and local authorities.
 - 8. Each system calculations, components and alarming to be on shop drawings.

1.05 SYSTEM INSTALLATION AND INSPECTION

- A. Required Inspections:
 - 1. All underground and above ground fire line piping must be inspected by owner's representative prior to being covered or concealed.
- B. Fire Stopping:
 - 1. All fire stopping of any and all fire rated assemblies must be inspected and approved by a State Inspector prior to the work being concealed.

- C. Hydrostatic Testing Requirements:
 - 1. The required hydrostatic testing of the underground and above ground fire line piping must be witnessed and approved by City Inspector prior to being covered or concealed.
- D. Underground Fire Line Pipe Flush Test Requirements:
 - 1. The required flush test of the underground fire line piping must be witnessed by an Owners representative prior to being connected to the above ground piping or riser.
- E. Acceptance Inspections & Testing:
 - 1. Allow fire protection and life safety systems installation and acceptance test must be inspected, test, witnessed and approved by an AHJ and Owner's representative.
- F. Plans Review & Approval:
 - 1. All fire protection and life safety system drawings and specifications must be reviewed by this office to ensure code compliance prior to start of any work.

1.06 REGULATORY REQUIREMENTS

- A. Materials: Conform to UL and FM Global Requirements and Standards.
- B. Sprinkler System: Conform to NFPA 13, State of Alabama Fire Marshall Requirements, Hueytown Fire Requirements and Alabama State Building Commission Requirements.
- C. Stationary Fire Pumps, NFPA 20.
- D. Private Service Mains: Conform to NFPA 24.
- E. NFPA 25, Inspections, Testing and Maintenance of Water-Based Fire Protection Systems.
- F. NFPA 72, Standard for the Installation, Maintenance and Use of Protective Signaling Systems.
- G. NFPA 72E, Standard on Automatic Fire Detectors.
- H. Applicable Building Codes.
- I. Welding Materials and Procedures: Conform to ASME Code.
- J. Valves: Bear UL, FM label or marking. Provide manufacturer's name and pressure rating marked on valve body.
- K. Products Requiring Electrical Connection: Listed and classified as suitable for the purpose specified and indicated.

1.07 EXTRA MATERIALS

- A. Provide extra sprinklers under provisions of NFPA 13, State and Local requirements.
- B. Provide suitable wrenches for each sprinkler type.
- C. Provide metal storage cabinet in location designated. (Designate location).

PART 2 - PRODUCTS

2.01 PIPING BELOW GRADE AND BELOW SLAB ON GRADE

- A. Ductile Iron: Cement lined ANSI A-21.50.
- B. Joints on Ductile Iron: Standard mechanical joint ANSI A-21.11. Provide with retainer glands at all fittings and thrust blocks minimum 1 cubic yard of concrete at all changes of direction.

2.02 WET SPRINKLER SYSTEM

A. Wet System - Above Ground Piping:

1. Black Steel Pipe:

- a. All piping 1-1/2" and smaller, all piping larger than 1-1/2" with cut grooves on threaded and all welded piping, Schedule 40 black steel ASTM A53, ASTM A795, ASTM A135.
- b. Piping larger than 1-1/2" for roll grooving only, Schedule 10 ASTM A795, ASTM B36.10. Schedule 10 pipe may not be used for threading or cut grooving. Schedule 7 pipe will not be accepted.
- c. Cast iron threaded fittings ANSI B16.4 cast iron flanges and flanged fittings ANSI B16.1.
- d. Malleable iron threaded fittings, ANSI B16.3.
- e. Mechanical Grooved Couplings: Malleable iron housing clamps to engage and lock, "C" shaped elastomeric sealing gasket, steel bolts, nuts and washers; galvanized for galvanized pipe.
- f. Mechanical Formed Fittings: Carbon steel housing with integral pipe stop and O-ring pocked and O-ring, uniformly compressed into permanent mechanical engagement into pipe.
- g. Malleable Iron Fittings 175 lb. (250 lb.); ASME B16.3, threaded fittings.

Black Steel Piping and fittings shall be domestic manufacturer. Bull Moose Tube, Victaulic, or Wheatland are approved manufacturers. Substitutions require prior approval.

All piping and fittings prior to PRV shall be rated for 250psi.

2. Copper Tubing: ASTM B75; ASTM B88; Type K, hard drawn.

- a. Fittings: ASME B16.22, wrought copper and bronze, solder joint, pressure type.
- b. Joints: AWS A5.8 Classification BCuP-3 or BCuP-4 silver braze.

Copper Piping and fittings shall be domestic manufacturer. Bull Moose Tube, ARGCO, Mueller, or Cerro are approved manufacturers. Substitutions require prior approval.

B. Sprinklers:

- 1. Sprinklers to be UL approved glass bulb quick response type.
- 2. All sprinkler heads to be rated for 175°F, unless otherwise noted on drawings.
- 3. Suspended Ceiling (Lay-in and Gypsum):
 - a. Manufacturers:
 - 1) Viking Model M.
 - 2) Tyco, Reliable, Victaulic.
 - b. Type: Quick response concealed pendant type with painted cover plate.
 - c. Cover Plate: White. Unless indicated otherwise. Provide color chart to Architect for color selection.

- d. Finish: Sprinkler Head – chrome plated.
 - e. Fusible Link: Glass bulb type temperature rated for specific area hazard.
 - 4. Exposed Area Type:
 - a. Manufacturers:
 - 1) Viking Model M.
 - 2) Tyco, Reliable, Victaulic.
 - b. Type: Quick response upright type with guard.
 - c. Finish: Brass or chrome plated.
 - d. Fusible Link: Glass bulb type temperature rated for specific area hazard.
 - e. Guards: Finish to match sprinkler finish.
 - 5. Sidewall Type:
 - a. Manufacturers:
 - 1) Viking Model M.
 - 2) Tyco, Reliable, Victaulic.
 - b. Type: Quick response recessed sidewall type.
 - c. Finish: Chrome plated.
 - d. Escutcheon Plate Finish: Chrome plated in color.
 - e. Fusible Link: Glass bulb type temperature rated for specific area hazard.
 - 6. Dry Pendent Sprinklers (Cooler/Freezer and all areas subject to temperature below 40 deg F.):
 - a. Manufacturers:
 - 1) Viking Model M.
 - 2) Tyco, Reliable, Victaulic.
 - b. Type: Quick response recessed sidewall type with matching push on escutcheon plate.
 - c. Escutcheon Plate Finish: Chrome plated.
 - d. Fusible Link: Glass bulb type temperature rated for specific area hazard.
- C. Pipe Hangers and Supports:
- 1. Conform to NFPA 13.
 - 2. Hangers for Pipe Sizes ½ to 1-1/2 inch: Carbon steel, adjustable swivel, split ring.
 - 3. Hangers for Pipe Sizes 2 Inches and Over: Carbon steel, adjustable, clevis.
 - 4. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods.
 - 5. Wall Support for Pipe Sizes to 3 Inches: Cast iron hook.
 - 6. Wall Support for Pipe Sizes 4 Inches and Over: Welded steel bracket and wrought steel clamp.
 - 7. Vertical Support: Steel riser clamp.
 - 8. Floor Support: Cast iron adjustable pipe saddle, lock nut, nipple, floor flange, and concrete pier or steel support.
 - 9. Copper Plate Support: Carbon steel ring, adjustable, copper plated.
 - 10. All hangers to be a maximum of 12 inches from the end of a branch line or an arm-over for drop.
- Pipe hangers and supports shall be of one manufacturer. Grinnell, Anvil or Tolco are approved manufacturers. Substitutions require prior approval.
- D. Gate Valves:
- 1. Up to and including 2 Inches:
 - a. Manufactures:
 - 1) Nibco Model T-104-O.
 - 2) Where Nibco is listed, Victaulic, Stockham, Watts, Tyco and Milwaukee are equal.
 - b. Bronze body, bronze trim 175 psi WP, UL Listed, rising stem, handwheel, solid wedge or disc, threaded ends.

2. Over 2 Inches:
 - a. Manufactures:
 - 1) Nibco Model F-607-OTS.
 - 2) Where Nibco is listed, Victaulic, Watts, Tyco and Milwaukee are equal.
 - b. Iron body, bronze trim 175 psi WP, UL Listed, rising stem pre-grooved for mounting tamper switch, handwheel, OS&Y, solid bronze or cast iron wedge, flanged or grooved ends.

- E. Butterfly Valves:
 1. Cast or Ductile Iron Body
 - a. Manufactures:
 - 1) Nibco Model GD-4765-4/8.
 - 2) Where Nibco is listed, Victaulic, Watts, Tyco and Milwaukee are equal.
 2. Cast or ductile iron, chrome or nickel plated ductile iron or aluminum bronze disc, resilient replaceable EPDM seat, lug, or grooved ends, extended neck, handwheel and gear drive and integral indicating device, and internal tamper switch rated, UL / FM approved.

- F. Check Valves:
 1. Up to and including 2-1/2 inches to 6 inches:
 - a. Manufacturers:
 - 1) Nibco Model G-917-W.
 - 2) Where Nibco is listed, Victaulic, Watts, Tyco and Milwaukee are equal.
 - b. Iron body and swing disc, bronze seat, stainless steel spring, grooved ends, 175 psi WP.

- G. Water Flow Switch:
 1. System sensor WFD water flow detector. Poetter Reomer, Viking, and Tyco are acceptable manufacturers.

- H. Supervisory Switches:

System sensor OSY2 Model tamper detector. Poetter Roemer, Viking, and Tyco are acceptable manufacturers.

- I. Fire Department Siamese Connection:
 1. Crocker Figure No. 6410-PC chrome plated exposed with clappers, caps and chains.
 2. Location to be coordinate with Fire Chief and Architect.

Elkhart, Croker and Guardian Fire are acceptable manufacturers

- J. Test and Drain Assembly:
 1. Viking Model A-1 complete with sight glass and 1/2" orifice for test purpose. Pipe discharge to drain riser on to exterior and spill on splash block.

Tyco, Victaulic, and Reliable are acceptable manufacturers.

- K. Fire Pump:
 1. The pump shall be an electronically driven vertical mounted inline, single stage U.L. 448 factory assembled and tested electrically. Pump approved for fire pump use in accordance with the requirements of NFPA 20. Pump shall be ISO 9001 Certified.
 2. The pump shall be rated at 150 GPM with a 45 psi boost. The pumping unit shall deliver not less than 150% of its rated capacity at not less than 65% of total rated head with the shut off pressure not exceeding 140% of the total rated head.
 3. The pump impeller shall be cast bronze statically and dynamically balanced and keyed to the shaft.
 4. The pump shaft shall be made of SAE 1045 steel with bronze sleeves, key locked and threaded to tighten with shaft rotation. Shaft bearings shall be grease-lubricated ball

- bearings in case-iron housing and seals shall be stuffing box type with bronze packing gland.
5. The pump shall be coupled to the ending drive with a flexible coupling capable of absorbing torsional vibration and shaft misalignment. Provide a metal coupling guard.
 6. The pump shall be driven by U.L. listed and FM approved Nema MG-1, open-drip proof, squirrel cage 7.5HP motor, 460 Volts 3 phase, manufactured in full compliance with NFPA 20 and NFPA 70.
 7. The fire pump shall be provided with all NFPA required accessories including automatic air release, circulation relief valve, suction and discharge pressure gages, concentric tapered reducing fitting on pump discharge, eccentric-tapered reducing fitting on pump suction and base elbow supports.
 8. Provide a low suction control valve on the pump discharge piping to maintain a 20 psi suction pressure.
 9. The pump and drive unit shall be factory assembled and tested and mounted on a common base. Install on a 4" high housekeeping pad.
 10. The pump and driver shall be a Patterson 3x3 VIP UL-FM. Approved equals are Aurora and Allis-Chalmers.
- L. Automatic Pump Controller:
1. Provide and install a U.L. 218 listed NFPA 20 automatic control panel listed for fire pump control.
 2. The control cabinet shall be floor mounted on a concrete pad against an outside wall. Provide in panel two separate compartments, one for the starter and associated controls and one compartment for an automatic transfer switch.
 3. The controller shall not exceed 70" in height, 58" in width and 20" in depth.
 4. The controller shall provide "soft start" starting for the pump motor and short-circuit with stand rating at least equal to the short-circuit current available at the controller location. The controller shall be manual and automatic with manual-off-automatic selection switch, power on lamp, connection points to the fire alarm system to include motor running, condition, loss-of-line power and line-power phase reversal, pressure switches to start and shut down pump. Provide a minimum run timer set for 15 minute run time and automatic controller to test run pump a minimum 30 minutes each week. Provide on controller panel a visual indicator connected to the power conductors on the line side of the motor starter indicating operating voltage is available at the starter coil.
 5. Provide in a separate compartment in the control panel an automatic transfer switch to transfer from normal power to emergency and to switch from emergency to normal power.
 6. The pump shall be started by fire alarm relay, deluge valve relay or push button starter.
 7. The automatic control panel shall be factory assembled, wired and tested such that the only field wiring required shall be power in and motor circuit out.

2.03 JOCKEY PUMP

- A. Pressure-Maintenance Pump (Jockey Pump)
1. Provide and install a pressure-maintenance jockey pump, electrically driven, cast iron or stainless body, bronze or stainless steel impeller with mechanical seals. The pump shall be rated for 2.5 GPM at 55 psi boost. Pump shall be equal to a Patterson 0.5 HP, 480/3. Model #PM3-8 Series.
- B. Pressure Maintenance Pump (Jockey Pump) Controller
1. Provide and install a UL 508 factory assembled, wired and tested for combined automatic and non-automatic operation.
 2. The enclosure shall be UL 508, Nema 250 type 2.
 3. The controller shall be rated for the specified more power and includes fusible disconnect switch, pressure switch.

4. Controller shall be a Master Model JPC-1.5-3-46 complete.

2.04 FIRE PUMP ALIGNMENT

- A. The pump/motor shall be "rough" aligned at factory to assure proper fit for final alignment.
- B. Pre-Alignment: After the pump has been properly secured to its concrete base and properly grouted, then pump/motor shall be pre-aligned with a straight edge and calipers prior to piping. Assure that the pump is level, all bolts secured and the grout is completely dry before piping is fitted to the pump. The flange bolts must easily slide into place and pipe flanges must not place any strain on the pump.
- C. Final Alignment: Final alignment shall be done after the system is filled. The pump/motor alignment shall be done with laser alignment equipment and shims are to be new and calibrated. The alignment technicians shall have been trained and certified by the manufacturer of the specific laser unit being used.
- D. Alignment must be to the following specifications:
 1. Parallel Misalignment – 0.004" T.I.R.
 2. Angular Misalignment – 0.002" T.I.R.
 3. T.I.R. – Total Indicated Run Out.
 4. Alignment must be done from the pump/motor shafts, not from the coupling.
- E. A laser alignment report is to be completed on each pump/motor giving job name, equipment name, identification number of pump and motor, initial vertical and horizontal values and final vertical and horizontal values.
 1. The pump manufacturer's representative shall be responsible for the pump/motor alignment. The mechanical contractor shall verify this by co-signing the alignment report.

2.05 FIRE PUMP DOWELING

- A. After final coupling alignment is complete, motor feet and pump base to be doweled to base.
- B. Drill holes through diagonally opposite feet and into pump base. Hole diameter to be 1/64 inch less than dowel pins.
- C. Clean out chips, ream holes in feet and base for "light push fit."
- D. Insert pins approximately flush with feet
- E. Installation:
 1. The installation must meet all established standards and be according to all applicable laws, regulations and codes.
- F. Training:
 1. The contractor must plan and organize a training session of a minimum two hours for the building maintenance staff, in the presence of building owner or his representative.
 2. The training session must include the normal operation, emergency procedures and system maintenance.
 3. Training personnel roster shall be included in closeout documents.
- G. Test & Verification:

1. Hydrostatic tests must be performed on the entire sprinkler piping system, as required by NFPA 13.
2. In addition to the standard hydrostatic test, an air pressure leakage test at 40 psi (2.8 bars) shall be conducted for 24 hours. Any leakage that results in a loss of pressure in excess of 1 1/2 psi (0.1 bar) during the 24 hours shall be corrected.
3. A drain test using the auxiliary drain valve fully open (drain located on water supply side, deluge valve inlet) must be performed to make sure that no back pressure in drain piping exists, which could affect the proper operation of the preaction system.
4. An air supply test must be performed, to confirm that normal air pressure can be restored within 30 minutes.
5. The verification of the fire alarm system must be done in accordance with the NFPA 72, Chapter 7 (and CAN/ULC-S537 in Canada).

H. Report & Certification:

1. An inspection report and a certificate must be supplied to the engineer at the completion of the project. All test results shall be registered in a booklet to be included with the inspection report.

The proper operation and coordination for the system's installation, including the automatic sprinkler system, detection system, signaling system and initial start-ups are all under the responsibility of the fire protection contractor.

2.06 FIRE STOP SYSTEMS

- A. All wall and floor penetrations are to be closed. Refer to the Arch. Life Safety Plans and close all openings with a U.L. listed assembly compatible with the rating of the wall or floor being penetrated.
- B. Non-rated walls – sheet rock joint compound may be used to seal opening.
- C. For piping passing through listed sheet rock walls or partitions:
 1. Uninsulated pipe passing through 2 hour walls or partitions – minimum 5/8" depth of Hilti FS 605 filling annular space between wall and pipe on both sides of wall, U.L. Listing #WL1056.
 2. Uninsulated pipe passing through 2 hour walls or partitions – minimum 1-1/4" depth of Hilti FS 601 filling annular space between pipe and wall on both sides of wall, U.L. Listing #WL1054.
- D. For piping passing through concrete floors, concrete walls or concrete block walls.
 1. Uninsulated Schedule 40 steel pipe; fill annular space between pipe and opening with Hilti #FS 605. U.L. Listing #CJ1184.

PART 3 - EXECUTION

3.01 PREPARATION

- A. Install piping in accordance with NFPA 13 for sprinkler systems, NFPA 14 for standpipe and hose systems, and NFPA 24 for service mains.
- B. Connect to site fire service installed under another section. Verify the site with civil drawings for the exact size and location of the service prior to beginning work.
- C. Route piping in orderly manner, plumb and parallel to building structure. Maintain gradient.

- D. Install piping to conserve building space, to not interfere with use of space and other work.
- E. Group piping whenever practical at common elevations.
- F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment.
- G. Inserts:
 - 1. Provide inserts for placement in concrete formwork.
 - 2. Provide inserts for suspending hangers from reinforcement concrete slabs and sides of reinforced concrete beams.
 - 3. Provide hooked rod to concrete reinforcement section for inserts carrying pipe over 4 inches.
 - 4. Where concrete slabs form finished ceiling, locate inserts flush with slab surface.
- H. Pipe Hanger and Supports:
 - 1. Install in accordance with NFPA 13 and NFPA 14.
 - 2. Hangers on branch lines to comply with NFPA 13, 9.2.3.
 - 3. Hangers on mains to comply with NFPA 13, 9.2.4.
 - 4. All hangers to be a maximum of 12 inches from the end of a branch line or an arm-over for a drop.
 - 5. Support vertical piping at every floor. Support riser piping independently of connected horizontal piping.
 - 6. Where several pipes can be installed in parallel and at same elevation, provide multiple trapeze hangers may be used.
 - 7. Provide copper plated hangers and supports for copper piping.
 - 8. Prime coat exposed steel hangers and supports. Hangers and supports located in crawl spaces, pipe shafts, and suspended ceiling spaces are not considered exposed.
- I. Slope piping and arrange systems to drain at low points.
- J. Prepare pipe, fittings, supports, and accessories for finish painting. Where pipe support members are welded to structural building framing, scrape, brush clean, and apply one coat of zinc rich primer to welding.
- K. Do not penetrate building structural members unless indicated.
- L. Provide sleeves when penetrating floors and wall. Seal pipe and sleeve penetrations to achieve fire resistance equivalent to fire separation required.
- M. When installing more than one piping system material, ensure system components are compatible and joined to ensure the integrity of the system. Provide necessary joining fittings. Ensure flanges, unions, and couplings for servicing are consistently provided.
- N. Die cut threaded joints with full cut standard taper pipe threads and connect with Teflon tape or Teflon pipe compound applied to male threads.
- O. Install valves with stems upright or horizontal, not inverted.
- P. Provide valves for shut-off or isolating service and where shown on plans.
- Q. Provide drain valves at main shut-off valves, low points of piping and apparatus.
- R. Install piping in attic directly on top of joists. Install plastic sheeting over top of pipe and secure joists. Insulation to be installed over pipe and plastic sheeting.

- S. Provide automatic sprinkler coverage at the bottom of hydraulic elevator shafts and elevator machine room in Accordance with NFPA 13 and local requirements.
- T. Exterior exposed equipment shall be chrome plated.
- U. All fire department or maintenance connections shall be coordinated with the Fire Department.
- V. The fire protection contractor is responsible for coordination and labelling of fire devices supplied under this specification.
- W. Where pipes penetrate exterior or finished surfaces escutcheons shall be used. Escutcheons shall be chrome finished and single piece design.
- X. All devices and equipment shall be labelled as required by NFPA 13, 20, 24.

1.00 GENERAL:

1.01 SCOPE:

- A. Include Section 15410 "GENERAL PROVISIONS - PLUMBING AND FIRE PROTECTION", with this Section.
- B. Repair existing insulation at points of connection to existing work.
- C. "Exposed" is defined as: Exposed to view when construction is complete. Items which are not "exposed" are "concealed".
- D. Insulate all items subject to sweating or loss of heat.
- E. All insulation shall be installed by licensed applicator and applied in accordance with the Manufacturer's Recommendations.

1.02 INSULATION REQUIREMENTS:

- A. Comply with NFPA 90A.
- B. Pipe hanger saddles are specified in Section 15450 "MATERIALS AND METHODS - PLUMBING"
- C. Use insulation and adhesives with Underwriter's Laboratories flame spread rating not over 25 without evidence of continued progressive combustion, and smoke developed rating not exceeding:
 - 1. 50 for pipe covering located in air ducts, plenum or casing.
 - 2. 150 for all other pipe, and equipment insulation.

2.00 PRODUCTS:

2.01 FIBERGLASS PIPE COVERING:

- A. Snap-on glass fiber insulation minimum density 5#/cu. ft. maximum thermal conductivity at 75°F mean temperature 0.25 BTU/(hr) (sq. ft.) (°F/in.) with UL rated vinyl coated and embossed vapor barrier laminate of aluminum foil and kraft reinforced with glass fiber yarns (ASJ).
- B. For all lines seal jacket with self sealing lap and staple with outward clinching staples 3" o.c. Butt adjoining sections of insulation tightly and seal with self-adhering butt joint strips.
- C. Cover fittings to thickness of adjacent covering with factory pre-molded fitting covers. Cover flanged valve bodies with flanged unions. Do not cover screwed unions on hot lines. Finish fittings with a skim-coat of insulating cement and when cement is dry fitting shall be covered with glass fab and vinyl acrylic mastic. Finish fittings exposed in equipment rooms, boiler room, and in finished spaces with vinyl acrylic mastic over glass fab.
- D. At Contractor's option, concealed tees may be insulated with field fabricated tee covers consisting of straight pipe covering on run of tee with notch at branch together with pipe covering on branch contoured to fit notch. Glass fab shall be applied around main, lapping contoured joint at branch by 1" minimum for the full circumference of joint. Cover entire fitting covering with vinyl- acrylic mastic over glass fab, 1/8" thick (dry) coat. Submit sample of fabricated tee covering to Architect for approval before work is begun.

2.02 ALUMINUM JACKET PIPING COVER:

- A. 0.010" thick corrugated aluminum jacket with laminated polyethylene and draft paper adhered liner.

- B. Securely rivet jacket in place and band with flat aluminum bands 18" o.c.
- C. Finish fittings on aluminum jacketed lines with 1/8" thick (dry) coat of vinyl acrylic mastic reinforced with glass cloth.

2.03 MANUFACTURERS

- A. Acceptable Manufacturers for Fiberglass Insulation Materials:
 - 1. Owens-Corning.
 - 2. Certaniteed.
 - 3. Knauf.
 - 4. Manville Corporation
- B. Acceptable Manufacturers for Foamed Plastic Closed Cell Elastometric Insulation Materials:
 - 1. Armstrong AP.
 - 2. Rubatex.
- C. Acceptable Manufacturers for Adhesives, Mastics and Coatings:
 - 1. Armstrong.
 - 2. Benjamin Foster.
 - 3. Childers.
 - 4. Marathon.
- D. Acceptable Manufacturers for Metal Jackets:
 - 1. Childers.
 - 2. Manville Metal-Loc.

2.04 SCHEDULES - PIPING

- A. Plumbing Piping:
 - 1. Domestic Cold Water Interior, Above Grade:
 - a. Glass Fiber Pipe Insulation
 - 1) All pipe sizes: 1 inch thick.
 - 2) Pipes located in walls: ½ inch thick.
 - b. Foamed Plastic Pipe Insulation
 - 1) All pipe sizes: 1 inch thick.
 - 2) Pipes located in walls: ½ inch thick.
 - 2. Domestic Hot and Recirculating Water Interior, Above Grade:
 - a. Glass Fiber Pipe Insulation
 - 1) All pipe sizes: 1-1/2 inch thick.
 - 2) Pipe located in walls: 1 inch thick.
 - b. Foamed Plastic Pipe Insulation
 - 1) All pipe sizes: 1 inch thick.
 - 2) Pipes located in walls: ½ inch thick.
 - 3. Floor Drain Bodies, Traps and Waste Piping Between Floor Drain and Waste Stack for Floor Drains Serving Refrigeration Equipment, Ice Machine and AC Units; Interior, Above Grade:
 - a. Glass Fiber Pipe Insulation
 - 1) All pipe sizes: 1 inch thick.

2.05 INSTALLATION – EQUIPMENT INSULATION GENERAL

- A. Install in accordance with NAIMA Insulation Standards.
- B. Factory Insulated Equipment: Do not insulate.

- C. Exposed Equipment: Locate insulation and cover seams in least visible locations.
- D. Apply insulation close to equipment by grooving, scoring, and beveling insulation. Fasten insulation to equipment with studs, pins, clips, adhesive, wires or bands.
- E. Fill joints, cracks, seams and depressions with bedding compound to form smooth surface. On cold equipment, use vapor barrier cement.
- F. Insulated equipment containing fluids below ambient temperature: Insulate entire system.
- G. Finish insulation at supports, protrusions, and interruptions.
- H. Equipment in Mechanical Rooms or Finished Spaces: Finish with canvas jacket or as scheduled.
- I. Nameplates and ASME Stamps: Bevel and seal insulation around; do not insulate over.
- J. Equipment Requiring Access for Maintenance, Repair, or Cleaning: Install insulation so it can be easily removed and replaced without damage.
- K. Install in accordance with NAIMA National Insulation Standards.
- L. Exposed Piping: Locate insulation and cover seams in least visible locations.
- M. Insulated pipes conveying fluids below ambient temperature: Insulate entire system including fittings, valves, unions, flanges, strainers, flexible connections, pump bodies, and expansion joints.
- N. Fit pipe hangers over insulation.
- O. Inserts and Shields:
 - 1. Application: Protect insulated piping at hangers and supports with insulation shield. On pipe sizes over 2 inches, provide insert.
 - 2. Insulation Protection Shield: Galvanized steel formed in half circle to fit insulation. Length and gauge as follows:
 - a. Up to NPS 4: 12 inches long and 22 gauge.
 - b. NPS 6: 18 inches long and 22 gauge.
 - c. NPS 8 through 12: 24 inches long and 18 gauge.
 - d. NPS 14 and Large: 24 inches long and 16 gauge.
 - 3. Insulation-Insert Material: Water repellent treated, ASTM C533, Type I calcium silicate; or ASTM C552, Type II cellular glass of same thickness and vapor barrier jacket specified for surrounding insulation. Insert shall be a minimum of 2 inches longer than the shield.
 - 4. For Trapeze or Clamped Systems: Insert and shield shall cover entire circumference of pipe.
 - 5. For Clevis Hangers: Insert shall cover lower 180 degrees of pipe.
 - 6. Option: At Contractor's option, insert may be factory fabricated Thermal Hanger Shield (insulation insert encased in sheet metal shield) equal to Pipe Shield, Inc. "Insulated Pipe Supports."
- P. Continue insulation through metal studs, walls, sleeves, pipe hangers, and other pipe penetrations. Finish firestopping at supports, protrusions, and interruptions. At fire separations, refer to Division 7 and Section 15410: Sleeves.
- Q. Exterior Applications: Provide vapor barrier jacket. Insulate fittings, joints and valves with insulation of like material and thickness as adjoining pipe, and finish with glass mesh reinforced vapor barrier cement. Cover with aluminum jacket with seams located on bottom side of horizontal piping.

3.00 EXECUTION:

3.01 PLUMBING PIPING INSULATION:

- A. Bodies of floor drains serving refrigeration equipment, AC units and ice machines and traps and waste piping between such drains and waste stack: "Fiberglass Pipe Covering", 1" thick.
- B. Cold water piping, interior, above grade: "Fiberglass Pipe Covering", 1" thick. Pipe insulation in partitions and chases may be 1/2" thick "Arma-cell" or approved equal.
- C. Hot and Hot Water Return water piping, interior, above grade: "Fiberglass Pipe Covering", 1-1/2" thickness. Pipe insulation in partitions and chases may be 1" thick "Arma-cell" or approved equal.
- D. Exposed P-Traps, stops and supplies on handicapped lavatories, and sinks. Equal to "PRO-WRAP" by McGuire.
- E. Insulation with aluminum jacket: All exposed hot and cold water piping in Mechanical Rooms, Janitor's Closets and Water Heater Rooms.

1.00 PRODUCTS:

1.01 SCOPE:

- A. Include Section 15410, "GENERAL PROVISIONS – PLUMBING AND FIRE PROTECTION", with this Section.
- B. Pay particular attention to requirements in the General Provisions for substitution of products not named or listed as substitutions.

2.00 PRODUCTS:

2.01 CLEANOUTS:

- A. Furnish and install cleanouts where indicated on drawings and at all 90-degree bends, angle, upper terminals and not over 50 feet apart on straight runs. All cleanouts to have bronze countersunk tapered slotted plugs, except acid waste piping cleanouts, which shall be standard of piping system used. Flush-with-floor cleanout access covers shall have non-skid covers. All wall cleanout access covers shall have polished satin finish. All cleanouts shall be full size of pipe, piping larger than 6" shall have minimum 6" cleanout covers.
- B. Exposed Cleanouts: Cast brass plug type, J.R. Smith #4470.
- C. Wall type cleanout plug and access covers, J.R. Smith #4472. Cleanout plug must be within 1" of finish wall and must be tapped for access cover.
- D. Install wall cleanouts on stacks at flush valve fixtures 12" above top of flush valve, 12" above finish floor on sinks, lavatories and water coolers and 12" above grab bars at fixtures with grab bars. Locate cleanouts to clear baseboard at floor.
- E. Floor type cleanout access covers: J.R. Smith #4248-NB. Plug must be within 3" of finished floor. Grout cleanout below access cover to seal watertight.
- F. Outside Cleanouts: J.R. Smith #4258 cleanout access encased in a 18" X 18" X 6" deep concrete pad. See Detail on Drawings.

2.02 REDUCED PRESSURE ZONE BACKFLOW PREVENTER AND DOUBLE CHECK VALVE ASSEMBLIES:

- A. One (1) inch and larger: Equal to Watts #909 with gate valves and inlet strainer. Provide additional valve upstream of strainer. Clayton, Beeco, Febco, Conbraco, Wilkins or equal. Provide same size as piping.
- B. One-half (1/2) inch and three-fourth (3/4) inch: Watts #9D, Wilkins #750, same size as pipe.
- C. Pipe relief from backflow preventer full size to nearest floor drain. Provide factory made air gap for relief connection.
- D. Double check valve assemblies: Watts, Clayton or Beeco.

2.03 PLUMBING FIXTURES AND EQUIPMENT:

- A. All "wetted" domestic potable fixtures, piping materials, valves shall meet the Federal Lead Free Guidelines. All materials shall be clearly marked and submitted with complete data during submittal review.

- B. Unless otherwise specified, all fixtures complete as catalogued, commercial grade, white color, exposed metal trim chromium plated.
- C. Fixtures and brass shall be securely anchored. Carriers shall be securely anchored to floor with lug bolts in all holes as recommended by the manufacturer.
- D. Flush valve "YJ" supports shall be installed 1" below vacuum breaker on all water closet flush valves and around vacuum breaker on urinals.
- E. Seal all fixtures at wall and floor with white silicone sealant. Seal countertop fixtures with clear silicone sealant.
- F. Mount all fixtures at standard mounting height unless otherwise noted.
- G. Furnish sinks and lavatories with correct number of drilling required by the faucet and accessories. Cock hole covers are not acceptable.
- H. All items complete as catalogued as shown on drawings.

2.04 SUBSTITUTE MANUFACTURERS:

- A. Where Kohler is listed above, American Standard or Zurn may be substituted.
- B. Where J.R. Smith is listed above, Josam, Zurn, or Wade may be substituted.
- C. Where Elkay water coolers are mentioned above, Halsey Taylor, or Oasis may be substituted, only if water ways are constructed of totally lead free materials.
- D. Where McGuire is listed above for traps, outlets and stops, EBC, Kohler, Crane, Eljer or American Standard may be substituted.
- E. Where Symmons is listed above, Chicago Faucet or Powers, Zurn may substituted.
- F. Where Chicago Faucet is listed, T&S Brass may be substituted.
- G. Where Elkay sink (s) are listed above, Just may be substituted.
- H. Where Church is listed above, Bemis, Beneke or Centoco may be substituted.
- I. Where Lochinvar tank type water heaters are listed, A.O. Smith or Rheem may be substituted.
- J. Where Stern Williams is listed above, Fiat may be substituted.
- K. Where Sloan is listed, Toto and Zurn may be substituted.
- L. Where Symmons is listed above for shower control valves, Speakman, Leonard, Powers, T&S or Zurn may be substituted.
- M. Where Armstrong is listed above, the equal of B & G, Taco, Grundfos or Thrush may be substituted.

3.00 EXECUTION:

3.01 INSTALLATION:

- A. Equipment shall be installed in accordance with manufacturer's recommendation.

- B. See details for mounting instruction and accessories.
- C. Install electric water heaters so elements can be removed without disconnecting and/or removing heater.
- D. Cleanouts on water closet stacks shall be installed minimum 12" above top of the flush valve on standard water closets, minimum 12" above top of grab bar on handicapped water closets and minimum 12" above top of tanks on non-handicapped tank type water closets. On urinal locate cleanouts minimum 12" above top of flush valve on handicapped urinals and 12" above finish floor on standard units. On lavatories and sinks - 12" above finish floor and all other fixtures 12" above floor or above top of fixture.
- F. Stops and supplies are to be installed with chrome plated brass nipples penetrating wall with deep escutcheon at wall. Compression type stops are not acceptable.
- G. All floor mounted fixtures supports are to be securely attached to the floor using anchors in all mounting hole of size as recommended by manufacturer.
- H. Provide wood backing in wall at all flush valve brackets and faucet supports and anchor brackets and supports to wood backing with anchors of sufficient length to penetrate backing.
- I. Handicapped flush valve shall be installed with the pull handle on the open side or side opposite the adjacent wall.

SECTION 16010 - COMMON WORK RESULTS FOR ELECTRICAL

1.0 - GENERAL

1.01 RELATED DOCUMENTS

- A. The "General Conditions" and "Special Conditions" of Contract as written and referred to hereinbefore are adopted and made part of Division 16.

1.02 DESCRIPTION OF WORK

- A. Provide equipment, labor, etc., required to install complete working electrical system as shown and specified.
- B. Provide fixed electrical equipment, except where specifically noted otherwise.
- C. Provide equipment and/or wiring normally furnished or required for complete electrical systems but not specifically specified on the drawings or in specifications, as though specified by both.
- D. All equipment and wiring shall be new.
- E. Electrical work includes, but is not limited to:
 - 1. Arrange with local utility companies for services as shown or specified.
 - 2. Removal or relocation of electrical services located on or crossing through project property, above or below grade, obstructing construction of project or conflicting with completed project or any applicable code.
 - 3. Complete 600-volt Distribution System. Provide meters, switchboards, panelboards, circuit breakers, power outlets, convenience outlets, switches, and/or other equipment forming part of system.
 - 4. Complete raceway systems for the following systems.
 - a. Voice and Data.
 - b. Powered fiber cable system.
 - c. Speaker Systems
 - d. Security Systems
 - 5. Connection of all appliances and equipment.
 - 6. Coordination with power utility and providing an aid to construction as noted in the drawings.
 - 7. Complete emergency lighting and power system, including individual battery units and/or inverters.
 - 8. Complete fire alarm system.
 - 9. Complete emergency responder radio system testing as described on the drawings. Provide allowance for system design, furnishing materials, and installing as described on the drawings.
 - 10. Complete lighting systems.
 - 11. Complete electrical generation system.
 - 12. Provide temporary facilities for construction power.
 - 13. Coordination with general contractor for access panels in hard ceilings or walls required for access to Division 16 components.

1.03 WORK NOT INCLUDED

- A. Furring for conduit and equipment.
- B. Finish painting of conduit and equipment.
- C. Installation of motors except where specifically noted.
- D. Installation of telephone instruments.
- E. Flashing of conduits into roofs and outside walls. Inform General Contractor of number and size of roof penetrations prior to bidding.
- F. Active network devices including switches and transceivers, wireless activation point devices unless specifically noted in the Contract Documents.

1.04 RELATED WORK SPECIFIED ELSEWHERE

- A. Classification of excavation: Architectural Division.
- B. Painting: Painting Division.
- C. Concrete Work: Concrete Division.

1.05 REQUIREMENTS OF REGULATORY AGENCIES

- A. Obtain and pay for all permits required for the work. Comply with all ordinances pertaining to work described herein.
- B. Install work under this Division per drawings, specifications, latest edition of the National Electrical Code, Local Building Codes, and any special codes having jurisdiction over specific portions within complete installation. In event of conflict, install work per most stringent code requirements determined by Architect.
- C. Arrange, pay fees for and complete work to pass required tests by agencies having authority over work. Deliver to Architect Certificates of Inspection and approval issued by authorities.

1.06 QUALIFICATIONS OF CONTRACTOR

- A. Has completed minimum two projects same size and scope in past five (5) years.
- B. This qualification applies to Sub-Contractors.
- C. Use workmen experienced in their respective trade. Submit qualifications of Superintendent for review.
- D. Owner reserves right to reject bid of any Contractor failing to meet these qualifications.
- E. Licensed and bonded in state where project is located.

1.07 GENERAL JOB REQUIREMENTS

- A. Drawings and Specifications:
 - 1. Electrical work is shown on E series drawings inclusive. Follow any supplementary drawings as though listed above.
 - 2. Drawings show general run of circuits and approximate location of equipment. Right is reserved to change location of equipment and devices, and routing of conduits to a reasonable extent, without extra cost to Owner.
 - 3. Refer conflicts between drawings and specifications describing electrical work and work under other Divisions to Architect for remedial action.
 - 4. Use dimensions in figures in preference to scaled dimensions. Do not scale drawings for exact sizes or locations.
 - 5. Execution of Contract is evidence that Contractor has examined all drawings and specifications related to work and is informed to extent and character of work. Later claims for labor and materials required due to difficulties encountered, which could have been foreseen had examination been made, will not be recognized.
 - 6. Charges for extra work not allowed unless work authorized by written order from Architect approving charge for work.
- B. Specifications and Drawings:
 - 1. Specifications and Drawings shall be complementary and be used for the complete interpretation of the electrical work.
 - 2. Unless noted or modified by specific notation to the contrary, the indication and/or description of any electrical item in the documents carries with it the instruction to furnish, install and connect same. It shall be understood that the intent governs the work, regardless of whether or not this instruction is explicitly stated. The use of the words "furnish" or "provide" with the absence of the word "install" shall be defined to include the installation and connection of the equipment and/or materials unless specific instructions are included for others to install and/or connect.

3. No exclusion from or limitation in drawings or specifications for the electrical work shall be reason for omitting the appurtenances, accessories, or devices necessary to complete any required system or item of equipment or compliance with codes.
 4. The drawings are shown in part diagrammatic, intended to convey the scope of work, indicating the general arrangement of equipment, conduit and outlets. Follow the drawings in laying out the work and verify places for the installation of the materials and equipment. Wherever a question exists as to the exact intended location of outlets or equipment, obtain instructions from the Architect before proceeding with the work.
- C. Visit to Site:
1. Visit site to survey existing conditions affecting work. Include necessary materials and labor to accomplish the electrical work, including relocation of existing services and utilities on building site in bid. No consideration given to future claims due to existing conditions.
- D. Definitions:
1. Provide: Furnish, install and connect complete.
 2. Wire: Furnish all necessary wiring and connect complete.
 3. Install: Set in place and wire complete.
 4. Work: Materials completely installed and connected.
 5. AWG: American Wire Gage.
 6. NEC: National Electrical Code (latest edition)
 7. NFPA: National Fire Protection Association.
 8. OSHA: Occupation Safety and Health Administration.
 9. UL: Underwriters Laboratories, Inc.
 10. NEMA: National Electrical Manufacturers Association.
 11. IEEE: Institute of Electrical and Electronic Engineers.
- E. Workmanship, Guarantee and Approval:
1. Work under this Division shall be first class with emphasis on neatness and workmanship.
 2. Install work using competent mechanics, under supervision of foreman, all duly certified by local authorities. Installation subject to Architect's constant observation, final approval, and acceptance. Architect may reject unsuitable work.
 3. Furnish Architect written guarantee, stating that if workmanship and/or material executed under this Division is proven defective within one (1) year after final acceptance, such defects and other work damaged will be repaired and/or replaced.
 4. In event that project is occupied, or systems placed in operation in several phases at Owner's request, guarantee will begin on date each system or item of equipment is accepted by Owner.
- F. Observations of Work and Demonstration of Operation:
1. At all observations of work, open panel covers, junction box covers, pull box covers, device covers, and other equipment with removable plates for check. Provide sufficient personnel to expedite cover removal and replacement.
 2. Contractor to assist Architect in demonstration of operation of new systems to satisfaction of Owner. Contractor to have manufacturer available for demonstration of systems where requested by Owner.
- G. Testing of Electrical Systems:
1. Test Completed work as follows:
 - a. Perform tests required by Architect to indicate compliance with specifications, drawings and applicable codes. Provide instruments, labor and materials for tests.
 - b. Refer to other Division 16 specification sections for additional testing requirements.
- H. Materials and Substitutions:
1. All material shall be new, with U.L. label where available. If U.L. label is not available, material shall be manufactured in accordance with applicable NEMA; IEEE and Federal Standards.

2. No material shall be substituted for specified, except by prior written approval of Architect. Specified catalog numbers are used for description of equipment and standard of quality only. Equivalent material given consideration only if adequate comparison data including samples are provided. Approval required prior to bid date. Bid substituted material only if approved in writing by Architect.
 3. Submit to Architect within 30 days after award of contract a complete list of proposed material manufacturers. List does not preclude submission of shop drawings. Approval of manufacturer on list does not constitute approval of specific material or equipment.
- I. Shop and Erection Drawings:
1. Submit complete shop drawings for all material and equipment furnished under Division 16 specifications. Shop drawings shall be submitted on timely basis to allow adequate lead time for review, re-submission, if necessary, manufacture and delivery to allow access of material to project at correct time based on schedule established by Architect/Contractor. Include complete descriptive data with dimensions, operating data and weight for each item of equipment. Carefully examine shop drawings to assure compliance with drawings and specifications prior to submittal to Architect. Shop drawings and submittals shall bear the stamp of approval of the Electrical and General Contractor as evidence drawings have been checked by them. Drawing submitted without this stamp of approval will not be considered and will be returned for proper resubmission.
 2. Review of shop drawings does not relieve Contractor of responsibility for errors and omissions in shop drawings. Contractor is responsible for dimensions and sizes of equipment. Inform Architect in writing of equipment differing from that shown.
 3. Prepare erection drawings when required by Architect. Investigate thoroughly all conditions affecting work and indicate on drawing. Architect will review erection drawings before work commences.
 4. Coordination shop drawings will be required for the following areas, drawn to a scale of not smaller than 1/4" - 1'-0":
 - a. Electrical equipment rooms and areas.
 - b. Electrical and mechanical equipment areas.
 - c. Start drawings as HVAC shop drawings indicating all ductwork piping, equipment and locations of mechanical room floor drains, and electrical connections. Indicate elevations of all ductwork and piping. Draw sections as required to clarify congested situations.
 - d. Next, the Plumbing Section shall add all piping and plumbing equipment to the drawings.
 - e. Next, the Fire Protection Section shall add all sprinkler heads and fire protection piping.
 - f. Next, the Electrical Sections shall add all electrical fixtures, conduit and equipment.
 - g. Next, the drawings shall be submitted to the General Contractor for final coordination.
 - h. Finally, after the General Contractor has approved the drawings, they shall be submitted to the Architect for approval.
 - i. Finally, after the General Contractor has approved the drawings, they shall be submitted to the Engineer for approval.
- J. Cooperation:
1. Carefully coordinate work with other contractors. Refer conflicts between trades to Architect.
 2. Arrange and coordinate work to avoid conflict with trades to allow for accessibility, conserve space and to provide for maintenance.
 3. Work to be installed as progress of project will allow. Schedule of work determined by General Contractor and/or Architect.
- K. Maintenance and Operating Instructions for Equipment:

1. Submit to Architect one (1) set of data prepared by manufacturer for each item of electrical equipment completely describing equipment. Data to include parts lists, description of operation, shop drawings, wiring diagrams, maintenance procedures and other literature required for maintenance of equipment. Bind in booklet form for presentation.
- L. "Record" Drawings:
1. Provide "Record" prints at the completion of job. Keep set of prints on job and record day to day changes to Contract drawings with red pencil. Indicate actual location of conduit systems, outlets, and equipment. Turn over prints to Architect at final observation.
 2. Provide as built drawings created from record drawings.
- M. Items for Owner:
1. Provide following items for Owner at time of substantial completion:
 - a. Certificates of inspection and approval from authorities having jurisdiction.
 - b. Written guarantees.
 - c. As built drawings.
 - d. Final approved shop drawings (1 set).
 - e. Spare fuses (furnish receipt).
 - f. Maintenance data (1 set).
 - g. Affidavit of Owner Instruction (1 copy).
- N. Protection and Storage:
1. Provide warning lights, bracing, shoring, rails, guards and covers necessary to prevent damage or injury.
 2. Do not leave exposed or unprotected, electrical items carrying current. Protect personnel from exposure to contact with electricity.
 3. Protect work and materials from damage by weather, entrance of water or dirt. Cap conduit during installation.
 4. Avoid damage to materials and equipment in place. Repair, or remove and replace damaged work and materials.
 5. Exercise particular care when working around telephone (electronic) equipment to prevent entrance of dust, moisture and debris into the equipment. Provide dust barriers and partitions as required.
 6. Deliver equipment and materials to job site in original, unopened, labeled container. Store to prevent damage and injury. Store ferrous materials to prevent rusting. Store finished materials and equipment to prevent staining and discoloring. Store materials affected by condensation in warm dry areas. Provide heaters. Storage space on site and in building designated by Owner/Architect.
 7. Install equipment per manufacturer's recommendations. Conflicts between contract documents and these recommendations, deferred to Architect.
- O. Cutting and Repairing:
1. Cut and repair walls, floors, roof, etc., required to install work. Where work cut is finished, employ original installer of finish to repair finish. Do not cut structural members.
- P. Anchors:
1. Provide anchors for all equipment, raceways, hangers, etc. to safely support weight of item involved. Anchors to consist of expansion type devices similar to "Redhead" or lead expansion anchors. Plastic anchors are not acceptable. Protect telephone equipment from drilling residue.
- Q. Cleaning and Painting:
1. Clean equipment furnished in this Division after completion of work.
 2. Touch-up or re-paint damaged painted finishes.
 3. Remove debris, packing cartons, scrap, etc., from site.
- R. Control Wiring:

1. Control Wiring including low voltage and line voltage interlock wiring will be furnished and installed under another Division, except where specifically shown otherwise. Carefully coordinate power and control wiring interface.
- S. Code Compliance:
1. Entire electrical installation shall comply with all aspects of code including local interpretations.

1.08 GENERAL JOB REQUIREMENTS

- A. It is the intention of these specifications to indicate a standard of quality for all materials incorporated in this work. Manufacturer's names and catalog numbers are used to designate the item of equipment or material as a means of establishing grade and quality. Where several manufacturers are named, only the named manufacturer's products will be considered unless explicitly stated otherwise by the Electrical Engineer. Where several manufacturers are named, only the named manufacturers' products will be considered, and the Contractor's bid shall be based on their product.
- B. Where the phrase "OR APPROVED EQUIVALENT" or "OR EQUIVALENT" or "EQUIVALENT TO" or "ACCEPTED SUBSTITUTE" is used in these specifications, the names or name mentioned are to be used as a basis of quality. Other manufacturers will be considered if the quality of the proposed material is equivalent to that of materials named in the opinion of the Electrical Engineer; However, such unnamed manufacturers' products will be considered as substitutions and shall not be used as a basis for bidding.
- C. Basis of quality shall include material, workmanship, weight, finishes and gauges of material, appearances, capacity and performance. Manufacturer's representation as to availability of equipment, replacement parts and service personnel in the area will be a factor in consideration of submittals.
- D. Furnish standard products and manufacturers regularly engaged in production of such equipment.
- E. Furnish manufacturer's latest standard design.
- F. All materials and equipment shall have manufacturer standard warranty unless indicated otherwise.
- G. All equipment shall conform to applicable IEEE, UL, ANSI and/or NEMA Standards.
- H. Obtain manufacturer's recommendations and instructions for all installed equipment including installation instructions, preparation cleaning, tests and pre-service checks, and then ensure all have been performed prior to completion of work.

PART 2 NOT USED

PART 3 NOT USED

END OF SECTION 16010

SECTION 16012 - ELECTRICAL SUBMITTALS

PART 1 - GENERAL

1.1 DESCRIPTION OF SUBMITTAL CATEGORIES:

- A. Submittals required are defined below and specified in each section. Refer to Section 01300.
- B. Shop Drawings include fabrication, layout, wiring diagrams, erection, setting, coordination, similar drawings and diagrams and performance data.
- C. Samples are units of work, materials or equipment items, showing the workmanship, pattern, trim and similar qualities proposed.
- D. Manufacturer's Data is standard printed product information concerning the standard portions of the manufacturer's products.
- E. Certifications are written statements, executed specifically for the project application by an authorized officer of the contracting firm, manufacturer or other firm as designated, certifying to compliance with the specified requirements.
- F. Test Reports are specific reports prepared by independent testing laboratories, showing the results of specified testing. Industry Standards are printed copies of the current standards in the industry.
- G. Manufacturer's Product Warranties are manufacturer's standard printed commitment in reference to a specific product and normal application, stating that certain acts of restitution will be performed by the manufacturer if the product fails under certain conditions and times limits.
- H. Operating Instructions are the written instructions by the manufacturer, fabricator or installer of equipment or systems, detailing the procedures to be followed by the Owner in operation, control and shut-down.
- I. Maintenance Manuals are the compiled information provided for the Owner's maintenance of each system of operating equipment. Maintenance Materials are extra stock of parts or materials for the Owner's initial use in maintaining the equipment and systems in operation.
- J. Guarantees are signed commitments to the Owner that certain acts of restitution will be performed if certain portions of work fail within certain conditions and time limits.
- K. Product Data includes manufacturer's data pertaining to the products, materials and equipment of the work.

1.2 SUBMITTAL FORM AND PROCEDURES:

- A. Submittals shall be made within 30 days of contract signing for projects of 12 months construction time or less. Make within 60 days for longer than 12 months construction time.
- B. Submit shop drawings for all material and equipment furnished under Division 16 to Architect. Refer to Section 01300 get from Architect for submittal procedures.
- C. Multiple System Items: Where a required submittal relates to an operational item of

equipment used in more than one system, increase the number of copies as necessary to complete maintenance manuals for each system.

- D. Response to Submittals: Submittals will be returned with indication that documents comply with specifications or that documents do not comply and what action must be taken to comply.
- E. Coordinate electrical submittals through Contractor to Architect and assist Contractor in preparation of submittal.
- F. Submittals shall bear the stamp and signature of electrical and general contractor. Failure to place same on drawings require resubmittal before review.

1.3 SPECIFIC SUBMITTAL REQUIREMENTS:

- A. Shop Drawings:
 - 1. To accurate scale except where diagrammatic representations are specifically indicated.
 - 2. To show clearance dimensions of critical locations and show dimensions of spaces required for operation and maintenance of equipment.
 - 3. To show conduit and conductor connections and other service connections.
 - 4. To show interfaces with other work including structural support.
 - 5. To include complete descriptive data, with dimensions, operating data and weight.
 - 6. To indicate deviation from the contract documents.
 - 7. To explain deviations.
 - 8. To show how deviations coordinate with portions of the work, currently or previously submitted.
- B. Review of shop drawings shall not relieve Contractor of responsibility for errors or omissions in shop drawings. Any equipment which will not fit into space shown on drawings shall be called to the attention of the Architect in writing.
- C. Samples: Architect's review of sample submittals:
 - 1. Limited to general type, pattern and finish.
 - 2. Not to include testing and inspection of the submitted samples.
 - 3. Compliance with specified requirements is exclusive responsibility of the Contractor.
- D. Manufacturer's Data:
 - 1. Where pre-printed data covers more than one distinct item, mark copy to indicate which item is to be provided.
 - 2. Delete portions of data not applicable.

3. Mark data showing portion of operating range required for project application.
 4. Elaboration of standard data describing a non-standard product processed as a shop drawing.
- E. For each product include:
1. Manufacturer's production specifications.
 2. Installation or fabrication instructions.
 3. Source of supply.
 4. Sizes, weights, speeds and operating capacities.
 5. Conduit and wire connection sizes and locations.
 6. Statements of compliance with required standard and governing regulations.
 7. Performance data, where applicable.
 8. Other information needed to confirm compliance. Manufacturer's recommended parts list.
- F. Certifications: Submit with notarized execution.
- G. Test Reports: Submit notarized test reports signed and dated by firm performing test.
- H. Manufacturer's Product Warranties: Where published warranty includes deviation from required warranty, product is disqualified from use on project, unless manufacturer issues a specific project warranty.
- I. Operating Instructions submittal required:
1. Manufacturer's operating instructions for each item of electrical equipment.
 2. Supplement with additional project application instructions where necessary.
 3. Specific operating instructions for each electrical system which involves multiple items of equipment. Instructions for charging, start-up, control or sequencing of operation, phase or seasonal variations, shut-down, safety and similar operations.
 4. Typewritten in completely explained and easily understood English language.
- J. Maintenance Manual Requirements:
1. Emergency instructions including addresses and telephone numbers for service sources.
 2. Regular system maintenance procedures.
 3. Proper use of tools and accessories.

4. Wiring and control diagram for each system.
 5. Manufacturer's data for each operational item in each system.
 6. Manufacturer's product warranties and guarantees relating to the system and equipment items in the system.
 7. Shop drawings relating to the system.
 8. Bind each maintenance manual in one or more vinyl-covered, 2", 3-ring binders, plus pocket-folders for folded drawings. Index with thumb tab for sections. Mark the back spine and front cover of each binder with system identification and volume number.
- K. Maintenance Materials: Deliver to Owner in fully identified containers or packages suitable for storage.
- L. Guarantees: Where indicated as "Certified", provide guarantee which, in addition to execution by an authorized officer of each guarantor, is attested to by the Secretary of each guarantor and bears the corporate seal. Submit draft of each guarantee prior to execution.

END OF SECTION 16012

SECTION 16014 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Systems and equipment requiring identification are shown on the drawings, and extent of identification is specified herein and in individual sections of work.
- B. Types of electrical identification include:
 - 1. Exposed conduit color marking.
 - 2. Buried cable and conduit warnings.
 - 3. Cable/conductor identification.
 - 4. Operational instructions and warnings.
 - 5. Danger signs.
 - 6. Equipment/system identification signs (nameplates).

1.2 SUBMITTALS:

- A. Manufacturer's Data:
 - 1. Product specifications and installation instructions for each material and device.
- B. Samples:
 - 1. Provide for each color, lettering style and other graphic representation.

PART 2 - PRODUCTS

2.1 ELECTRICAL IDENTIFICATION MATERIAL:

- A. Color-Coded Conduit Markers:
 - 1. Color code all conduit with 3/4 inch wide band of vinyl plastic electrical tape, 3M Company "Scotch 35", applied two (2) full turns around conduit, 6" from all conduit terminations into switchboards, panelboards, motor control centers, starters, cabinets, control panels, pullboxes, outlet boxes, etc., on each side of walls, floors or roof penetrated by conduit and where conduit enters wall to outlets below.

<u>CONDUIT COLOR CODE</u>	
<u>SYSTEM</u>	<u>COLOR</u>
120/208 Volts - Normal	Black
277/480 Volts - Normal	Yellow
120/208 Volts - Emergency	Black and Red
277/480 Volts - Emergency	Yellow and Red
Intercom/Paging/Music/Telephone/Dictation	Brown
Computer/Word Processing/Monitoring/Security	Blue
Fire Alarm	Orange

- B. Where authority does not allow tape use paint acceptable to authority.
- C. Underground Line Marker/ Warning tape:
 - 1. Permanent colored, detectable plastic tape with foil core (color per AWWA

Standard for utility being identified), with continuous-printed legend; for direct-burial service; minimum 6" wide x 4 mils thick. Legend to indicate type service of cable (e.g. "WARNING: Buried Electric Line").

D. Cable/Conductor Identification Bands:

1. Manufacturer's standard vinyl-cloth self-adhesive cable/conductor markers, wrap-around type; pre-numbered plastic coated, or write-on type with clear plastic self-adhesive cover flap, lettered to show circuit identification.

E. Self-Adhesive Plastic Signs:

1. Manufacturer's standard, self-adhesive, pre-printed, flexible vinyl signs for operational instructions or warnings. Sizes suitable for application and visibility, with proper wording for application.
2. Color: Orange with black lettering.

F. Danger Signs:

1. Manufacturer's standard "DANGER" signs, baked enamel finish on 20 gage steel; standard red, black and white graphics; 14" x 10" unless 10" x 7" is largest which can be applied, or where larger size is needed for visibility use recognized explanation wording (as examples: HIGH VOLTAGE, KEEP AWAY, BURIED CABLE, DO NOT TOUCH SWITCH).

G. Engraved Signs (Nameplates)

1. 1/8" thick melamine plastic laminate, complying with FS LP-387, sizes as indicated, engrave with standard letter style of sizes and wording indicated (1/4" letters minimum) white field, black letters for normal service; red field, white letters for essential service; yellow field, blue letters for D.C. service; orange field, white letters for UPS service. Punched for screws.
2. Fasteners: Self-tapping stainless steel screws, except contact epoxy adhesive where screws cannot or should not penetrate substrate.

H. Lettering and Graphics:

1. Coordinate names, abbreviations and other designations used with those shown or specified. Provide numbers, lettering, and wording as indicated or required for identification and operation/maintenance.

PART 3 - EXECUTION

3.1 APPLICATION AND INSTALLATION:

A. General Installation Requirements:

1. After completion of painting.
2. Comply with governing regulations and requests of governing authorities for identification of electrical work.

B. Conduit Identification:

1. Where high voltage conduit is exposed, apply identification to conduit.
- C. Underground Cable and Duct Identification:
1. During back-filling of underground cable or duct, install continuous marker warning tape, directly over buried line 6" to 12" below finished grade. Where multiple lines are buried in common trench not exceeding 24" width, install a single line marker.
 2. Install line marker warning tape for every buried ductbank.
- D. Operational Identification and Warnings:
1. Provide operational signs for main switch.
- E. Danger Signs:
1. Provide for 5 KV to 35 KV medium voltage switchgear, sectionalizer loop switches, etc., as shown and described herein.
 2. Provide as required by codes.
- F. Engraved Plastic Laminated Signs: Install on each major unit of electrical equipment in the building. Provide single line of text, 1/4" high lettering on 1" high sign (1-1/2" high where 2 lines required). Matching terminology and numbering of contract documents. Provide signs for each unit of the following categories (signs shall identify item fed, voltage where fed from):
1. Electrical cabinets and enclosures. Indicate voltage.
 2. Access panel/doors to electrical facilities.
 3. Major electrical switchgear (indicate voltage).
 4. Electrical substations.
 5. Safety switches and circuit breakers.
 6. Transformers.
 7. Feeders in pull and junction boxes and in all switchgear. Fasten with nylon ties.
 8. All equipment furnished in this Division of the specifications.
 9. Install signs where indicated or most visible. Secure with screws or epoxy adhesive. Secure to feeder cables with nylon ties.
 10. Nameplate sign shall include system voltage and source of feed (where applicable).
- G. Outlet pull, and junction boxes shall be identified with circuit number(s), and source panel or switchgear/switchboard indicated with legible text written with permanent black marker. Write text and box cover.
- H. Branch circuit and feeder conductors shall be identified where they enter pullboxes,

switchgear, switchboards, panelboards, transformers, and handholes. Feeder identification shall include source, conductor size, and phase identification.

- I. Provide engraved device plates for wiring devices where indicated on drawings or related sections of the specifications.
 1. Use black letters for devices on normal circuits; use red letters for essential circuits.

END OF SECTION 16014

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Installation of raceway systems for all work in Division 16 and required fittings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Metallic Raceways:

- 1. Republic
- 2. Wheatland
- 3. Allied
- 4. Clifton
- 5. Triangle
- 6. Walker
- 7. Western
- 8. AFC

B. Non-Metallic Raceways

- 1. Carlon
- 2. National Pipe & plastics
- 3. Can-Tex
- 4. Allied

C. Fittings

- 1. Thomas & Betts
- 2. Hubbell: RACO; Killark
- 3. Appleton
- 4. Midwest
- 5. EFCOR
- 6. OZ Gedney
- 7. Bridgeport
- 8. AFC

2.2 RACEWAYS

- A. Rigid galvanized steel conduit to conform to ASA Standard C80.1 and U.L. Standard No. 6 for rigid metallic conduit, except hot dipped galvanized after threading.
 - 1. Fittings, ells, couplings, etc., galvanized threaded type meeting above standards. Threadless fittings not allowed.
 - 2. Terminate rigid conduit with two locknuts, one inside, one outside of the cabinet, junction or outlet and a bushing. Bushing - malleable iron with smooth bakelite ring molded into edge of bushing to prevent damage to cable, OZ Mfg. Co., type "B" or approved equal. Where grounding bushings are required, construction of bushing similar to above except a lug provided for grounding connection, OZ type "BLG" or approved equal.

- B. Rigid intermediate grade conduit, IMC, to conform to UL Standard No.1242; hot dipped galvanized or approved equivalent.
 - 1. All fittings, ells, couplings, etc., constructed to same standards as rigid steel conduit. Fittings - threaded type with all threads engaged. Use "Uni-swivel" couplings in dry locations only.
 - 2. Conduit terminations same as rigid steel conduit.
- C. Flexible steel conduit, "Greenfield", continuous spirally wound and inter-locked, threadless, galvanized conforming to U.L. and CSA Standards for flexible steel conduit.
 - 1. Connectors and fittings galvanized steel, threadless type with insulated throats, U.L. approved for grounding means.
- D. Liquid tight flexible steel conduit constructed similar to flexible steel conduit above, except with polyvinyl chloride jacket.
 - 1. Fitting Assembly - sealing type, with steel gland, nylon ring and ground cone inside locknut. All fittings with insulated throat, U.L. approved for grounding means.
- E. Electrical metallic tubing, EMT, threadless, steel type conforming to ASA Standard C80.3 galvanized inside and out, and with additional corrosion resistant finish.
 - 1. Fittings, connectors, couplings, etc., insulated throat galvanized steel screw indenter.
- F. Plastic conduit, PVC, polyvinyl chloride compound, rated for direct burial, Schedule 40, except as noted otherwise.
 - 1. Fittings same material as conduit and installed with watertight joint compound recommended by manufacturer.
- G. Type EB - encased burial duct: Polyvinyl chloride compound conforming to NEMA Standard TC-6, UL listed and designed for encased burial use.
 - 1. Fittings same material as conduit and installed with watertight joint compound recommended by manufacturer.

PART 3 - EXECUTION

3.1 INSTALLATION:

- A. Install conduit as follows:
 - 1. Use rigid steel or intermediate grade conduit for:
 - a. Transitions from circuits run underground to above ground.
 - b. Circuits run in concrete in contact with earth.
 - c. Circuits in hazardous and wet locations.
 - d. Circuits exposed to mechanical damage.
 - e. All feeders (1-1/4" diameter and larger).
 - f. All motor circuits.

2. Use electrical metallic tubing, EMT, for:
 - a. Branch circuits (conduit 1" diameter and smaller) in dry locations.
 - b. Telephone circuits.
 - c. Auxiliary systems and controls (low voltage systems such as fire alarm nurse call sound systems, etc).
 - d. Feeders run overhead in dry locations.
 - e. Branch circuits in concrete slab (above slab on grade).
3. Use PVC conduit for:
 - a. Circuits run underground.
 - b. For branch circuits in concrete slab.
 - c. Where specifically shown on drawings.
 - d. No PVC shall be exposed.

Note: Do not use PVC in Patient Care Areas.

4. Use type EB conduit for exterior concrete encased application where shown.
- B. Size conduit per NEC. Minimum size 3/4" diameter, but no more than 3#12 installed in 3/4" conduit.
 - C. Run conduit concealed where possible. Run concealed conduit above furred ceiling in an orderly manner. Multiple conduits grouped and run parallel.
 - D. In concrete slab: Install conduits in center of concrete slabs and tie to reinforcing steel with tie wires. Do not install conduit larger than 1" in concrete slabs unless approved by Architect. Install with minimum of 2" between parallel runs. Do not cross conduits in slab unless necessary, then only one conduit crossover in 12" space.
 - E. Exposed Conduit: Use only where specifically shown or approved. Run perpendicular to building walls and partitions and tight against structure. Conceal vertical portion of conduits where possible.
 - F. Paint underground metal conduit with 2 coats of asphaltum or bituminous. Make underground conduit fittings watertight using Teflon tape. Do not use split couplings and similar fittings underground and exposed to moisture. Run underground conduits minimum 24" below grade. Do not run conduit in slag fill.
 - G. Paint conduit fittings and threads exposed to moisture with Rustoleum silver paint after installation.
 - H. Furnish offsets required to meet field conditions. Make bends in conduit in accordance with the National Electrical Code, except make minimum radius of 6 times conduit diameter or 6" whichever is greater. Bend IMC conduit without deforming.
 - I. Where conduit crosses expansion joints, install expansion type fittings OZ type EX with bonding jumper or approved equal.
 - J. Make connections to equipment away from wall with conduit extensions exposed from

ceiling to floor, anchored with floor flange and/or angle frame as required. Make connections to equipment with flexible conduit from tee conduit in conduit riser.

K. Vibrating equipment and equipment requiring adjustment, i.e.: motors, transformers, etc: make final connections with flexible conduit.

L. Isolate conduit connections to equipment on roof from roof penetration of conduit with short section of flexible conduit between roof penetration and equipment.

M. Use liquidtight flexible conduit where exposed to moisture, oil, etc.

N. Install conduit to avoid hot water pipes. Maintain 9" clearance of such pipes, unless closer crossings are unavoidable. Maintain minimum 1" clearance from covering of pipe crossed.

O. Support conduit per NEC. Support individual conduits with galvanized hangers and rods as follows:

1" diameter and smaller	1/4" dia. rod
1-1/4" to 3" diameter	3/8" dia. rod
Larger than 3" diameter	1/2" dia. rod

P. Individual conduit hangers - Minnerallac, or approved equal. Support EMT near each joint. Support for multiple conduit runs consist of Uni-strut channel as required with 1/2" diameter galvanized bolts or rods anchored to structure. Provide "U" bolt clamps for each conduit on hangers. Support vertical riser conduits with galvanized bolted clamps at each floor. Do not support conduit to ceiling support system.

Q. Terminate conduits entering sheet metal boxes with double locknuts and bushings. Terminate conduit exposed to moisture with watertight hubs.

R. Install appropriate seal-off where conduits exit hazardous areas, areas of temperature differential etc.

S. Where ground conductor installed in conduits 1-1/4" and larger provide grounding bushings, and bond full size ground wire to bushings and from bushing to box or cabinet. Bond with self-tapping screw and appropriate lug. Where ground wires are run in smaller conduits, bond to outlet and junction boxes with self-tapping screw lug. Provide other conduits with non-grounding bushings as described under another article. Provide all service entrance metallic raceways with grounding bushing and bond to ground bus; bond sized per N.E.C..

T. Conduit work in hazardous areas, or areas with large temperature differential: Use rigid steel or IMC conduit with sealing fittings, poured with hardening compound after conductors are pulled-in. Seals installed per NEC. Conduit seals Crouse-Hinds type EYS or approved equal.

U. PVC Conduit Installation:

1. Above ground: Allow for expansion and contraction.
2. Below grade: Encase in 3" sand fill. Backfill free of large rocks and debris.
3. Make elbows, bends, etc., with heated bender when factory bends are not available.
 - a. When below slab, provide rigid elbows.

4. Make cuts with hacksaw and deburr ends.
5. Make joints as follows:
 - a. Clean outside of conduit to depth of socket, and inside of socket with approved cleaner. Apply solvent cement to interior of socket and exterior of conduit, Insert conduit in socket and rotate 1/4 to 1/2 turn and allow to dry.
6. Where non-metallic conduit is used for power wiring install insulated ground wire, sized per NEC unless shown larger.

V. Sleeves:

1. Provide sleeves for raceways penetrating floor and structural members. Sleeves consist of Electrical Metallic Tubing set in forms. (Exception: Use Schedule 40 PVC for individual ground conductors).
2. Size sleeves to allow 1/2" clearance around raceway extending from bottom of floor construction to 2" above floor, minimum sleeve size 2-1/2" diameter. After raceways are installed, seal space between the raceway and sleeve with non-hardening, fireproof, compound, CTC PR-855 sealant, T&B "Flame Safe" for 2 hour fire rating or approved equal.

END OF SECTION 16110

SECTION 16120 - CONDUCTORS (Low Voltage, 600 Volts)

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Furnishing, installing and testing 600 volt conductors for lighting, power, and auxiliary systems.

PART 2 - PRODUCTS

2.1 CONDUCTORS:

- A. 98% conductivity copper; #12 AWG minimum; #10 AWG and smaller solid, #8 and larger stranded.
- B. Conductors furnished with NEC, 600 volt, insulation as follows:
 - 1. Dry locations:
 - a. # 6 AWG and smaller]: type THW, THWN or XHHW (do not intermix in circuits)
 - b. # 4 AWG and larger: type RHH-RHW-USE, (cross linked polyethylene)
 - 2. Wet locations: type RHH-RHW-USE
- C. Wiring for controls and auxiliary systems #14 AWG minimum with NEC type THWN insulation.
- D. Luminaire Wire: Incandescent - Use type SF-2, #16 for luminaires up to 300 watts, and #14 over 300 watts, except for luminaires in concrete pour use #12 or larger or as shown. Conductors in channels of, and flex to fluorescent luminaires type THHN or XHHW.
- E. Ungrounded System Wiring: All wiring connected to the secondary side of isolating transformers: Cross-linked polyethylene insulation with dielectric constant of less than 3.5; 30 mills minimum thickness, resistance constant greater than 20,000 at 60 degrees F, shall be suitable for wet and dry locations. Cable - G.E. No. SI-58053 or approved equivalent.
- F. Color Code as follows and/or per local ordinances. Conductors #10 and smaller with colored insulation. Conductors #8 and larger not available in colors, color coded with colored pressure sensitive tape. Apply minimum 2" of tape to each individual phase or neutral conductor in half lapped pattern. The equipment ground conductor shall be taped green for its entire exposed length. Color-code as follows:

<u>Phase</u>	<u>120/208 Volts</u>	<u>277/480 Volts</u>
A	Black	Brown
B	Red	Orange
C	Blue	Yellow
Neutral	White	Gray
Eq Grnd	Green	Green

- G. Manufacturers of copper conductors: Phelps Dodge, Capital Cable, Southwire, Senator, United Copper, Cero Wire & Cable, American, or approved equal.

PART 3 - EXECUTION

- A. Install wiring complete with connections to equipment.
- B. No wiring installed until after plastering and similar work is complete and dry.
- C. Install wiring so conductors are not in tension in completed system.
- D. Form wiring neatly and group in circuits. Tie grouped conductors with nylon ties, T&B "Tyrap" or approved equal.
- E. Use pulling compound of Ideal "Yellow 77", Minerallac No. 100, or approved equal. Do not use pulling compound for circuits on secondary side of ungrounded isolation transformers.
- F. Join and terminate copper conductors individually.

1. Lugs in damp locations connected to copper bus: 98% conductivity copper or bronze Thomas & Betts "Locktite", Burndy "QA" or approved equivalent.
 2. Lugs in dry locations and lugs connected to aluminum bus - heavy casting aluminum, CU/AL rated, listed under UL Standard 486B, rated 90 degrees C; plated to prevent electrolysis, Thomas & Betts, Blackburn, IlSCO or approved equivalent.
- G. Provide lugs where not furnished as part of equipment - furnish as specified above, to connect all conductors.
- H. Furnish lugs for conductors #2/0 and larger with two bolt tongue or approved equivalent.
- I. Make conductor taps #8 and larger from a second conductor with 98% conductivity bolted insulated connector, T&B "IDT", IlSCO "KUP-L-TAP" or approved equivalent. Insulate splices with 600 volt "heat shrink" covers T&B or equal.
- J. Splice conductors #8 and larger with solid copper barrel, type fittings applied with an appropriate hydraulic tool. Splices used only where approved. Splice fittings: Burndy "Hydent". Insulate splices with 600 volt "heat shrink" covers T&B or equal.
- K. Joints #10 and smaller: T&B Sta-Kon wire joints EPT66M, with insulating caps, installed with WT161 Tool or C nest of WT11M Tool; Ideal Super/Nuts; Ideal Wing Nuts; 3M "Scotchlock" or Buchanan Electric Products B Cap or Series 2000 Pressure connectors complete with nylon snap on insulators installed with C24 pressure tool. Where conductors are connected to screw terminals, use nylon insulated, locking fork, T&B Sta-Kon or approved equal. Where joints are made in damp or wet locations insulate splices with 600 volt "heat shrink" covers T&B or equal.
- L. Provide cable supports: As required by NEC. Supports with malleable screwed conduit fitting and non-conductive wedges drilled for the conductors; O.Z. Manufacturing Company or approved equal. Furnish pullbox, sized per NEC for each cable support.
- M. Bond circuit ground wires where installed to all devices, equipment, outlet and junction boxes, and grounding bushings (where provided) with a full size conductor and screw type connection.
- N. Securely fasten non-ferrous identifying tapes, pressure sensitive labels or engraved nameplates to all cables, feeders and power circuits in vaults, pull boxes, manholes, switchboard rooms, terminations of cables, etc.
- O. Mark all branch circuit conductors at panel terminations including neutrals with pressure sensitive numbers to correspond to circuit numbers connected.
- P. Connect circuits and feeders as shown on drawings. Drawings are diagrammatic and do not show every detail required in the wiring system. Detail wiring accomplished per NEC.
- Q. All conductors making up parallel feeders to be same size, same type, and same insulation, all cut same length. Bond each group of conductors making up a phase or neutral at both ends in an approved manner.
- R. DO NOT COMBINE CIRCUITS unless specifically approved by the Architect (or) Engineer. No more than 3 phase or current carrying conductors in a circuit.

END OF SECTION 16120

PART 1 - GENERAL

1.1 SCOPE OF WORK:

- A. Grounding Details

PART 2 - PRODUCTS

2.1 SYSTEM GROUNDING:

- A. Bond and ground main service neutral, cabinets, equipment, conduits, metallic piping systems, etc., per the latest edition of NEC.
- B. Ground conductors - 98% conductivity copper, either bare or with green THW insulation. Other conductor requirements same as described for low voltage, 600 volts, conductors.
- C. Ground Connections:
 - 1. Make with mechanical connectors where accessible and with "Cadweld" or approved equivalent where inaccessible.
 - 2. Use high alloy cast copper and/or silicon bronze mechanical connectors with Hex or Allen head bolts where permitted.
 - 3. Use Burndy "GAR" or approved equivalent.
 - 4. Size as required for piping connections.
 - 5. Thoroughly clean prior to installation of clamps and/or lugs.
 - 6. Use bolted or screwed on mechanical connectors. Do not use clip-on connections.
 - 7. Bond ground conductor to metal raceway at each end of the run.
 - 8. Seal connections between dissimilar metals (i.e.: bronze to steel), with approved epoxy resin.
 - 9. Coat connections with "No-OXID-A" compound as manufactured by Dearborn Chemical Company.
- D. Provide lighting and power circuits with green covered ground wire sized per NEC, or as shown, except not smaller than #12 AWG. Bond ground wire to all outlet boxes, junction and pull boxes, cabinets, equipment, etc., with self-tapping screw or bolt and appropriate lug. See Section covering "Raceways" for use of grounding bushing.

2.2 DRIVEN GROUND SYSTEM:

- A. Provide driven ground rods and buried ground conductor interconnecting ground rods as required by code.
- B. Ground rods 3/4"x10'-0" copper clad steel, Thompson #558 or approved equal. Ground rods installed with tops driven to 1'-6" minimum below grade. Connect ground wire to ground rod with Thompson #493 "U" bolt bronze clamp.

- C. Exterior buried ground conductor #2/0, soft drawn, bare, tinned copper, installed 2'-0" minimum below grade.
- D. Bond all masses of metal, i.e.: pipes, conduits, fence posts, etc., within 6'-0" of the buried ground conductor to ground conductor with #6 AWG bare, solid, tinned copper wire, attached to object with appropriate clamp, lug, etc.. Obtain complete set of drawings to determine quantity and location of required connections.
- E. All connectors lugs, hardware, etc., for building ground system similar to that for other grounding as described above.

PART 3 - EXECUTION

3.1 EQUIPMENT GROUND 'GREEN WIRE CONCEPT':

- A. Ground electrical equipment enclosures and conductor enclosures including metal raceways, outlet boxes, cabinets, switch boxes, motor frames, diesel engine frame, transformer cases, metallic piping systems such as water, gas, waste, air and metallic enclosures for all electrical equipment.
- B. Provide separate grounding conductor for all circuits to insure adequate ground fault return path.
- C. Install separate ground conductors in conduit.
- D. Bond green wire to equipment enclosure at source and at apparatus served.
- E. Insulate grounding conductor size to carry ground fault current safely. Minimum size for green wire grounding lead per N.E.C. or as indicated.
- F. Do not use grounded current return conductors (neutrals) for equipment grounding. Connect common grounding lead to supply side of service disconnect unit only.
- G. Do not ground neutral conductor after it has been grounded at service entrance, transformer or generator.
- H. Maintain electrical continuity of conduit systems by threaded fittings with joints made-up wrench tight. Install insulated bushing and locknuts on terminating conduits. Provide conduits containing ground wires with grounding bushings bonded to ground wire with short full size jumper.
- I. Provide receptacles with approved green covered bonding jumper from the grounding terminal screw connected to outlet box.
- J. Install ground rods in quantity to provide a maximum of 5 ohms ground resistance. Where multiple rods required, separate a minimum of 6 feet and interconnect with wire of ground size shown.
- K. Test ground systems as specified in Section 16010.
- L. Install tags on ground connections to piping or electrode systems for all telephone equipment grounds.

END OF SECTION 16121

SECTION 16130 - OUTLET BOXES, JUNCTION BOXES AND GUTTERS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Outlet, junction boxes, conduit bodies, wiring gutters and their installation.

PART 2 - PRODUCTS

2.1 OUTLET AND JUNCTION BOXES:

- A. Provide wiring devices, fixtures and special system outlets with outlet box. Use galvanized steel for concealed boxes and exposed boxes in dry locations. Use cast iron conduit fittings similar to "Condulets" or "Unilets" with threaded hubs for exposed boxes outside and exposed to moisture.
- B. Concealed outlets and exposed outlets in unfinished spaces for lights, switches, wall receptacles, etc.; consist of standard galvanized steel outlet boxes and plaster rings.
 - 1. Provide 1/16" thick boxes and covers of form and dimension adapted to its specific use and location, kind of fixture to be used and number, size and arrangement of connecting conduits.
 - 2. Provide 3/8" fixture studs where required.
 - 3. Ceiling Outlet Boxes: 4" octagonal or 4-11/16" square as required, due to number of wires, and 2" deep minimum. Ceiling boxes in slabs concrete type. Plaster rings not required for ceiling outlet unless needed for device.
 - 4. Paint junction boxes provided with blank covers to match surroundings, except use blank device plates in finished areas.
 - 5. Switch and receptacle outlet boxes: 4" square with plaster rings as necessary. Provide multigang boxes where shown or required. Provide metal barriers to separate emergency and normal service wiring per N.E.C.
 - 6. Steel City, Appleton, Raco, Bowers or approved equivalent.
- C. Use galvanized cast iron boxes, approved equivalent to Crouse-Hinds type "FS" or Appleton condulets, with appropriate covers for wall outlets in exposed conduit work and exposed to moisture.
- D. Use galvanized cast iron boxes equivalent to Crouse-Hinds type GRF for ceiling outlets in exposed conduit work exposed to moisture.
- E. Use square cut steel outlet boxes for outlets exposed in finished locations. Use round or square to adapt to device installed. Wiremold, Hoffman or approved equivalent.

2.2 LARGE JUNCTION BOXES:

- A. Furnish pull, tap and cable support boxes required by NEC for excessive number of 90 degree conduit bends, conductor taps and cable supports.

1. Box construction per NEC and manufactured with galvanized sheet steel, 12 gage minimum, with angle iron frame where required for rigidity; welded or bolted construction. Install bolts to prevent damage to cables in box.
2. Boxes with removable screw type covers and plated screws. Provide split covers where necessary for access. Maximum single piece cover - 36" x 36".
3. Provide separate junction boxes for each feeder. If conduit is installed so separate junction boxes are not practical, one large pull-box may be used with each set of feeder conductors separated by 12 gage steel barriers. Furnish junction box or each compartment in junction box with ground lug for connection of ground wire.

2.3 CONDUIT BODIES:

- A. Conduit bodies shall be installed to provide ease of pulling conductors and to provide neat appearance of conduit installation, and as shown on drawings. Conduit bodies constructed of malleable iron or copper free aluminum castings. Bodies shall be finished with standard durable exterior coatings of manufacturer specified. Provide rollers in type "C" and type "LB" bodies, 1-1/4" size and larger. Provide gasketed plated steel or malleable iron covers.
- B. Conduit bodies shall be manufactured by Crouse-Hinds, Pyle National, Killark, Appleton or approved equivalent.

2.4 GUTTERS (Wireways):

- A. 8" x 8" and smaller - use standard assembly manufactured by Square "D", Walker Electric, B&C Stamping Co., and General Electric. Make special and larger gutters of code grade galvanized sheet steel with hinged covers and approved fastening device.

2.5 SURFACE METAL RACEWAYS:

- A. Where indicated on the drawings, wiring shall be run in exposed metal raceways, metal molding or wiremold complete with outlet boxes and fittings. All circuits run in surface metal raceways shall have a ground conductor with green insulation sized per the NEC, but not smaller than No. 12 AWG screw connected to each outlet box. All wiring in surface metal raceways shall be type "THWN" conductors.

PART 3 - EXECUTION

3.1 INSTALLATION OF OUTLET BOXES:

- A. Fasten outlet boxes securely to structure.
- B. Set all flush outlet boxes so edge of device flange is flush with finished surface.
- C. Open no more knockouts in outlet box than required.
- D. Seal boxes during construction.
- E. Stagger back to back boxes 3" minimum. In rated walls use appropriate U.L. spacing.
- F. Coordinate and verify rough-in location and mounting height of all boxes with drawings

and other trades prior to installation.

G. Support All Boxes:

1. Outlet boxes - with 1/4" diameter galvanized rods or bolts anchored to structure.
2. Outlet boxes for surface mounted luminaires on furred ceilings with 3/4" channel iron fastened to ceiling channels. See Section covering "Luminaires".
3. Pull, junction and cable boxes with 3/8" diameter galvanized rods or bolts (4 minimum).
4. Support outlet boxes in metal stud partitions with support that spans between two studs. Caddy "SGB", "TSGB", or "RBS" hangers or equal.

H. Install adjacent outlets at different levels in one vertical line where possible.

I. Provide green covered bonding jumper, screw connected to outlet box in all receptacle boxes.

J. Paint wiring connections in ground mounted outlets or floor outlets in wet locations with "Scotchkote" and fill box with "Duxseal".

K. Mark outlet box covers with permanent ink markers to indicate circuit number(s) and panel of origination. Use black markers for normal service circuits and orange for emergency service.

L. Use 4" octagonal boxes with blank covers for master outlets, installed to permit installation of collars by others.

M. Where outlet boxes installed in unfinished concrete walls or columns, provide 1" deep plaster ring with box and ring set in position before the concrete is poured so concrete will fill around the ring and cover plate can be installed flush with the unfinished surface. In case of brick walls, follow same procedure with mason filling around the plaster ring with mortar.

N. Install all outlets located on columns on centerline of column and bend or shift reinforcing so that the outlet box will be flush with the finished concrete. Provide plaster rings as required so that the plate is flush with the finished plaster or exterior concrete surface.

O. Where outlets installed in waterproofed columns or walls, provide 6"x6"x3" deep wood box placed in the forms before concrete is poured. Box will be removed before waterproofing is applied. General Contractor will waterproof wall and opening, after which Electrical Contractor will install outlet box. General Contractor will grout around box. Set boxes carefully so that cover plates will be flush.

P. Install conduit bodies where shown or where required for sharp bends and/or aesthetics in raceway system. Do not use in lieu of pullboxes except in limited space or as directed by Architect.

3.2 INSTALLATION OF JUNCTION BOXES:

A. All junction boxes shall be accessible.

B. Securely fastened to structure.

- C. Exterior below grade boxes shall be embedded 6" of concrete on sides and bottom. Top shall be level with finished grade unless shown otherwise.
- D. There shall be no more knockouts opened in any box than are actually required.
- E. Protection during construction.
- F. Identify (See Section 16014).

3.3 INSTALLATION OF GUTTERS:

- A. Mount gutters on 3/4" thick plywood backboard, sized for devices to be mounted, 2 coats of Albi No. 107A fire retardant paint (install label on board), mount all equipment thereon.
- B. Run conductors in gutter without reduction in size, entire length of gutter.
- C. Connect individual taps from conductor to tapped device with ILSCO insulated tap devices sized for conductors used.
- D. Gutter Tops: for copper conductors shall be ILSCO type GTA or PTA with GTC or PTC insulating covers or by "TEE" compression lugs as manufactured by Anderson or Burndy, wrapped with Scotch #33 electrical tape to a thickness which equals insulation level of wire.

END OF SECTION 16130

SECTION 16136 HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.
- B. Construction requirements for concrete bases.

1.02 RELATED REQUIREMENTS

- A. 16110 - Raceways
- B. 16130 - Outlet Boxes, Junction Boxes and Gutters
- C. 16510 - Lighting

1.03 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2019.
- D. ASTM D635 - Standard Test Method for Rate of Burning and/or Extent and Time of Burning of Plastics in a Horizontal Position; 2022.
- E. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2022.
- F. MFMA-4 - Metal Framing Standards Publication; 2004.
- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 101 - Life Safety Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- J. UL 5B - Strut-Type Channel Raceways and Fittings; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with actual equipment and components to be installed.
 - 2. Coordinate work to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at installed locations.
 - 4. Coordinate arrangement of supports with ductwork, piping, equipment and other potential conflicts.
 - 5. Notify Dewberry Engineers, Inc. of any conflicts with or deviations from the contract documents in writing. Obtain direction before proceeding with work.
- B. Sequencing:
 - 1. Do not install products on or provide attachment to concrete surfaces until concrete has cured.

1.05 QUALITY ASSURANCE

- A. Maintain at project site one copy of each referenced document that prescribes execution requirements.

- B. Installer Qualifications for Powder-Actuated Fasteners: Certified by fastener system manufacturer with current operator's license.
- C. Installer Qualifications for Field Welding.
- D. Product Listing Organization Qualifications: Organization recognized by OSHA as Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
 - 1. Comply with the following. Where requirements differ, comply with most stringent.
 - a. NFPA 70.
 - b. Manufacturer's Requirement.
 - c. Requirements of authorities having jurisdiction.
 - 2. Provide required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for complete installation of electrical work.
 - 3. Provide products listed, classified, and labeled as suitable for purpose intended, where applicable.
 - 4. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported plus 25% growth with a minimum safety factor of (2). Where this determination results in a load of less than 200 lbs., increase the strength until there is a minimum of 200 lbs. safety. Include consideration for vibration, equipment operation, and shock loads where applicable.
 - 5. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 - 6. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 - 7. Steel Components: Use corrosion-resistant materials suitable for environment where installed.
 - a. Indoor Dry Locations: Use zinc plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports: Straps and clamps suitable for conduit or cable to be supported.
 - 1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - e. nVent; Caddy: www.nvent.com/#sle.
 - 2. Conduit Straps: One-hole or two-hole type; steel.
 - 3. Conduit Clamps: Bolted type unless otherwise indicated.
 - 4. Products:
 - a. Gripple, Inc; Universal Bracket: www.gripple.com/#sle.
 - b. Gripple, Inc; Fast Trak: www.gripple.com/#sle.
 - c. Gripple, Inc; Universal Clamp (Threaded): www.gripple.com/#sle.
 - d. Gripple, Inc; Low Profile Bracket Kits: www.gripple.com/#sle.

- C. Outlet Box Supports: Hangers and brackets suitable for boxes to be supported.
 - 1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. Emerson Electric Co; O-Z/Gedney: www.emerson.com/#sle.
 - d. HoldRite, a brand of Reliance Worldwide Corporation: www.holdrite.com/#sle.
 - e. nVent; Caddy: www.nvent.com/#sle.
- D. Metal Channel/Strut Framing Systems:
 - 1. Manufacturers:
 - a. ABB: www.electrification.us.abb.com/#sle.
 - b. Atkore International Inc; Unistrut: www.unistrut.us/#sle.
 - c. Custom Strut and Roll Forming, LLC: www.customstrut.com/#sle.
 - d. Eaton Corporation: www.eaton.com/#sle.
 - e. Elgen Manufacturing Company, Inc: www.elgenmfg.com/#sle.
 - 2. Description: Factory-fabricated, continuous-slot, metal channel/strut and associated fittings, accessories, and hardware required for field assembly of supports.
 - 3. Comply with MFMA-4.
 - 4. Channel/Strut Used as Raceway, Where Indicated: Listed and labeled as complying with UL 5B.
 - 5. Channel Material:
 - a. Indoor Dry Locations: Use galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 - 6. Minimum Channel Thickness: Steel sheet, 12-gauge, 0.1046 inch (2.66mm).
 - 7. Minimum Channel Dimensions: 1-5/8 inch (41mm) wide by 13/16 inch (21mm) high.
- E. Hanger Rods: Threaded, zinc-plated steel unless otherwise indicated.
 - 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Electrical Equipment Supports: 1/2-inch (13mm) diameter.
 - b. Busway Supports: 1/2-inch (13mm) diameter.
 - c. Single Conduit up to 1-inch (27mm) Trade Size; 1/4-inch (6mm) diameter.
 - d. Single Conduit Larger than 1-inch (27mm) Trade size: 3/8-inch (10mm) diameter.
 - e. Trapeze Support for Multiple Conduits: 3/8-inch (10mm) diameter.
 - f. Outlet Boxes: 1/4-inch (6mm) diameter.
 - g. Luminaires: 1/4-inch (6mm) diameter.
- F. Nonpenetrating Rooftop Supports for Low-Slope Roofs:
 - 1. Manufacturers:
 - a. Atkore International Inc; Unistrut: www.unistrut.us/#sle.
 - b. Eaton Corporation: www.eaton.com/#sle.
 - c. nVent; Caddy: www.nvent.com/#sle.
 - d. PHP Systems/Design: www.phpsd.com/#sle.
 - 2. Description: Steel pedestals with thermoplastic bases that rest on top of roofing membrane, not requiring attachment to roof structure and not penetrating roofing assembly, with support fixtures as specified.
 - 3. Base Sizes: As required to distribute load sufficiently to prevent indentation of roofing assembly.
 - 4. Attachment/Support Fixtures: As recommended by manufacturer, same type as indicated for equivalent indoor hangers and supports.
 - 5. Mounting Height: Provide minimum clearance of 6 inches (150mm) under supported component to top of roofing.
- G. Anchors and Fasteners:
 - 1. Manufacturers - Mechanical Anchors:
 - a. Dewalt: anchors.dewalt.com/#sle.
 - b. Hilti, Inc: www.hilti.com/#sle.

- c. ITW Red Head, a division of Illinois Tool Works, Inc: www.itwredhead.com/#sle.
- d. Simpson Strong-Tie Company Inc: www.strongtie.com/#sle.
- 2. Unless otherwise indicated and where not otherwise restricted, use anchor and fastener types indicated for specified applications.
- 3. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
- 4. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
- 5. Hollow Masonry: Use toggle bolts.
- 6. Hollow Stud Walls: Use toggle bolts.
- 7. Steel: Use beam clamps, machine bolts, or welded threaded studs.
- 8. Sheet Metal: Use sheet metal screws.
- 9. Wood: Use wood screws.
- 10. Plastic and lead anchors are not permitted.
- 11. Hammer-driven anchors and fasteners are not permitted.
- 12. Preset Concrete Inserts: Continuous metal channel/strut and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Manufacturer: Same as manufacturer of metal channel/strut framing system.
 - b. Comply with MFMA-4.
 - c. Channel Material: Use galvanized steel.
 - d. Minimum Channel Thickness: Steel sheet, 12-gauge, 0.1046 inch (2.66) minimum base metal thickness.
- 13. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) for compliance with applicable building code.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install hangers and supports in accordance with NECA 1.
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- E. Unless specifically indicated or approved by Dewberry Engineers, Inc., do not provide support from suspended ceiling support system or ceiling grid.
- F. Unless specifically indicated or approved by Dewberry Engineers, Inc., do not provide support from roof deck.
- G. Do not penetrate or otherwise notch or cut structural members without approval of Dewberry Engineers, Inc.
- H. Field Welding, Where Approved by Dewberry Engineers, Inc.
- I. Equipment Support and Attachment:
 - 1. Use metal, fabricated supports, and/or supports assembled from metal channel/strut to support equipment as required.
 - 2. Use metal channel/strut secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel/strut to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.

4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4 inch (100mm) high concrete pad.
 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- J. Conduit Support and Attachment: See Section 16110 for additional requirements.
 - K. Interior Luminaire Support and Attachment: See Section 16510 for additional requirements.
 - L. Exterior Luminaire Support and Attachment: See Section 16510 for additional requirements.
 - M. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
 - N. Secure fasteners in accordance with manufacturer's recommended torque settings.
 - O. Remove temporary supports.
 - P. Identify independent electrical component support wires above accessible ceilings, where permitted, with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03 FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION 16136

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PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates.
- D. Floor box service fittings.

1.02 RELATED REQUIREMENTS

- A. Section 16120 – Conductors
- B. Section 16121 - Grounding.
- C. Section 16130-Boxes for Electrical Systems.
- D. Section 16014 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 16155 - Wiring Connections: Cords and plugs for equipment.
- F. Section 16145 - Lighting Control Devices: Devices for automatic control of lighting, including occupancy sensors, in-wall time switches, and in-wall interval timers.

1.03 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; 2014h, with Amendments (2017).
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush Mounted (General Specification); 2014g, with Amendment (2017).
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interruption; Current Edition, Including All Revisions.
- L. UL 1310 - Class 2 Power Units; Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
 - 2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
 - 3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
 - 4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
 - 5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.

6. Notify Dewberry Engineers, Inc. of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.
- B. Sequencing:
 1. Do not install wiring devices until final surface finishes and painting are complete.

1.05 SUBMITTALS

- A. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- B. Field Quality Control Test Reports.
- C. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- D. Operation and Maintenance Data:
 1. GFCI Receptacles: Include information on status indicators.
- E. Project Record Documents: Record actual installed locations of wiring devices.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. Extra Wall Plates: One of each style, size, and finish.

1.06 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' experience.
- D. Products: Listed, classified, and labeled as suitable for the purpose intended.
- E. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Hubbell Incorporated
- B. Leviton Manufacturing Company, Inc
- C. Lutron Electronics Company, Inc
- D. Pass & Seymour, a brand of Legrand North America, Inc

2.02 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide tamper resistant receptacles for receptacles installed where children might be present.
- E. Provide GFCI circuit breakers or remote GFCI modules for personnel protection for circuits feeding receptacles that are not readily accessible and require GFCI protection.
- F. Provide GFCI protection for receptacles serving equipment and appliances in locations as required by the current edition of the National Electrical Code.

- G. Devices indicated as GFCI receptacles on the Drawings shall be of the GFCI type. Do not rely on upstream protection or "feed-thru protection" by another device unless specifically indicated otherwise.
- H. Unless noted otherwise, do not use combination switch/receptacle devices.
- I. For flush floor service fittings, use tile rings for installations in tile floors.
- J. For flush floor service fittings, use carpet flanges for installations in carpeted floors.

2.03 WIRING DEVICE FINISHES

- A. Provide wiring device finishes as described below unless otherwise indicated.
- B. Wiring Devices Installed in Unfinished Spaces: Use galvanized steel wall plates.
- C. Wiring Devices Installed in Wet or Damp Locations: Use with specified weatherproof cover.
- D. Wiring Devices Connected to Emergency Power: Red with red nylon wall plate.
- E. Flush Floor Box Service Fittings: Receptacle color specified above with brass cover and ring/flange.

2.04 WALL SWITCHES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Hubbell Incorporated
 - 3. Leviton Manufacturing Company, Inc
 - 4. Pass & Seymour, a brand of Legrand North America, Inc:
 - 5. Wiremold
 - 6. Walker
- B. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
- C. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the drawings.

2.05 RECEPTACLES

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 - 3. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 - 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 - 5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer.
- B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
 - 2. NEMA configurations specified are according to NEMA WD 6.
- C. Convenience Receptacles:
 - 1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 - 2. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

3. Tamper Resistant Convenience Receptacles: Industrial specification grade Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type; single or duplex as indicated on the drawings.
 4. Tamper Resistant and Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
- D. GFCI Receptacles:
1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, Class A.
 - a. Provide test and reset buttons of same color as device.
 2. Standard GFCI Receptacles: Industrial specification grade Commercial specification grade, duplex, 20A, 125V, NEMA 5-20R.
 3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
 4. Tamper Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type.
 5. Tamper Resistant GFCI Receptacles: Hospital grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type.
 6. Tamper Resistant and Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type and as weather resistant type complying with UL 498 Supplement SD suitable for installation in damp or wet locations.
- E. USB Charging Devices:
1. USB Charging Devices - General Requirements: Listed as complying with UL 1310.
 - a. Charging Capacity - Two-Port Devices: 2.1 A, minimum.
 - b. Charging Capacity - Four-Port Devices: 4.2 A, minimum.
 2. USB Charging/Tamper Resistant Receptacle Combination Devices: Two-port (Type A) USB charging device and receptacle, hospital grade, duplex duplex, 20A, 125V, NEMA 5-20R 20A, 125V, NEMA 5-20R, listed and labeled as tamper resistant type.
- F. Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings , configuration as indicated on the drawings.

2.06 WALL PLATES

- A. Manufacturers:
1. Hubbell Incorporated: www.hubbell-wiring.com/#sle.
 2. Leviton Manufacturing Company, Inc: www.leviton.com/#sle.
 3. Lutron Electronics Company, Inc: www.lutron.com/#sle.
 4. Pass & Seymour, a brand of Legrand North America, Inc: www.legrand.us/#sle.
 5. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wall plates by the same manufacturer in locations indicated.
- B. Wall Plates: Comply with UL 514D.
1. Configuration: One piece cover as required for quantity and types of corresponding wiring devices.
 2. Size: Standard.
 3. Screws: Metal with slotted heads finished to match wall plate finish.
 4. Provide screwless wall plates with concealed mounting hardware where indicated.
- C. Stainless Steel Wall Plates: Brushed satin finish, Type 302 stainless steel.

- D. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.
- E. Weatherproof Covers for Wet or Damp Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

2.07 FLOOR BOX SERVICE FITTINGS

- A. Manufacturers:
 - 1. Hubbell Incorporated: www.hubbell.com/#sle.
 - 2. Thomas & Betts Corporation: www.tnb.com/#sle.
 - 3. Wiremold, a brand of Legrand North America, Inc: www.legrand.us/#sle.
- B. Description: Service fittings compatible with floor boxes provided under Section 16138 with components, adapters, and trims required for complete installation.
- C. Flush Floor Service Fittings:
 - 1. Single Service Flush Convenience Receptacles:
 - a. Cover: Rectangular.
 - b. Configuration: One standard convenience duplex receptacle(s) with rectangular decorator style flap opening(s).
 - 2. Single Service Flush Communications Outlets:
 - a. Cover: Rectangular.
 - 3. Single Service Flush Furniture Feed:
 - a. Cover: Rectangular.
 - b. Configuration: One 2-1/8 inch by 3/4-inch combination threaded opening(s).
 - 4. Dual Service Flush Combination Outlets:
 - a. Cover: Rectangular.
 - b. Configuration:
 - 1) Power: One standard convenience duplex receptacle(s) with rectangular decorator style flap opening(s).
 - 5. Dual Service Flush Furniture Feed:
 - a. Cover: Rectangular.
 - b. Configuration:
 - 1) Power: One 2-1/8 inch by 3/4-inch combination threaded opening(s).
 - 2) Communications: One One 2-1/8 inch by 1 inch combination threaded opening(s).
 - 6. Accessories:
 - a. Tile Rings: Finish to match covers; configuration as required to accommodate specified covers.
 - b. Carpet Flanges: Finish to match covers; configuration as required to accommodate specified covers.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

- G. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 16123 as required for installation of wiring devices provided under this section.
 - 1. Mounting Heights (to center of device) :Unless otherwise indicated, as follows:
 - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 3. Where multiple receptacles, wall switches, or wall dimmers are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 4. Locate wall switches on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Dewberry Engineers, Inc. to obtain direction prior to proceeding with work.
 - 5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Where split-wired duplex receptacles are indicated, remove tabs connecting top and bottom receptacles.
- J. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- K. Install wall switches with OFF position down.
- L. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- M. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- N. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- O. Identify wiring devices in accordance with Section 16014.
- P. Install poke-through closure plugs in each unused core holes to maintain fire rating of floor.

3.04 FIELD QUALITY CONTROL

- A. Inspect each wiring device for damage and defects.

- B. Operate each wall switch, wall dimmer, and fan speed controller with circuit energized to verify proper operation.
- C. Test each receptacle to verify operation and proper polarity.
- D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.06 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION 16140

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SECTION 16145 - LIGHTING CONTROL DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following lighting control devices:
 - 1. Time switches.
 - 2. Outdoor and indoor photoelectric switches and daylight sensors.
 - 3. Switch-box occupancy sensors.
 - 4. Indoor occupancy sensors.
 - 5. Outdoor motion sensors.
 - 6. Multi-pole contactors.
 - 7. Wallbox-style dimmers.
- B. Related Sections include the following:
 - 1. Division 16 Section "Switches and Receptacles" for manual light switches.

1.3 DEFINITIONS

- A. LED: Light-emitting diode.
- B. PIR: Passive infrared.

1.4 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show installation details for occupancy and light-level sensors.

PART 2 - PRODUCTS

2.1 GENERAL LIGHTING CONTROL DEVICE REQUIREMENTS

- A. Line-Voltage Surge Protection: An integral part of the devices for 120- and 277-V solid-state equipment. For devices without integral line-voltage surge protection, field-mounting surge protection shall comply with IEEE C62.41 and with UL 1449.
- B. Manufacturers:
 - 1. Wattstopper
 - 2. Acuity Brands
 - 3. Eaton
 - 4. Cooper Lighting - Greengate
 - 5. Substitutions: See Section 01600 - Product Requirements.

2.2 TIME SWITCHES

- A. Digital Time Switches: Electronic, solid-state programmable units with alphanumeric display complying with UL 917.
1. Contact Configuration: SPDT (Single-Pole Double-Throw)
 2. Contact Rating: 20-A ballast load, 120/208/240/277 Vac. Contact output for both maintained and momentary (pulse) to allow control of latching contactors.
 3. Programs: 4 channels.
 - a. For each channel, provide daily, weekly, or yearly schedules with a minimum of 1000 set points and an annual holiday schedule (up to 99 holidays) to override normal schedule.
 4. Circuitry: Allow connection of a photoelectric relay as substitute for on and off function of a program on selected channels.
 5. Astronomical Time: User scheduled for on or off function of a program on selected channels.
 6. Battery Backup: 8 year lithium battery.
 7. Memory: All programming and time functions shall be stored in EEPROM non-volatile memory.
 8. Surge Protection: Circuitry shall utilize transient voltage surge protection for voltage surges up to 6000V.
 9. Manual and Remote override.
- B. Wallbox Time Switch: Digital programmable time switch, designed to replace a standard toggle switch, to turn lights OFF after a preset time period.
1. Completely self-contained control system, with standard single-gang switch device mounting and grounding strap with ground wire. Provide with compatible single-gang wallplate, color to match device (See section for "Switches and Receptacles" for device finish).
 2. Switching mechanism shall be a latching air gap relay and utilize "zero crossing circuitry" to maximize relay life. Switch shall also be capable of operating as a manual ON-OFF switch.
 3. Switch circuitry shall be compatible with all types of lighting loads, including tungsten, halogen, and fluorescent and HID ballasts (electro-magnetic and electronic).
 4. Switch shall have no minimum load requirement and be capable of handling up to 800 watts (at 120 volt) or 1200 watts (at 277 volt) of lighting load.
 5. Switch circuitry for time-off period shall be adjustable from 5 minutes to 12 hours (increments of 5 minutes up to one hour, and 15 minutes from 1 hour to 12 hours).
 6. The time switch shall have optional warnings, including light flash and audible beep, for notifying occupant that the time-off period is expiring.

2.3 OUTDOOR PHOTOELECTRIC SWITCHES

- A. Description: Solid state, with SPST dry contacts rated for 1800-VA tungsten or 1000-VA inductive, to operate connected relay, contactor coils, microprocessor input, and complying with UL 773A.
1. Light-Level Monitoring Range: 1.5 to 10 fc (16 to 108 lx), with an adjustment for turn-on and turn-off levels within that range, and a directional lens in front of photocell to prevent fixed light sources from causing turn-off.
 2. Time Delay: Instant ON; 10-second delay OFF, to prevent false operation.
 3. Surge Protection: Metal-oxide varistor type, complying with IEEE C62.41 for Category A1 locations.
 4. Mounting: Twist lock receptacle complying with ANSI/IEEE C136.10, with base mounting accessory as required to direct sensor to the North sky exposure.

2.4 INDOOR PHOTOELECTRIC SWITCHES

- A. On/Off (closed loop) Photoelectric Switch: Solid-state, light-level sensor unit, with separate relay unit, to detect changes in lighting levels that are perceived by the eye. Cadmium sulfide photoresistors are not acceptable.
1. Sensor Output: Contacts rated to operate the associated relay, complying with UL 773A. Sensor shall be powered from the relay unit.
 2. Relay Unit: 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. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 3. Light-Level Monitoring Range: 10 to 200 fc (108 to 2150 lx), with an adjustment for turn-on and turn-off levels within that range.
 4. Time Delay: Adjustable from 5 to 300 seconds to prevent cycling, with deadband adjustment.
 5. Indicator: Two LEDs to indicate the beginning of on and off cycles.
- B. Dimming Control (Open-Loop) for Daylight Compensation: Electronic solid-state controller with separate photo-sensor to measure incoming light and proportionally adjust the dimmer output.
1. Controller Output to Dimmer: 0-10Vdc, compatible with dimming ballasts by Advance, Osram-Sylvania and Lutron. (Ecoyo Series)
 2. Control system shall use open-loop algorithms to determine signal output to dimming ballasts.
 3. Photosensor: 30-3000 fc monitoring range, low-voltage.

- C. Dimming Control (Closed-Loop) for Daylight Compensation: Self-contained, ceiling-mounted control device that detects changes in light levels and raises or lowers electrical fluorescent lighting in response.
1. Controller output to fluorescent dimming ballast is 0-10Vdc, compatible with dimming ballasts by Advance, Osram-Sylvania, and Lutron (ECO10 series).
 2. The photosensor shall be low-voltage, powered by 24Vdc power pack.
 3. The photosensor shall utilize a photocell that measures only in the visual spectrum and has a response curve that matches the photopic curve. It shall not measure in the ultra violet or infrared range (<5% for wavelengths < 400 nm or > 700 nm).
 4. Sensor adjustments shall be made remotely with wireless remote control that shall be furnished with the product.
 5. The photosensor shall have a control range of 20 –60 footcandles.

2.5 INDOOR OCCUPANCY SENSORS

- A. Switch Box Sensors: PIR type with integral power-switching contacts rated for 800 W at 120-V ac, suitable for incandescent light fixtures, fluorescent light fixtures with magnetic or electronic ballasts, or 1/6-hp motors; (rated for 1000 W at 277-V ac).
- B. Wall- or ceiling-mounting, sensor.
1. Operation: Unless otherwise indicated, turn lights on when covered area is occupied and off when unoccupied; with a time delay for turning lights off, adjustable over a minimum range of 1 to 30 minutes.
 2. Sensor Output: Contacts rated to operate the connected relay, complying with UL 773A. Sensor shall be powered from the relay unit. Sensor shall include auxiliary single-pole, double-throw isolated relay.
 3. Relay Unit: 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. Power supply to sensor shall be 24-V dc, 150-mA, Class 2 power source as defined by NFPA 70.
 4. Mounting:
 - a. Sensor: Suitable for mounting in any position on a standard outlet box.
 - b. Relay: Externally mounted through a 1/2-inch knockout in a standard electrical enclosure.
 - c. Time-Delay and Sensitivity Adjustments: Recessed and concealed behind hinged door or coverplate.
 5. Indicator: LED, to show when motion is being detected during testing and normal operation of the sensor.
 6. Bypass Switch: Provide manual OFF/ON function facilitated by installation of a momentary contact switch.

- C. PIR Type: Ceiling mounting; detect occupancy by sensing a combination of heat and movement in area of coverage.
 - 1. Detector Sensitivity: Detect occurrences of 6-inch minimum movement of any portion of a human body that presents a target of at least 36 sq. in..
 - 2. Detection Coverage (Room): Detect occupancy anywhere in a circular area of 1000 sq. ft. when mounted on a 96-inch high ceiling.
 - 3. Detection Coverage (Corridor): Detect occupancy within 90 feet when mounted on a 10-foot high ceiling.
- D. Ultrasonic Type: Ceiling mounting; detect occupancy by sensing a change in pattern of reflected ultrasonic energy in area of coverage.
 - 1. Detector Sensitivity: Detect a person of average size and weight moving at least 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 - 2. Detection Coverage (Small Room): Detect occupancy anywhere within a circular area of 600 sq. ft. when mounted on a 96-inch high ceiling.
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on an 8-foot high ceiling.
 - 4. Detection Coverage (Large Room): Detect occupancy anywhere within a circular area of 2000 sq. ft. when mounted on a 96-inch high ceiling.
 - 5. Detection Coverage (Corridor): Detect occupancy anywhere within 90 feet when mounted on a 10-foot high ceiling in a corridor not wider than 14 feet.
- E. Dual-Technology Type: Wall or Ceiling mounting; detect occupancy by using a combination of PIR and ultrasonic detection methods in area of coverage. Particular technology or combination of technologies that controls on and off functions shall be 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 minimum movement of any portion of a human body that presents a target of at least 36 sq. in., and detect a person of average size and weight moving at least 12 inches in either a horizontal or a vertical manner at an approximate speed of 12 inches/s.
 - 3. Detection Coverage (Standard Room): Detect occupancy anywhere within a circular area of 1000 sq. ft. when mounted on a 96-inch high ceiling.

2.6 MULTIPOLE LIGHTING CONTACTORS

- A. Approved Manufacturers:
 - 1. Allen-Bradley/Rockwell Automation.
 - 2. ASCO Power Technologies, LP; a division of Emerson Electric Co.
 - 3. Cutler-Hammer; Eaton Corporation.
 - 4. GE Industrial Systems.
 - 5. Square-D

- B. Description: Electrically operated and electrically held, complying with NEMA ICS 2 and UL 508.
 - 1. Current Rating for Switching: Listing or rating consistent with type of load served, including tungsten filament, inductive, and high-inrush ballast (ballast with 15 percent or less total harmonic distortion of normal load current).
 - 2. Control-Coil Voltage: Match control power source.

2.7 WALLBOX-STYLE DIMMERS

- A. Dimmer Switches: Modular, full-wave, solid-state units with integral, quiet on/off switches and audible frequency and EMI/RFI filters.
 - 1. Control: Continuously adjustable slider; with single-pole or three-way switching to suit connections.
 - 2. Incandescent Lamp Dimmers: Modular, 120V, 60 Hz with continuously adjustable slider; single pole with soft tap or other quiet switch; EMI/RFI filter to eliminate interference; and 5-inch (130-mm) wire connecting leads.
 - 3. Fluorescent Lamp Dimmer Switches: Modular; compatible with dimmer ballasts; trim potentiometer to adjust low-end dimming; dimmer-ballast combination capable of consistent dimming with low end not greater than 1% of full brightness (depending on ballast-type).

2.8 CONDUCTORS AND CABLES

- A. Power Wiring to Supply Side of Remote-Control Power Sources: Not smaller than No. 12 AWG.
- B. Classes 2 and 3 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 18 AWG.
- C. Class 1 Control Cable: Multiconductor cable with stranded copper conductors not smaller than No. 14 AWG.
- D. Provide unshielded, twisted-pair cable for control and signal transmission conductors.

PART 3 - EXECUTION

3.1 SENSOR INSTALLATION

- A. Install according to manufacturer's instructions. Install and aim sensors in locations to achieve at least 90 percent coverage of areas indicated. Do not exceed coverage limits specified in manufacturer's written instructions.
- B. Do not install ultrasonic or dual-technology occupancy sensors closer than 4 feet from air supply outlets / diffusers.

3.2 WIRING INSTALLATION

- A. Wiring Method: Comply with Division 16 Section "Conductors." Minimum conduit size shall be 1/2 inch.

- B. Wiring within Enclosures: Bundle, lace, and train conductors to terminal points. Separate power-limited and nonpower-limited conductors according to conductor manufacturer's written instructions.
- C. Provide field-mounting transient voltage suppressors for lighting control devices locations that do not have integral line-voltage surge protection.
- D. Size conductors according to lighting control device manufacturer's written instructions, unless otherwise indicated.
- E. Splices, Taps, and Terminations: Make connections only on numbered terminal strips in junction, pull, and outlet boxes; terminal cabinets; and equipment enclosures.
- F. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A and UL 486B.

3.3 IDENTIFICATION

- A. Identify components and power and control wiring.
- B. Label time switches and contactors with a unique designation. Provide a typewritten directory identifying circuits and spaces controlled by contactors.

3.4 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. After installing time switches and sensors, and after electrical circuitry has been energized, adjust and test in compliance with manufacturer recommendations.
 - 2. Operational Test: Verify actuation of each sensor and adjust time delays per manufacturers instructions.
- B. Remove and replace lighting control devices where test results indicate that they do not function properly.
- C. Additional testing and inspecting, at Contractor's expense, may be performed to determine compliance of work with specified requirements.

3.5 ADJUSTING

- A. Occupancy Sensor Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting sensors to suit actual occupied conditions. Provide up to two visits to site outside normal occupancy hours for this purpose.
- B. Daylight Sensor Adjustments: Contractor shall provide on-site service to adjust sensors immediately after owner has occupied the space. An additional on-site visit shall be provided up to 12 months from date of substantial completion. At the end of the adjustment period, contractor shall turn-over accessories used for making adjustments, such as wireless remote controls, to the Owner.

END OF SECTION 16145

SECTION 16155 WIRING CONNECTIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical connections to equipment.

1.02 RELATED REQUIREMENTS

- A. Section 16123- Conductors.
- B. Section 16110-Conduit for Electrical Systems .
- C. Section 16138-Boxes for Electrical Systems.
- D. Section 16140-Wiring Devices.
- E. Section 16170-Enclosed Switches.

1.03 REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (Reaffirmed 2020).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2021.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.05 QUALITY ASSURANCE

- A. Comply with requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.01 MATERIALS

- A. Disconnect Switches: As specified in Section 16170.
- B. Wiring Devices: As specified in Section 16140.
- C. Flexible Conduit: As specified in Section 16110.
- D. Wire and Cable: As specified in Section 16123.
- E. Boxes: As specified in Section 16138.

2.02 EQUIPMENT CONNECTIONS

- A. Electrical Connection: Flexible conduit.
- B. Provide field-installed disconnect switch.
- C. Voltage: as indicated on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquid tight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- F. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- G. Install terminal block jumpers to complete equipment wiring requirements.
- H. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION 16155

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Safety switches and disconnects and separately mounted circuit breakers.
- B. Provide shop drawing.

PART 2 - PRODUCTS

2.1 DISCONNECT SWITCHES:

- A. Heavy duty rated 250 or 600 volts as required; quick-make, quick-break operation; horsepower rated. If switch is not available with proper horsepower rating, classify switch as isolating switch only and provide nameplate reading "DO NOT OPEN UNDER LOAD". Operating handle interlocked with switch door to prevent opening door with switch closed. Provide mechanical over-ride for authorized personnel to open switch door without operating switch handle.
- B. Fusible or non-fusible as shown. Furnish Bussman "Fuse-Tron" fuses for each fusible position, size as shown. Furnish 3 spare fuses for each size.
- C. Furnish with provisions for locking with padlock. Enclosures for switches NEMA 1, general purpose, NEMA 3R, raintight, or special enclosure, as shown.
- D. Standard product of Siemens, Square "D", General Electric, or Cutler Hammer.

2.2 SEPARATELY MOUNTED CIRCUIT BREAKERS:

- A. Furnish and install separately mounted circuit breakers for overcurrent protection of feeders and branch circuits where shown on drawings.
- B. Circuit breakers: Thermal-magnetic, molded case type, rated 600 volts, with interrupting rating of 22,000 rms amperes symmetrical minimum at 208 volts.
- C. Individual circuit breakers shall be mounted in NEMA 1, general purpose surface or flush enclosures as shown.
- D. Circuit breakers shall be the standard product of G.E., Siemens, Square "D" or Cutler Hammer.
- E. Lock-able switch.

PART 3 - EXECUTION

- A. Secure disconnect switches to building or equipment surface as shown. If location shown is not suitable for installing, provide Unistrut P-1000 rack mounted as directed to secure switch.
- B. Disconnects shall be located to be accessible and within 5 feet or closer to equipment served.

- C. Provide engraved nameplates identifying equipment served, fuse or breaker size. Refer to Specification Section 16014.

END OF SECTION 16170

SECTION 16171 - ENCLOSED SWITCHES AND CIRCUIT BREAKERS

PART 1 GENERAL

1.01 RELATED DOCUMENTS:

- A. Documents: Drawings, General Conditions of the Contract and Division 01 Sections apply to this Section
- B. Section 16180: Fuses

1.02 SUMMARY:

- A. This Section includes the following individually mounted, enclosed switches and circuit breakers:
 - 1. Fusible switches.
 - 2. Non-fusible switches.
 - 3. Molded-case circuit breakers.
 - 4. Molded-case switches.
 - 5. Enclosures.

1.03 DEFINITIONS

- 1. GD: - General Duty
- 2. GFCI: - Ground-Fault Circuit Interrupter
- 3. HD: - Heavy Duty
- 4. RMS: - Root Mean Square
- 5. SPDT: - Single Pole, Double Throw
- 6. HID - High Intensity Discharge

1.04 SUBMITTALS

- A. Product Data: For each type of enclosed switch, circuit breaker, accessory, and component indicated. Include dimensioned elevations, sections, weights, and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
 - 1. Enclosure types and details for types other than NEMA 250, Type 1.
 - 2. Current and voltage ratings.
 - 3. Short-circuit current rating.
 - 4. UL Listing for series rating of installed devices.
 - 5. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field Quality-control test reports including the following:
 - 1. Test procedures used.
 - 2. Test results that comply with requirements.
 - 3. Results of failed tests and corrective action taken to achieve test results that comply with requirements.
- D. Operation and Maintenance Data: For enclosed switches and circuit breakers to include in emergency, operation, and maintenance manuals. In addition, include the following:
 - 1. Manufacturer's written instructions for testing and adjusting enclosed switches and circuit breakers.
 - 2. Time-current curves, including selectable ranges for each type of circuit breaker.

PART 2 PRODUCTS

2.01 FUSIBLE AND NON-FUSIBLE SWITCHES:

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D/Group Schneider.
- B. Fusible switch, NEMA KS 1, Type HD, with clips or bolt pads to accommodate specified fuses,

lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.

- C. Non-fusible switch, NEMA KS 1, Type HD, lockable handle with capability to accept two padlocks, and interlocked with cover in closed position.
- D. Accessories:
 - 1. Equipment Ground Kit: Internally mounted and labeled for copper and aluminum ground conductors.
 - 2. Neutral Kit: Internally mounted; insulated, capable of being grounded, and bonded; and labeled for copper and aluminum neutral conductors.
 - 3. Auxiliary Contact Kit: Auxiliary set of contacts arranged to open before switch blades open.

2.02 MOLDED-CASE CIRCUIT BREAKERS AND SWITCHES:

- A. Manufacturers:
 - 1. Eaton Corporation; Cutler-Hammer Products.
 - 2. General Electric Co.; Electrical Distribution & Control Division.
 - 3. Siemens Energy & Automation, Inc.
 - 4. Square D/Group Schneider.
- B. Molded-Case Circuit Breaker: NEMA AB 1, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 150 A and larger.
 - 2. Adjustable Instantaneous-Trip Circuit Breakers: Magnetic trip element with front mounted, field adjustable trip setting.
 - 3. Electronic Trip-Unit Circuit Breakers: RMS sensing; field-replaceable rating plug; with the following field-adjustable settings:
 - a. Instantaneous trip.
 - b. Long- and short -time pickup levels.
 - c. Long- and short -time adjustments.
 - d. Ground-fault pickup level, time delay, and I^2t response.
 - 4. Current-Limiting Circuit Breakers: Frame sizes 400 A and smaller and let-through ratings less than NEMA FU 1, RK-5.
 - 5. Integrally Fused Circuit Breakers: Thermal-magnetic trip element with integral limiter-style fuse listed for use with circuit breaker and trip activation on fuse opening or on opening of fuse compartment door.
 - 6. GFCI Circuit Breakers: Single- and two-pole configurations with 5 mA trip sensitivity.
- C. Molded-Case Circuit Breaker Feature and Accessories:
 - 1. Standard Frame sizes, trip ratings, and number of poles.
 - 2. Lugs: Mechanical style suitable for number, size, trip ratings, and conductor material.
 - 3. Application Listing: Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment, Type HID for High Intensity Discharge lighting loads.
 - 4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage.
 - 5. Ground Fault Protection: Integrally mounted relay and trip unit with adjustable pickup and time-delay settings push-to-test feature and ground fault indicator.
 - 6. Auxiliary Switch: Two SPDT switches with "a" and "b" contacts; "a" contacts mimic circuit-breaker contacts, "b" contacts operate in reverse of circuit-breaker contacts.
- D. Molded-Case Switches: Molded-case circuit breaker with fixed, high-set instantaneous trip only, and short-circuit withstand rating equal to equivalent breaker frame size interrupting rating. Molded-Case Switch Accessories:
 - 1. Verify that accessories retained below are available and appropriate for molded-case switch types and ratings retained.
 - 2. Lugs: Mechanical style suitable for number, size, trip ratings, and material of conductors.
 - 3. Application Listing: Type HACR for heating, air-conditioning, and refrigerating equipment.

4. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 75 percent of rated voltage. Provide "dummy" trip unit where required for proper operation.

2.03 ENCLOSURES

- A. NEMA AB 1 and NEMA KS 1 to meet environmental conditions of installed location.
 1. Outdoor Locations: NEMA 250, Type 3R.
 2. Other Wet or Damp Indoor Locations: NEMA 250, Type 4.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine elements and surfaces to receive enclosed switches and circuit breakers for compliance with installation tolerances and other conditions affecting performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 INSTALLATION

- A. Comply with applicable portions of NECA 1, NEMA PB 1.1, and NEMA PB 2.1 for installation of enclosed switches and circuit breakers.
- B. Mount individual wall-mounting switches and circuit breakers with tops at uniform height, unless otherwise indicated. Anchor floor-mounting switches to concrete base.
- C. Comply with mounting and anchoring requirements specified in Division 16 Section "Electrical Supports and Seismic Restraints."
- D. Temporary Lifting Provisions: Remove temporary lifting eyes, channels, and brackets and temporary blocking of moving parts from enclosures and components.

3.03 IDENTIFICATION

- A. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."
- B. Enclosure Nameplates: Label each enclosure with engraved metal or laminated-plastic nameplate as specified in Division 16 Section "Electrical Identification."

3.04 ADJUSTING

- A. Set field-adjustable switches and circuit-breaker trip ranges in accordance with overcurrent device study (see Division 16 Section "Overcurrent Protective Device Study").

3.05 CLEANING

- A. On completion of installation, vacuum dirt and debris from interiors; do not use compressed air to assist in cleaning.
- B. Inspect exposed surfaces and repair damaged finishes.

END OF SECTION

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PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Cartridge fuses rated 600 V and less for use in switches.
 - 2. Spare-fuse cabinets.

1.3 SUBMITTALS

- A. Product Data: Include the following for each fuse type indicated:
 - 1. Dimensions and manufacturer's technical data on features, performance, electrical characteristics, and ratings.
 - 2. Let-through current curves for fuses with current-limiting characteristics.
 - 3. Time-current curves, coordination charts and tables, and related data.
 - 4. Fuse size for elevator feeders and elevator disconnect switches.
- B. Ambient Temperature Adjustment Information: If ratings of fuses have been adjusted to accommodate ambient temperatures, provide list of fuses with adjusted ratings.
 - 1. For each fuse having adjusted ratings, include location of fuse, original fuse rating, local ambient temperature, and adjusted fuse rating.
 - 2. Provide manufacturer's technical data on which ambient temperature adjustment calculations are based.
- C. Operation and Maintenance Data: For fuses to include in emergency, operation, and maintenance manuals.
 - 1. In addition to items specified in Division 01 Section "Operation and Maintenance Data," include the following:
 - a. Let-through current curves for fuses with current-limiting characteristics.
 - b. Time-current curves, coordination charts and tables, and related data.
 - c. Ambient temperature adjustment information.

1.4 QUALITY ASSURANCE

- A. Source Limitations: Obtain fuses from a single manufacturer.

- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Comply with NEMA FU 1.
- D. Comply with NFPA 70.

1.5 PROJECT CONDITIONS

- A. Where ambient temperature to which fuses are directly exposed is less than 40 deg F (5 deg C) or more than 100 deg F (38 deg C), apply manufacturer's ambient temperature adjustment factors to fuse ratings.

1.6 COORDINATION

- A. Coordinate fuse ratings with utilization equipment nameplate limitations of maximum fuse size.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Cooper Bussman, Inc.
 - 2. Eagle Electric Mfg. Co., Inc.; Cooper Industries, Inc.
 - 3. Ferraz Shawmut, Inc.
 - 4. Tracor, Inc.; Littelfuse, Inc. Subsidiary.

2.2 CARTRIDGE FUSES

- A. Characteristics: NEMA FU 1, nonrenewable cartridge fuse; class and current rating indicated; voltage rating consistent with circuit voltage.
- B. Basis of design products:
 - 1. Class L, current-limiting time delay – Bussman "Low Peak" KRP-C
 - 2. Class RK1, time-delay, dual-element – Bussman "Low Peak", LPS-RK
 - 3. Class RK5, time-delay, dual-element – Bussman "Fusetron" FRS-R
 - 4. Class J, time-delay, dual-element – Bussman "Low Peak" LPJ
 - 5. Class L, fast-acting, current-limiting, Bussman "Limitron" KTU

2.3 SPARE-FUSE CABINET

- A. Cabinet: Wall-mounted, 0.05-inch- (1.27-mm-) thick steel unit with full-length, recessed piano-hinged door and key-coded cam lock and pull.
 - 1. Size: Adequate for storage of spare fuses specified with 15 percent spare capacity minimum.
 - 2. Finish: Gray, baked enamel.

3. Identification: "SPARE FUSES" in 1-1/2-inch- (38-mm-) high letters on exterior of door.
4. Fuse Pullers: For each size of fuse.
5. Place in the main electrical room.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine utilization equipment nameplates and installation instructions. Install fuses of sizes and with characteristics appropriate for each piece of equipment.
- B. Evaluate ambient temperatures to determine if fuse rating adjustment factors must be applied to fuse ratings.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 FUSE APPLICATIONS

- A. Motor Branch Circuits:
 1. Motors larger than 5 hp – RK1
 2. Motors 5 hp and smaller – RK5
- B. Other Branch Circuits: Class RK5, time delay.
- C. Feeders:
 1. 600 amp and smaller – RK1
 2. Larger than 600 amp – Class L time-delay
- D. Service Entrance:
 1. Larger than 600 amp – Class L fast-acting
 2. 600 amp and smaller – Class RK1
- E. Low-Voltage Transformer: Class RK1
- F. Elevator Machine Disconnect – Class J dual-element, time-delay

3.3 INSTALLATION

- A. Install fuses in fusible devices. Arrange fuses so rating information is readable without removing fuse.
- B. Install spare-fuse cabinet(s).

3.4 IDENTIFICATION

- A. Install labels indicating fuse replacement information on inside door of each fused switch.

END OF SECTION 16180

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Packaged engine generator system and associated components and accessories:
 - 1. Engine and engine accessory equipment.
 - 2. Alternator (generator).
 - 3. Generator set control system.
 - 4. Generator set enclosure.

1.02 RELATED REQUIREMENTS

- A. Section 03300 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 15190 - Facility Natural-Gas Piping.
- C. Section 15192 - Facility Liquefied-Petroleum Gas Piping.
- D. Section 15810 - HVAC Ducts and Casings.
- E. Section 16121-Grounding and Bonding for Electrical Systems.
- F. Section 16136-Hangers and Supports for Electrical Systems.
- G. Section 16014-Identification for Electrical Systems.

REFERENCE STANDARDS

- H. ASTM D975 - Standard Specification for Diesel Fuel; 2023a.
- I. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- J. NECA/EGSA 404 - Standard for Installing Generator Sets; 2014.
- K. NEMA MG 1 - Motors and Generators; 2021.
- L. NFPA 30 - Flammable and Combustible Liquids Code; 2021, with Amendment (2020).
- M. NFPA 37 - Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines; 2021.
- N. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- O. NFPA 99 - Health Care Facilities Code; 2021, with Amendment.
- P. NFPA 110 - Standard for Emergency and Standby Power Systems; 2022.
- Q. UL 142 - Steel Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.
- R. UL 1236 - Battery Chargers for Charging Engine-Starter Batteries; Current Edition, Including All Revisions.
- S. UL 2085 - Protected Aboveground Tanks for Flammable and Combustible Liquids; Current Edition, Including All Revisions.
- T. UL 2200 - Stationary Engine Generator Assemblies; Current Edition, Including All Revisions.

1.03 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate compatibility of generator sets to be installed with work provided under other sections or by others.
 - a. Transfer Switches – Coordinate with fire pump controller design and equipment.
 - 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the spaces dedicated for engine generator system.
 - 3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Coordinate the work to provide electrical circuits suitable for the power requirements of the actual auxiliary equipment and accessories to be installed.
 5. Notify Dewberry Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Preinstallation Meeting: Convene one week before starting work of this section; require attendance of all affected installers.

1.04 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features. Include alternator starting capabilities, engine fuel consumption rates, and cooling, combustion air, and exhaust requirements.
 1. Include generator set sound level test data.
 2. Include characteristic trip curves for overcurrent protective devices upon request.
 3. Include alternator thermal damage curve upon request.
- C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
 1. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Derating Calculations: Indicate ratings adjusted for applicable service conditions.
- F. Specimen Warranty: Submit sample of manufacturer's warranty.
- G. Evidence of qualifications for installer.
- H. Evidence of qualifications for maintenance contractor (if different entity from installer).
- I. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
- J. Manufacturer's factory emissions certification.
- K. Manufacturer's certification that products meet or exceed specified requirements.
- L. Source quality control test reports.
- M. Provide NFPA 110 required documentation from manufacturer, including but not limited to:
 1. Certified prototype tests.
 2. Torsional vibration compatibility certification.
 3. NFPA 110 compliance certification.
 4. Certified rated load test at rated power factor.
- N. Manufacturer's detailed field-testing procedures.
- O. Field quality control test reports.
- P. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
- Q. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- R. Maintenance contracts.
- S. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.

- T. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.
 - 2. Extra Fuses: Two of each type and size.
 - 3. Extra Filter Elements: Two of each type, including fuel, oil and air.

1.05 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70 (National Electrical Code).
 - 2. NFPA 110 (Standard for Emergency and Standby Power Systems); meet requirements for Level 1 system.
 - 3. NFPA 37 (Standard for the Installation and Use of Stationary Combustion Engines and Gas Turbines).
 - 4. NFPA 30 (Flammable and Combustible Liquids Code).
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years' experience.
 - 1. Authorized service facilities located within 200 Miles (320 km) of project site.
- D. Installer Qualifications: Company with minimum three years' experience with engine generator systems of similar size, type, and complexity.
- E. Maintenance Contractor Qualifications: .
 - 1. Contract maintenance office located within 200 miles (320 km) of project site.
- F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store generator sets in accordance with manufacturer's instructions and NECA/EGSA 404.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's instructions to avoid damage to generator set components, enclosure, and finish.

1.07 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.08 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum five-year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Packaged Engine Generator Set:
 - 1. Caterpillar Inc;
 - 2. Cummins Power Generation Inc;
 - 3. Generac Power Systems
 - 4. Kohler Co
- B. Substitutions: See Section 016000 - Product Requirements.

- C. Source Limitations: Furnish engine generator sets and associated components and accessories produced by a single manufacturer and obtained from a single supplier.

2.02 PACKAGED ENGINE GENERATOR SYSTEM

- A. Provide new engine generator system consisting of all required equipment, sensors, conduit, boxes, wiring, piping, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. System Description:
 - 1. Application: Emergency/standby.
 - 2. Configuration: Single packaged engine generator set operated independently (not in parallel).
 - 3. Total System Power Rating: As indicated on drawings, standby including applicable derating adjustments. Adjust kW as required for reconnectable loads of 3 phase alternator selection to single phase applications to meet overall kW and SkVA indicated on the Drawings.
 - 4. Where design is based on single generator set, use of multiple, smaller unit(s) operated in parallel to obtain equivalent total system power rating is not permitted.
- D. Packaged Engine Generator Set:
 - 1. Voltage: As indicated on drawings.
 - 2. Frequency: 60 Hz.
 - 3. Main Line Circuit Breaker:
 - a. Type: Electronic trip with long time, short time, and instantaneous pickup and delay.
 - b. Trip Rating: As indicated on drawings.
 - c. Features:
 - 1) Shunt trip where indicated on drawings.
 - 2) Auxiliary contacts where indicated on drawings.
- E. Generator Set General Requirements:
 - 1. Prototype tested in accordance with NFPA 110 for Level 1 systems.
 - 2. Factory-assembled, with components mounted on suitable base.
 - 3. List and label engine generator assembly as complying with UL 2200.
 - 4. Power Factor: Unless otherwise indicated, specified power ratings are at 0.8 power factor for three phase voltages and 1.0 power factor for single phase voltages.
 - 5. Provide suitable guards to protect personnel from accidental contact with rotating parts, hot piping, and other potential sources of injury.
 - 6. Main Line Circuit Breakers: Provide factory-installed line side connections with suitable lugs for load side connections.
- F. Seismic Qualification: Provide engine generator assemblies and associated components suitable for application. Include certification of compliance with submittals.
- G. Service Conditions: Provide engine generator system and associated components suitable for operation under the service conditions at the installed location.
- H. Starting and Load Acceptance Requirements:
 - 1. Cranking Method: Cycle cranking complying with NFPA 110 (15 second crank period, followed by 15 second rest period, with cranking limiter time-out after 3 cycles), unless otherwise required.
 - 2. Cranking Limiter Time-Out: If generator set fails to start after specified cranking period, indicate over crank alarm condition and lock-out generator set from further cranking until manually reset.
 - 3. Start Time: Capable of starting and achieving conditions necessary for load acceptance within 10 seconds (NFPA 110, Type 10).
 - 4. Maximum Load Step: Supports 100 percent of rated load in one step.
 - a. Maximum Voltage Deviation with Load Step: 3 percent.

- b. Maximum Frequency Deviation with Load Step: 0.5 percent.
- 5. Motor Starting Capability: Supports starting of motor load indicated with a maximum voltage dip of 25 percent for general load steps and 15 percent for steps serving fire pumps.
- I. Exhaust Emissions Requirements:
 - 1. Comply with federal (EPA), state, and local regulations applicable at the time of commissioning; include factory emissions certification with submittals.
 - 2. Do not make modifications affecting generator set factory emissions certification without approval of manufacturer. Where such modifications are made, provide field emissions testing as necessary for certification.
- J. Sound Level Requirements:
 - 1. Do not exceed 85 dBA when measured at 23 feet (7m) 10 from generator set in free field (no sound barriers) while operating at full load; include manufacturer's sound data with submittals.

2.03 ENGINE AND ENGINE ACCESSORY EQUIPMENT

- A. Provide engine with adequate horsepower to achieve specified power output at rated speed, accounting for alternator efficiency and parasitic loads.
- B. Engine Starting System:
 - 1. System Type: Electric, with DC solenoid-activated starting motor(s).
 - 2. Battery(s):
 - a. Battery Type: Nickel-cadmium.
 - b. Battery Capacity: Size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature; capable of providing cranking through two complete periods of cranking limiter time-outs without recharging.
 - c. Provide battery rack, cables, and connectors suitable for the supplied battery(s); size battery cables according to manufacturer's recommendations for cable length to be installed and battery starter disconnect.
 - 3. Battery-Charging Alternator: Engine-driven, with integral solid-state voltage regulation.
 - 4. Battery Charger:
 - a. Provide dual rate battery charger with automatic float and equalize charging modes; suitable for maintaining the supplied battery(s) at full charge without manual intervention.
 - b. Capable of returning supplied battery(s) from fully discharged to fully charged condition within 24 hours, as required by NFPA 110 for Level 1 applications while carrying normal loads.
 - c. Recognized as complying with UL 1236.
 - d. Furnished with integral overcurrent protection; current limited to protect charger during engine cranking; reverse polarity protection.
 - e. Provide integral DC output ammeter and voltmeter with five percent accuracy.
 - f. Provide alarm output contacts as necessary for alarm indications.
 - 5. Battery Heater: Provide thermostatically controlled battery heater to improve starting under cold ambient conditions.
- C. Engine Speed Control System (Governor):
 - 1. Single Engine Generator Sets (Not Operated in Parallel): Provide electronic isochronous governor for controlling engine speed/alternator frequency.
 - 2. Generator Sets Used with Closed Transition Transfer Switches: Provide electronic isochronous governor with frequency regulation suitable for transfer.
 - 3. Frequency Regulation, Electronic Isochronous Governors: No change in frequency from no load to full load; plus/minus 0.25 percent at steady state.
- D. Engine Lubrication System:

1. System Type: Full pressure, with engine-driven, positive displacement lubrication oil pump, replaceable full-flow oil filter(s), and dipstick for oil level indication. Provide oil cooler where recommended by manufacturer.
 2. Oil Heater: Provide thermostatically controlled oil heater to improve starting under cold ambient conditions.
- E. Engine Cooling System:
1. System Type: Closed-loop, liquid-cooled, with unit-mounted radiator/fan and engine-driven coolant pump; suitable for providing adequate cooling while operating at full load under worst case ambient temperature.
 2. Fan Guard: Provide suitable guard to protect personnel from accidental contact with fan.
 3. Ducted Radiators: Where ducted radiator air discharge is to be field installed, provide suitable radiator duct flange/adaptor.
 4. Coolant Heater: Provide thermostatically controlled coolant heater to improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.
- F. Engine Air Intake and Exhaust System:
1. Air Intake Filtration: Provide engine-mounted, replaceable, dry element filter.
 2. Engine Exhaust Connection: Provide suitable, approved flexible connector for coupling engine to exhaust system.
 3. Exhaust Silencer: Provide critical grade or better exhaust silencer; select according to manufacturer's recommendations to meet sound performance requirements, where specified.

2.04 ALTERNATOR (GENERATOR)

- A. Alternator: 4-pole, 1800 rpm (60 Hz output) revolving field, synchronous generator complying with NEMA MG 1; connected to engine with flexible coupling; voltage output configuration as indicated, with reconnectable leads for 3 phase alternators.
- B. Exciter:
1. Exciter Type: Brushless; provide permanent magnet generator (PMG) excitation system; self-excited (shunt) systems are not permitted.
 2. PMG Excitation Short-Circuit Current Support: Capable of sustaining 300 percent of rated output current for 10 seconds.
 3. Voltage Regulation (with PMG excitation): Plus/minus 0.5 percent for any constant load from no load to full load.
- C. Temperature Rise: Comply with UL 2200.
- D. Insulation System: NEMA MG 1, Class F with a maximum winding temperature rise of 105 degree C. above 40 degree C ambient.
- E. Enclosure: NEMA MG 1, drip-proof.
- F. Total Harmonic Distortion: Not greater than five percent.
- G. Alternator Heater: Provide strip heater to prevent moisture condensation on alternator windings.

2.05 GENERATOR SET CONTROL SYSTEM

- A. Provide microprocessor-based control system for automatic control, monitoring, and protection of generator set. Include sensors, wiring, and connections necessary for functions/indications specified.
- B. Control Panel:
1. Control Panel Mounting: Unit-mounted unless otherwise indicated; vibration isolated.
 2. Generator Set Control Functions:
 - a. Automatic Mode: Initiates generator set start/shutdown upon receiving corresponding signal from remote device (e.g., automatic transfer switch).

- b. Manual Mode: Initiates generator set start/shutdown upon direction from operator.
 - c. Reset Mode: Clears all faults, allowing generator set restart after a shutdown.
 - d. Emergency Stop: Immediately shuts down generator set (without time delay) and prevents automatic restarting until manually reset.
 - e. Cycle Cranking: Programmable crank time, rest time, and number of cycles.
 - f. Time Delay: Programmable for shutdown (engine cooldown).
 - g. Voltage Adjustment: Adjustable through range of plus/minus 5 percent.
3. Generator Set Status Indications:
- a. Voltage (Volts AC): Line-to-line, line-to-neutral for each phase.
 - b. Current (Amps): For each phase.
 - c. Frequency (Hz).
 - d. Real power (W/kW).
 - e. Reactive power (VAR/kVAR).
 - f. Apparent power (VA/kVA).
 - g. Power factor.
 - h. Duty Level: Actual load as percentage of rated power.
 - i. Engine speed (RPM).
 - j. Battery voltage (Volts DC).
 - k. Engine oil pressure.
 - l. Engine coolant temperature.
 - m. Engine run time.
 - n. Generator powering load (position signal from transfer switch).
4. Generator Set Protection and Warning/Shutdown Indications:
- a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following protections/indications:
 - 1) Over crank (shutdown).
 - 2) Low coolant temperature (warning).
 - 3) High coolant temperature (warning).
 - 4) High coolant temperature (shutdown).
 - 5) Low oil pressure (warning).
 - 6) Low oil pressure (shutdown).
 - 7) Overspeed (shutdown).
 - 8) Low fuel level (warning).
 - 9) Low coolant level (warning/shutdown).
 - 10) Generator control not in automatic mode (warning).
 - 11) High battery voltage (warning).
 - 12) Low cranking voltage (warning).
 - 13) Low battery voltage (warning).
 - 14) Battery charger failure (warning).
 - b. In addition to NFPA 110 requirements, provide the following protections/indications:
 - 1) High AC voltage (shutdown).
 - 2) Low AC voltage (shutdown).
 - 3) High frequency (shutdown).
 - 4) Low frequency (shutdown).
 - 5) Overcurrent (shutdown).
 - 6) Fuel tank leak (warning), where applicable.
 - c. Provide contacts for local and remote common alarm.
 - d. Provide lamp test function that illuminates all indicator lamps.
5. Other Control Panel Features:
- a. Event log.
 - b. Communications Capability: Utilize Modbus communications protocol. Provide all accessories necessary for proper interface.
 - c. Remote monitoring capability via PC.

- C. Remote Annunciator:
1. Remote Annunciator Mounting: Wall-mounted; Provide flush-mounted annunciator for finished areas and surface-mounted annunciator for non-finished areas unless otherwise indicated.
 2. Generator Set Status Indications:
 - a. Generator powering load (via position signal from transfer switch).
 - b. Communication functional.
 3. Generator Set Warning/Shutdown Indications:
 - a. Comply with NFPA 110; configurable for NFPA 110 Level 1 or Level 2, or NFPA 99 systems including but not limited to the following indications:
 - 1) Over crank (shutdown).
 - 2) Low coolant temperature (warning).
 - 3) High coolant temperature (warning).
 - 4) High coolant temperature (shutdown).
 - 5) Low oil pressure (warning).
 - 6) Low oil pressure (shutdown).
 - 7) Overspeed (shutdown).
 - 8) Low fuel level (warning).
 - 9) Low coolant level (warning/shutdown).
 - 10) Generator control not in automatic mode (warning).
 - 11) High battery voltage (warning).
 - 12) Low cranking voltage (warning).
 - 13) Low battery voltage (warning).
 - 14) Battery charger failure (warning).
 - b. Provide audible alarm with silence function.
 - c. Provide lamp test function that illuminates all indicator lamps.
- D. Remote Emergency Stop: Provide approved red, mushroom style remote emergency stop button where indicated or required by authorities having jurisdiction.

2.06 GENERATOR SET ENCLOSURE

- A. Enclosure Type: Sound attenuating, weather protective.
- B. Enclosure Material: Steel or aluminum.
- C. Hardware Material: Stainless steel.
- D. Color: Manufacturer's standard.
- E. Access Doors: Lockable, with all locks keyed alike.
- F. Openings: Designed to prevent bird/rodent entry.
- G. External Drains: Extend oil and coolant drain lines to exterior of enclosure for maintenance service.
- H. Sound Attenuating Enclosures: Line enclosure with non-hydroscopic, self-extinguishing sound-attenuating material.
- I. Utilize an upward discharging radiator hood.
- J. Exhaust Silencers: Where exhaust silencers are mounted within enclosure in main engine compartment, insulate silencer to minimize heat dissipation as necessary for operation at rated load under worst case ambient temperature.
- K. Enclosure Accessories: Provide battery powered emergency light(s), power service receptacle, and power load center.
- L. Enclosure Space Heater: Provide thermostatically controlled enclosure space heater to prevent condensation and improve starting under cold ambient conditions; size according to manufacturer's recommendations for achieving starting and load acceptance requirements under worst case ambient temperature.

2.07 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Perform production tests on generator sets at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.
- C. Generator Set production testing to include, at a minimum:
 - 1. Operation at rated load and rated power factor.
 - 2. Single step load pick-up.
 - 3. Transient and steady state voltage and frequency performance.
 - 4. Operation of safety shutdowns.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of generator sets, and auxiliary equipment are consistent with the indicated requirements.
- C. Verify that rough ins for field connections are in the proper locations.
- D. Verify that mounting surfaces are ready to receive equipment.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install generator sets and associated accessories in accordance with NECA/EGSA 404.
- D. Arrange equipment to provide minimum clearances and required maintenance access.
- E. Unless otherwise indicated, mount generator set on properly sized, minimum 6 inch (150 mm) high concrete pad constructed in accordance with Section 03300.
- F. Provide required support and attachment in accordance with Section 16136.
- G. Provide required vibration isolation and/or seismic controls in accordance with Section 260548.
- H. Use manufacturer's recommended oil and coolant, suitable for the worst case ambient temperatures.
- I. Provide duct for cooling air intake/exhaust in accordance with Section 15810.
- J. Provide engine exhaust piping in accordance with Section 235100, where not factory installed.
 - 1. Include piping expansion joints, piping insulation, thimble, condensation trap/drain, rain cap, hangers/supports, etc. as indicated or as required.
 - 2. Do not exceed manufacturer's maximum back pressure requirements.
- K. Install exhaust silencer in accordance with Section 235100, where not factory installed.
- L. Provide grounding and bonding in accordance with Section 16121. Provide signage indicating neutral-ground bond under installed condition.
- M. Identify system wiring and components in accordance with Section 16014.
- N. Provide expanded galvanized steel platform around generator enclosure where generator base is greater than 24" above foundation or where height would exceed 6'7" to center line of circuit breaker and control panel.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide services of a manufacturer's authorized representative to prepare and start systems and perform inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.

- C. Notify Owner and Dewberry Engineers, Inc. at least two weeks prior to scheduled inspections and tests.
- D. Notify authorities having jurisdiction and comply with their requirements for scheduling inspections and tests and for observation by their personnel.
- E. Provide all equipment, tools, and supplies required to accomplish inspection and testing, including load bank and fuel.
- F. Preliminary inspection and testing to include, at a minimum:
 - 1. Inspect each system component for damage and defects.
 - 2. Verify tightness of mechanical and electrical connections are according to manufacturer's recommended torque settings.
 - 3. Check for proper oil and coolant levels.
- G. Prepare and start system in accordance with manufacturer's instructions.
- H. Perform acceptance test in accordance with NFPA 110.
- I. Inspection and testing to include, at a minimum:
 - 1. Verify compliance with starting and load acceptance requirements.
 - 2. Verify voltage and frequency; make required adjustments as necessary.
 - 3. Verify phase sequence.
 - 4. Verify control system operation, including safety shutdowns.
 - 5. Verify operation of auxiliary equipment and accessories (e.g., battery charger, heaters, etc.).
 - 6. Perform load tests in accordance with NFPA 110 (1.5 hour building load test followed by 2 hour full load test). Provide load bank as required to achieve full load condition. Provide metering equipment to record loads as required.
- J. Provide field emissions testing where necessary for certification.
- K. Sound Level Tests: Measure sound levels for compliance with specified requirements. Identify and report ambient noise conditions.
- L. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- M. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of system to Owner, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of system.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of four hours of training.
 - 3. Instructor: Manufacturer's authorized representative.
 - 4. Location: At project site.
- E. After successful acceptance test and just prior to Substantial Completion, replace air, oil, and fuel filters and fill fuel storage tank.

3.06 PROTECTION

- A. Protect installed engine generator system from subsequent construction operations.

3.07 MAINTENANCE

- A. See Section 017000 - Execution and Closeout Requirements, for additional requirements relating to maintenance service.
- B. Provide to Owner a proposal as an alternate to the base bid, a separate maintenance contract for the service and maintenance of engine generator system for two years from date of Substantial Completion; Include a complete description of preventive maintenance, systematic examination, adjustment, inspection, and testing, with a detailed schedule.
- C. Conduct site visit at least once every three months to perform inspection, testing, and preventive maintenance. Submit report to Owner indicating maintenance performed along with evaluations and recommendations.
- D. Provide trouble call-back service upon notification by Owner:
 - 1. Provide on-site response within 4 hours of notification.
 - 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 - 3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- E. Maintain an on-site log listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced.

END OF SECTION 16231

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SECTION 16271 LOW-VOLTAGE ELECTRICAL SERVICE ENTRANCE

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Electrical service requirements.

1.02 RELATED REQUIREMENTS

- A. Section 033000 - Cast-in-Place Concrete: Materials and installation requirements for cast-in-place concrete equipment pads.
- B. Section 16120- Conductors
- C. Section 16121-Grounding and Bonding for Electrical Systems.
- D. Section 16136-Hangers and Supports for Electrical Systems.
- E. Section 16110-Conduit for Electrical Systems.
- F. Section 16014-Identification for Electrical Systems: Identification products and requirements.
- G. Section 16442-Panelboards: Service entrance equipment.
- H. Section 16171-Enclosed Switches: Service entrance equipment.
- I. Section 16231-Generators: Emergency/standby power systems for interconnection with normal utility electrical supply.
- J. Section 16289-Surge Protective Devices: Service entrance surge protective devices.
- K. Section 312316 - Excavation.
- L. Section 312316.13 - Trenching: Excavating, bedding, and backfilling.
- M. Section 312323 - Fill: Bedding and backfilling.
- N. Section 337119 - Electrical Underground Ducts, Ductbanks, and Manholes.

1.03 PRICE AND PAYMENT PROCEDURES

- A. Allowances:
 - 1. See Section 012100 - Allowances, for allowances affecting this section.
 - 2. Include cash allowance for Utility Company charges associated with providing service.
- B. Unit Prices:
 - 1. See Section 012200 - Unit Prices, for additional unit price requirements.
 - 2. Primary:
 - a. Basis of Measurement: By the lineal foot (meter), for each configuration.
 - b. Basis of Payment: Includes all work designated to be provided by Contractor in "Division of Responsibility" under Part 2 article "Electrical Service Requirements" below, including purchase, delivery, and installation.
 - 3. Secondary:
 - a. Basis of Measurement: By the lineal foot (meter), for each configuration.
 - b. Basis of Payment: Includes all work designated to be provided by Contractor in "Division of Responsibility" under Part 2 article "Electrical Service Requirements" below, including purchase, delivery, and installation.
 - 4. Transformer Pad/Vault:
 - a. Basis of Measurement: Per unit, for each type.
 - b. Basis of Payment: Includes purchase, delivery, and installation.

1.04 DEFINITIONS

- A. Service Point: The point of connection between the facilities of the serving utility and the premises wiring as defined in NFPA 70, and as designated by the Utility Company.

1.05 REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code(R) (NESC(R)); 2023.

- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2015.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.06 ADMINISTRATIVE REQUIREMENTS

- A. No later than two weeks following date of the Agreement, notify Utility Company of anticipated date of service.
- B. Coordination:
 - 1. Verify the following with Utility Company representative:
 - a. Utility Company requirements, including division of responsibility.
 - b. Exact location and details of utility point of connection.
 - c. Utility easement requirements.
 - d. Utility Company charges associated with providing service.
 - 2. Coordinate the work with other trades to avoid placement of other utilities or obstructions within the spaces dedicated for electrical service and associated equipment.
 - 3. Coordinate arrangement of service entrance equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Coordinate the work with other installers to provide communication lines required for Utility Company meters.
 - 5. Notify Dewberry Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- C. Arrange for Utility Company to provide permanent electrical service. Prepare and submit documentation required by Utility Company.
- D. The Contractor shall pay the power and communication utilities fees, assessments, charges, etc. required by that utility to provide service to the facility. If an allowance for these costs is indicated within Specifications or on the Drawings these costs shall be drawn from this allowance with all remaining monies returned to the Owner. Include all costs on the Schedule of Values. See Paragraph 1.03.
- E. Preinstallation Meeting: Convene one week prior to commencing work of this section to review service requirements and details with Utility Company representative.
- F. Scheduling:
 - 1. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.
 - 2. Arrange for inspections necessary to obtain Utility Company approval of installation.

1.07 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Utility Company letter of availability for providing electrical service to project. Letter to include transformer kVA rating, impedance and available short circuit current at the service point.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product. Include ratings, configurations, standard wiring diagrams, outline and support point dimensions, finishes, weights, service condition requirements, and installed features.
- D. Shop Drawings: Include dimensioned plan views and sections indicating locations and arrangement of Utility Company and service entrance equipment, metering provisions, required clearances, and proposed service routing.
 - 1. Obtain Utility company approval of shop drawings prior to submittal.
- E. Drawings prepared by Utility Company.
- F. Project Record Documents: Record actual locations of equipment and installed service routing.

1.08 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. IEEE C2 (National Electrical Safety Code).

2. NFPA 70 (National Electrical Code).
 3. The requirements of the Utility Company.
 4. The requirements of the local authorities having jurisdiction.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.09 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.
- B. Store products indoors in a clean, dry space having a uniform temperature to prevent condensation (including outdoor rated products which are not weatherproof until completely and properly installed). Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle products carefully to avoid damage to internal components, enclosure, and finish.

PART 2 PRODUCTS

2.01 ELECTRICAL SERVICE REQUIREMENTS

- A. Provide new or modify the existing electrical service as indicated on the drawings consisting of all required conduits, conductors, equipment, metering provisions, supports, accessories, etc. as necessary for connection between Utility Company point of supply and service entrance equipment.
- B. Electrical Service Characteristics: As indicated on drawings.
- C. Utility Company: As indicated on drawings.
- D. Division of Responsibility:
1. Pad-Mounted Utility Transformers:
 - a. Transformer Vaults: Furnished and installed by Contractor per Utility Company requirements.
 - b. Transformers: Furnished and installed by Utility Company.
 - c. Transformer Grounding Provisions: Furnished and installed by Contractor per Utility Company requirements.
 - d. Transformer Protective Bollards: Furnished and installed by Contractor per Utility Company requirements.
 - e. Primary:
 - 1) Trenching and Backfilling: Provided by Contractor.
 - 2) Conduits: Furnished and installed by Contractor.
 - 3) Conductors: Furnished and installed by Utility Company.
 - f. Secondary:
 - 1) Trenching and Backfilling: Provided by Contractor.
 - 2) Conduits: Furnished and installed by Contractor.
 - 3) Conductors: Furnished and installed by Contractor.
 2. Pole-Mounted Utility Transformers:
 - a. Utility Poles: Furnished and installed by Utility Company.
 - b. Transformers: Furnished and installed by Utility Company.
 - c. Transformer Grounding Provisions: Furnished and installed by Utility Company.
 - d. Primary: Furnished and installed by Utility Company.
 - e. Secondary - Underground Service:
 - 1) Conduits and pull boxes furnished and installed by Contractor.
 - 2) Conductors: Furnished and installed by Contractor.
 - f. Secondary - Overhead Service:

- 1) Conduits/Service Masts: Furnished and installed by Contractor.
 - 2) Conductors: Furnished and installed by Contractor (Service Point at service mast).
3. Terminations at Service Point: Provided by Utility Company.
4. Metering Provisions:
 - a. Meter Bases: Furnished and installed by Contractor per Utility Company requirements.
 - b. Metering Transformer Cabinets: Furnished and installed by Contractor per Utility Company requirements.
 - c. Metering Compartments in Service Entrance Equipment: Furnished and installed by Contractor per Utility Company requirements.
 - d. Metering Transformers: Furnished and installed by Utility Company.
 - e. Conduits Between Metering Transformers and Meters: Furnished and installed by Contractor per Utility Company requirements.
 - f. Wiring Between Metering Transformers and Meters: Furnished and installed by Utility Company.
 - g. Communications Conduits for Meters: Furnished and installed by Contractor per Utility Company requirements.
- E. Products Furnished by Contractor: Comply with Utility Company requirements.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings and configurations of service entrance equipment are consistent with the indicated requirements.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02 PREPARATION

- A. Verify and mark locations of existing underground utilities.

3.03 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and Utility Company requirements.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required trenching and backfilling in accordance with Section 312316.13 as described in Section 16010.
- E. Construct cast-in-place concrete pads for utility equipment in accordance with Utility Company requirements and Section 03300 or as described in Section 16010.
- F. Provide required protective bollards in accordance with Utility Company requirements.
- G. Provide required support and attachment components in accordance with Section 16136.
- H. Provide grounding and bonding for service entrance equipment in accordance with Section 16121.
- I. Identify service entrance equipment, including main service disconnect(s) in accordance with Section 16014.

3.04 PROTECTION

- A. Protect installed equipment from subsequent construction operations.

END OF SECTION 16271

SECTION 16289 SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surge protective devices for service entrance locations.
- B. Surge protective devices for distribution locations.
- C. Surge protective devices for branch panelboard locations.

1.2 RELATED REQUIREMENTS

- B. Section 16121 - Grounding and Bonding for Electrical Systems.
- E. Section 16443 - Panelboards.
- H. Section 16140 - Wiring Devices: Receptacles with integral surge protection.
- I. Section 16710 - Structured Cabling: Protectors for communications service entrance.
- J. Section 16703 - Fire Detection and Alarm.

1.3 ABBREVIATIONS AND ACRONYMS

- A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.
- B. SPD: Surge Protective Device.

1.4 REFERENCE STANDARDS

- A. MIL-STD-220 - Method of Insertion Loss Measurement 2009c (Validated 2019).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- E. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 1283 - Standard for Electromagnetic Interference Filters Current Edition, Including All Revisions.
- G. UL 1449 - Standard for Surge Protective Devices Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Dewberry Engineers, Inc. of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.6 SUBMITTALS

A. See Section 01300 - Administrative Requirements, for submittal procedures.

B. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

SPDs with EMI/RFI filter: Include noise attenuation performance.

C. Shop Drawings: Include wiring diagrams showing all factory and field connections with wire and circuit breaker/fuse sizes.

D. Certificates: Manufacturer's documentation of listing for compliance with the following standards:

1. UL 1449.
2. UL 1283 (for Type 2 SPDs).

E. Field Quality Control Test Reports.

F. Manufacturer's Installation Instructions: Include application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

G. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.

H. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

I. Project Record Documents: Record actual connections and locations of surge protective devices.

1.7 QUALITY ASSURANCE

A. Comply with requirements of NFPA 70.

B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.

C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years' experience.

D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND PROTECTION

A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.9 FIELD CONDITIONS

A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

A. See Section 01780 - Closeout Submittals, for additional warranty requirements.

B. Manufacturer's Warranty: Provide minimum five year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.

C. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Field-installed, Externally Mounted Surge Protective Devices:

ABB/GE: www.electrification.us.abb.com/#sle.

Current Technology; a brand of Thomas & Betts Power Solutions.

nVent ERICO: www.nvent.com/#sle.

Schneider Electric; Square D Brand Surgellogic Products.

Surge Suppression, LLC (SSI): www.surgesuppression.com/#sle.

B. Factory-installed, Internally Mounted Surge Protective Devices:

1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.

C. Substitutions: See Section 016000 - Product Requirements.

D. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

2.2 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.

B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mounted SPDs.

C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.

D. Protected Modes:

Wye Systems: L-N, L-G, N-G, L-L.

Delta Systems: L-G, L-L.

Single Split Phase Systems: L-N, L-G, N-G, L-L.

High Leg Delta Systems: L-N, L-G, N-G, L-L.

E. UL 1449 Voltage Protection Ratings (VPRs):

Equivalent to basis of design.

208Y/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.

240/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.

480Y/277V System Voltage: Not more than 1,500 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.

480V Delta System Voltage: Not more than 1,800 V for L-G mode and 3,000 V for L-L mode.

F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.

G. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

a. Indoor clean, dry locations: Type 1.

b. Outdoor locations: Type 3R.

H. Mounting for Field-installed, Externally Mounted SPDs: Unless otherwise indicated, as specified for the following locations:

Provide surface-mounted SPD where mounted adjacent to surface-mounted equipment.

Provide flush-mounted SPD where mounted adjacent to flush-mounted equipment.

I. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.

Switchgear: See Section 16430.

Switchboards: See Section 16442.

Panelboards: See Section 16443.

Motor Control Centers: See Section 16424.

Busway Plug-in Units: See Section 16451.

2.3 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

A. Surge Protective Device:

Protection Circuits: Field-replaceable modular.

Surge Current Rating: Not less than 240 kA per mode/480 kA per phase.

Repetitive Surge Current Capacity: Not less than 5,000 impulses.

UL 1449 Nominal Discharge Current (I-n): 20 kA.

UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.

EMI/RFI Filtering: Provide EMI/RFI filter to attenuate electrical noise; listed as complying with UL 1283 for Type 2 SPDs.

Noise Attenuation: Not less than 40 dB at 100 kHz using MIL-STD-220 insertion loss test method.

Diagnostics:

Protection Status Monitoring: Provide indicator lights to report the protection for each phase.

Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.

Remote Status Monitoring: Provide Form C dry type contacts (normally open and normally closed) for remote annunciation of status.

Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.

Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch.

2.4 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

A. Distribution locations include SPDs connected to distribution panelboards, motor control centers, and busway.

B. Surge Protective Device:

1. Protection Circuits: Field-replaceable modular or non-modular.
2. Surge Current Rating: Not less than 160 kA per mode/320 kA per phase.
3. Repetitive Surge Current Capacity: Not less than 3,500 impulses.
4. UL 1449 Nominal Discharge Current (I-n): 20 kA.
5. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
6. EMI/RFI Filtering: Provide EMI/RFI filter to attenuate electrical noise; listed as complying with UL 1283 for Type 2 SPDs.
7. Noise Attenuation: Not less than 40 dB at 100 kHz using MIL-STD-220 insertion loss test method.
8. Diagnostics:
9. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.
10. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
11. Remote Status Monitoring: Provide Form C dry type contacts (normally open and normally closed) for remote annunciation of status.
12. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.

13. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch.

2.5 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

A. Surge Protective Device:

1. Protection Circuits: Field-replaceable modular.
2. Surge Current Rating: Not less than 80 kA per mode/160 kA per phase.
3. Repetitive Surge Current Capacity: Not less than 2,000 impulses.
4. UL 1449 Nominal Discharge Current (I-n): 20 kA.
5. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
6. EMI/RFI Filtering: Provide EMI/RFI filter to attenuate electrical noise; listed as complying with UL 1283 for Type 2 SPDs.
7. Noise Attenuation: Not less than 40 dB at 100 kHz using MIL-STD-220 insertion loss test method.
8. Diagnostics:
9. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.
10. Alarm Notification: Provide indicator light and audible alarm to report alarm condition.
Provide button to manually silence audible alarm.
11. Remote Status Monitoring: Provide Form C dry type contacts (normally open and normally closed) for remote annunciation of status.
12. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six digit LCD display that indicates quantity of surge events.
13. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch.

2.6 Powerline cord/direct-wired (120 VAC) suppressors:

- A. Suppressors shall consist of a three-stage hybrid design. First stage M.O.V., second stage air-core 300 uh inductor, and third stage silicon avalanche diode.
- B. The suppressor shall provide certified test data confirming a fail short failure mode
- C. Suppressor shall provide three suppression modes. Line to neutral, line to ground, and neutral to ground.
- D. Suppressor shall provide a maximum single impulse current rating of 10,000 amperes (8 x 20 us - waveform) per mode.
- E. Suppressor shall provide a pulse life rating of 3,000 amperes (8 x 20 us - waveform) every thirty (30) seconds for 2,000 occurrences.
- F. Suppressors maximum clamping voltage when subjected to the ANSI/IEEE C62.41 - 1980, Cat. B (6kv-1.2 x 50 us, 3kA impulse) shall not exceed 450 Volts peak.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
- C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.
- D. Verify system grounding and bonding is in accordance with Section 16060, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.

- E. Provide conductors with minimum ampacity as indicated on the drawings.
- F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.
- G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 16060 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.
- H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.3 Electronic Power Supply:

- A. Install one each powerline cord or direct-wired branch circuit suppressor between each equipment item and its power supply conductors as follows:
 - 1. Fire Alarm Master Panel
 - 2. Building Management System headend
 - 3. Security System headend
 - 4. Telephone switch
- B. Install suppressor according to manufacturer's recommendations.

3.4 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Section 7.19.1.
- D. Provide and install surge protection devices to meet the requirements of Section 16610 Lightning Protection for Structures.

3.5 CLEANING

- A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION 16289

SECTION 16423 GENERATOR DOCKING STATIONS

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Generator Docking Stations for low-voltage (600 V and less) applications and associated accessories:
 - 1. Docking Station for portable generator and load bank.
 - 2. Docking Station for portable generator connection.
 - 3. Docking Station for load bank temporary connection
 - 4. Includes service entrance rated stations.

1.02 RELATED REQUIREMENTS

- A. Section 03300 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 16121 - Grounding and Bonding for Electrical Systems.
- C. Section 16136 - Hangers and Supports for Electrical Systems.
- D. Section 16014 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 16210 - Low-Voltage Electrical Service Entrance.
 - 1. Includes Utility Company contact information.
- F. Section 16231 - Engine Generators: For interface with transfer switches.
 - 1. Includes code requirements applicable to work of this section.
 - 2. Includes additional testing requirements.
 - 3. Includes related demonstration and training requirements.
- G. Section 263600 – Transfer Switches

1.03 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- C. NETA ATS - Standard For Acceptance Testing Specifications For Electrical Power Equipment And Systems 2021.
- D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 99 - Health Care Facilities Code 2021, with Amendment.
- F. NFPA 110 - Standard for Emergency and Standby Power Systems 2022.
- G. UL 489 - Reference Standard for Molded Case Circuit Breakers.
- H. UL 1008 - Transfer Switch Equipment Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate compatibility of docking station to be installed with work provided under other sections or by others.
 - a. Engine Generators: See Section 16231.
 - b. Transfer Switches.
 - 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
 - 5. Notify Dewberry Engineers, Inc. of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

- B. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

1.05 SUBMITTALS

- A. See Section 013000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.
 - 1. Where applicable, include characteristic trip curves for overcurrent protective devices upon request.
- C. Shop Drawings: Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
 - 1. Clearly indicate whether proposed short circuit current ratings are based on testing with specific overcurrent protective devices or time durations; indicate short-time ratings where applicable.
 - 2. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Specimen Warranty: Submit sample of manufacturer's warranty.
- F. Evidence of qualifications for installer.
- G. Evidence of qualifications for maintenance contractor (if different entity from installer).
- H. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and operation of product.
- I. Manufacturer's certification that products meet or exceed specified requirements.
- J. Source quality control test reports.
- K. Manufacturer's detailed field-testing procedures.
- L. Field quality control test reports.
- M. Operation and Maintenance Data: Include detailed information on system operation, equipment programming and setup, replacement parts, and recommended maintenance procedures and intervals.
 - 1. Include contact information for entity that will be providing contract maintenance and trouble call-back service.
- N. Executed Warranty: Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.
- O. Maintenance contracts.
- P. Project Record Documents: Record actual locations of system components, installed circuiting arrangements and routing, and final equipment settings.
- Q. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 016000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Comply with the following:
 - 1. NFPA 70 (National Electrical Code).
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum five years' experience.
 - 1. Authorized service facilities located within 200 miles (320 km) of project site.

- D. Installer Qualifications: Company specializing in performing the work of this section with minimum three years documented experience with generator docking station systems of similar size, type, and complexity; manufacturer's authorized installer.
- E. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
 - 1. Contract maintenance office located within 200 miles (320 km) of project site.
- F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store docking stations in accordance with manufacturer's instructions.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's instructions to avoid damage to docking station switch components, enclosure, and finish.

1.08 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide minimum one year manufacturer warranty covering repair or replacement due to defective materials or workmanship.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Docking Stations:
 - 1. ESL Power Systems
 - 2. Trystar
 - 3. ASCO Power Technologies.
- B. Substitutions: See Section 016000 - Product Requirements.
- C. Source Limitations: Furnish generator docking stations and accessories produced by a single manufacturer and obtained from a single supplier.

2.02 TEMPORARY LOAD BANK AND GENERATOR DOCKING STATION

- A. Provide complete generator docking station suitable for permanent generator load bank testing and a backup portable generator.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Applications:
 - 1. Utilize mechanically interlocked mechanism to prevent cross-connecting power sources.
 - 2. Provide dry contact for annunciator circuit.
 - 3. Provide 3 pole circuit breakers for disconnecting means.
 - a. Circuit breaker to be 100% rated.
 - b. Circuit breaker to provide long time and instantaneous adjustable trip.
 - c. Provide ground fault protection where indicated.
 - 4. Provide color-coded series 16 cam style connectors for generator (male) and load bank (female) connection.
 - 5. Provide acceptance of signal from facility automatic transfer switch. Signaling from the transfer switch of a transfer to emergency power to immediately disconnect any load bank connection.

6. Voltage: As indicated on the drawings.
7. Ampere Rating: As indicated on the drawings.
8. Neutral Configuration: Solid neutral (unswitched), except as indicated.
9. Provide phase rotation monitor.
10. Provide pilot lights to indicate the following:
 - a. Primary Source Available
 - b. Alternate Source Available
11. Provide Surge Protection Device.

2.03 TEMPORARY GENERATOR DOCKING STATION:

- A. Provide complete generator docking station suitable for backup portable generator.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Applications:
 1. Utilize mechanically interlocked mechanism to prevent cross-connecting power sources.
 2. Provide dry contact for annunciator circuit.
 3. Provide 3 pole circuit breakers for disconnecting means.
 - a. Circuit breaker to be 100% rated.
 - b. Circuit breaker to provide long time and instantaneous adjustable trip.
 - c. Provide ground fault protection where indicated.
 4. Provide color-coded series 16 cam style connectors for generator (male) connection.
 5. Voltage: As indicated on the drawings.
 6. Ampere Rating: As indicated on the drawings.
 7. Neutral Configuration: Solid neutral (unswitched), except as indicated.
 8. Provide phase rotation monitor.
 9. Provide pilot lights to indicate the following:
 - a. Primary Source Available
 - b. Alternate Source Available
 10. Provide Surge Protection Device.

2.04 TEMPORARY LOAD BANK DOCKING STATION:

- A. Provide complete generator docking station suitable for connection of temporary load bank for permanent generator testing.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Applications:
 1. Utilize mechanically interlocked mechanism to prevent cross-connecting power sources.
 2. Provide dry contact for annunciator circuit.
 3. Provide 3 pole circuit breakers for disconnecting means.
 - a. Circuit breaker to be 100% rated.
 - b. Circuit breaker to provide long time and instantaneous adjustable trip.
 - c. Provide ground fault protection where indicated.
 4. Provide color-coded series 16 cam style connectors for generator (male) connection.
 5. Voltage: As indicated on the drawings.
 6. Ampere Rating: As indicated on the drawings.
 7. Neutral Configuration: Solid neutral (unswitched), except as indicated.
 8. Provide phase rotation monitor.
 9. Provide pilot lights to indicate the following:
 - a. Primary Source Available
 - b. Alternate Source Available
 10. Provide Surge Protection Device.

2.05 ALL DOCKING STATIONS

- A. Seismic Qualification: Provide docking stations and associated components suitable for application .

- B. Service Conditions: Provide generator docking stations suitable for continuous operation at indicated ratings under the service conditions at the installed location.
- C. Enclosures:
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Outdoor Locations: Type 3R or Type 4.
 - 2. Provide lockable door(s) for outdoor locations.
 - 3. Finish: Manufacturer's standard unless otherwise indicated.
- D. Short Circuit Current Rating:
 - 1. Withstand and Closing Rating: Provide generator docking stations with listed withstand rating not less than the available fault current at the installed location as indicated on the drawings.
- E. Provide service entrance rating where indicated on the drawings.

2.06 SOURCE QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Perform production tests on docking station at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of generator docking stations are consistent with the indicated requirements.
- C. Verify that rough-ins for field connections are in the proper locations.
- D. Verify that mounting surfaces are ready to receive generator docking stations.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required support and attachment in accordance with Section 16136.
- E. Install docking stations plumb and level.
- F. Unless otherwise indicated, mount floor-mounted docking stations on properly sized 4-inch-high concrete pad constructed in accordance with Section 03300.
- G. Provide grounding and bonding in accordance with Section 16121.
- H. Identify docking stations and associated system wiring in accordance with Section 16014.

3.03 FIELD QUALITY CONTROL

- A. See Section 014000 - Quality Requirements, for additional requirements.
- B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.
- C. Prepare and start system in accordance with manufacturer's instructions.
- D. Generator Docking Stations:
 - 1. Inspect and test in accordance with NETA ATS, except Section 4.
 - 2. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The insulation-resistance tests listed as optional are not required.

- a. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- E. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- F. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.04 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05 CLOSEOUT ACTIVITIES

- A. See Section 017800 - Closeout Submittals, for closeout submittals.
- B. See Section 017900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of generator docking station to Owner, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of docking station.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Instructor: Manufacturer's authorized representative.
 - 3. Location: At project site.
- E. Coordinate with related generator demonstration and training as specified in Section 16231.

3.06 PROTECTION

- A. Protect installed docking station from subsequent construction operations.

END OF SECTION 16423

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section includes distribution panelboards and lighting and appliance branch-circuit panelboards.

1.2 SUBMITTALS

- A. Product Data: For each type of panelboard, overcurrent protective device, accessory, and component indicated. Include dimensions and manufacturers' technical data on features, performance, electrical characteristics, ratings, and finishes.
- B. Shop Drawings: For each panelboard and related equipment.
 - 1. Dimensioned plans, elevations, sections, and details. Show tabulations of installed devices, equipment features, and ratings. Include the following:
 - a. Enclosure types and details for types other than NEMA 250, Type 1.
 - b. Bus configuration, current, and voltage ratings.
 - c. Short-circuit current rating of panelboards and overcurrent protective devices.
 - d. Features, characteristics, ratings, and factory settings of individual overcurrent protective devices and auxiliary components.

1.3 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- B. Comply with NEMA PB 1.
- C. Comply with NFPA 70.

PART 2 - PRODUCTS

2.1 MANUFACTURED UNITS

- A. Enclosures: Flush- and surface-mounted cabinets. NEMA PB 1, Type 1.
 - 1. Rated for environmental conditions at installed location.
 - a. Outdoor Locations: NEMA 250, Type 3R.
 - 2. Front: Secured to box with concealed trim clamps. For surface-mounted fronts, match box dimensions; for flush-mounted fronts, overlap box.
- B. Phase and Ground Buses: Hard-drawn copper, 98 percent conductivity.
- C. Conductor Connectors: Suitable for use with conductor material.
 - 1. Ground Lugs and Bus Configured Terminators: Compression type.

- D. Service Equipment Label: UL labeled for use as service equipment for panelboards with main service disconnect switches.
- E. Future Devices: Mounting brackets, bus connections, and necessary appurtenances required for future installation of devices.
- F. Panelboard Short-Circuit Rating:
 - 1. Fully rated to interrupt symmetrical short-circuit current available at terminals.

2.2 DISTRIBUTION PANELBOARDS

- A. Doors: Secured with vault-type latch with tumbler lock; keyed alike. Omit for fused-switch panelboards.
- B. Main Overcurrent Protective Devices: Circuit breaker.
- C. Branch Overcurrent Protective Devices:
 - 1. For Circuit-Breaker Frame Sizes 125 A and Smaller: Bolt-on circuit breakers.
 - 2. For Circuit-Breaker Frame Sizes Larger Than 125 A: Bolt-on circuit breakers; plug-in circuit breakers where individual positive-locking device requires mechanical release for removal.

2.3 LIGHTING AND APPLIANCE BRANCH-CIRCUIT PANELBOARDS

- A. Branch Overcurrent Protective Devices: Bolt-on circuit breakers, replaceable without disturbing adjacent units.
- B. Doors: Concealed hinges; secured with flush latch with tumbler lock; keyed alike.

2.4 OVERCURRENT PROTECTIVE DEVICES

- A. Molded-Case Circuit Breaker: UL 489, with interrupting capacity to meet available fault currents.
 - 1. Thermal-Magnetic Circuit Breakers: Inverse time-current element for low-level overloads, and instantaneous magnetic trip element for short circuits. Adjustable magnetic trip setting for circuit-breaker frame sizes 250 A and larger.
 - 2. GFCI Circuit Breakers: Single- and two-pole configurations with 5-mA trip sensitivity.
 - 3. Molded-Case Circuit-Breaker Features and Accessories: Standard frame sizes, trip ratings, and number of poles.
 - a. Lugs: Compression style, suitable for number, size, trip ratings, and conductor materials.
 - b. Application Listing: Appropriate for application; Type SWD for switching fluorescent lighting loads; Type HACR for heating, air-conditioning, and refrigerating equipment.
 - c. Shunt Trip: 120-V trip coil energized from separate circuit, set to trip at 55 percent of rated voltage.
- B. Fused Switch: NEMA KS 1, Type HD; clips to accommodate specified fuses; lockable handle.
- C. Fuses are specified in Division 16 Section "Fuses."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install panelboards and accessories according to NEMA PB 1.1.
- B. Mount top of trim 74 inches (1880 mm) above finished floor, unless otherwise indicated.
- C. Mount plumb and rigid without distortion of box. Mount recessed panelboards with fronts uniformly flush with wall finish.
- D. Install overcurrent protective devices and controllers.
 - 1. Set field-adjustable switches and circuit-breaker trip ranges.
- E. Install filler plates in unused spaces.
- F. Identify field-installed conductors, interconnecting wiring, and components; provide warning signs as specified in Division 16 Section "Electrical Identification."
- G. Panelboard Nameplates: Label each panelboard with engraved metal or laminated-plastic nameplate mounted with corrosion-resistant screws.
- H. Ground equipment according to Division 16 Section "Grounding and Bonding."
- I. Connect wiring according to Division 16 Section "Conductors and Cables."

3.2 FIELD QUALITY CONTROL

- A. Prepare for acceptance tests as follows:
 - 1. Test insulation resistance for each panelboard bus, component, connecting supply, feeder, and control circuit.
 - 2. Test continuity of each circuit.
- B. Perform the following field tests and inspections and prepare test reports:
 - 1. Perform each electrical test and visual and mechanical inspection stated in NETA ATS, Section 7.5 for switches and Section 7.6 for molded-case circuit breakers. Certify compliance with test parameters.
 - 2. Correct malfunctioning units on-site, where possible, and retest to demonstrate compliance; otherwise, replace with new units and retest.

END OF SECTION 16442

SECTION 16460 – DRY TYPE TRANSFORMERS

PART 1 GENERAL

1.1 SCOPE:

- A. Dry type transformers.
- B. Provide shop drawings.

PART 2 PRODUCTS

2.01 SERVICE AND RATINGS:

- A. Transformers ventilated, for indoor service unless shown exterior, single or three phase as shown, with KVA rating shown.
- B. Voltage for 3 phase units 480V to 120/208V, three phase, four wire. Voltage of single phase units 480V to 120/240V, single phase, three wire. All units equipped with 2-2-1/2% FCBN and 2-2-1/2% FCAN taps, Special voltage transformation as shown.

2.02 INSULATION:

- A. Class-220 insulation, 115 degree C rise above 40 degree C ambient unless shown otherwise.

2.03 SOUND RATING:

- A. Maximum design sound level:

<u>K V A</u>	<u>DESIGN SOUND LEVEL</u>
0-9.0	40 db
10-50	45 db
51 - 150	50 db
167 - 300	55 db
301 - 500	60 db

- B. Sound levels determined per NEMA and ASA Standards. Mount core and coils on vibration isolator pads.

2.04 MANUFACTURERS:

- A. G.E., Eaton, Square "D", Siemens.

PART 3 EXECUTION

3.01 MOUNTING:

- A. Transformers must be floor mounted on a 4" housekeeping pad unless noted to be ceiling hung on the drawings. Ceiling hung transformers may be suspended from building structural members on 4 steel rods unless shown otherwise. Mount height as directed. Provide extra supports required due to size and weight. No units wall mounted except as shown.
- B. Use extreme care to eliminate noise and vibration. Suspended units; install in each rod, Amber/Booth type PBSR or Consolidated Kinetics type SRH vibration isolator size as directed.

- C. Floor mounted units shall be mounted on spring isolators. Use seal-tight flexible conduit for final connections to transformers.
- D. Shop drawings for each transformer to show physical size, conduit and cable space, connection diagrams, specified requirements, impedance, and maximum current inrush at rated voltage.
- E. Unless labeled otherwise, transformer ventilation openings should be located at least 0' - 6" away from walls or other obstructions to allow free circulation of air through and around each unit.
- F. Shop drawings for each transformer to show physical size, conduit and cable space, connection diagrams, specified requirements, impedance, and maximum current inrush at rated voltage.
- G. Provide with nameplate per 16014 - Electrical Identification.

END OF SECTION 16460

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK:

- A. Furnish and install all lighting luminaires, with all necessary accessories and lamps, as shown, specified, and/or scheduled.

1.2 RELATED SECTIONS:

- A. See Section for Lighting Control Systems.
- B. See Section 16010 or Section 16012 for requirement for submittals.
- C. See Division 1 for allowances and Owner-furnished items to be installed under this Section.

1.3 ABBREVIATIONS:

- A. H.I.D. - High Intensity Discharge (High Pressure Sodium, Mercury Vapor, Metal Halide)

1.4 SUBMITTALS:

- A. Shop drawing submittals for luminaires shall include the following for each luminaire: complete construction details including all dimensions, complete description of materials used, complete electrical data (including operating voltage), photometric test report from an independent testing lab, complete description of finish, and manufacturer catalog cutsheet of lamp to be used.

PART 2 - PRODUCTS

2.1 LUMINAIRES:

- A. Furnish and install luminaires as shown in luminaire schedule, or otherwise indicated on the drawings. Manufacturer catalog numbers shown are for general descriptive purposes only, and are intended only to establish the standard of quality.
- B. Locations of luminaires on electrical drawings are diagrammatic. Verify location of luminaires with architectural drawings prior to installation. Conflicts between electrical and architectural drawings shall be referred to the Architect for resolution.
- C. Provide luminaires complete with all options, accessories and other appurtenances required for a complete installation. Contractor shall verify type of ceiling and wall construction being installed, and provide luminaires properly configured for the type of construction.
- D. All luminaires shall be UL listed for the application being installed.
- E. Exit signs shall be furnished with 6" high letters with 3/4" stroke. Verify color of signage required by local code authorities. Signs shall meet all NFPA, UL and local building code requirements.

- F. Pendant stem mounted luminaires shall be furnished with ball aligner swivel, 30 degrees from vertical minimum, with swivel below canopy, with ½" diameter metal tube (stem).
- G. Plastic lenses and shielding shall meet NFPA and local building code requirements for light transmitting plastics.
- H. Metal luminaire housings shall be free of tool marks, dents, burrs and sharp edges. All metal parts shall be painted, galvanized, or otherwise corrosion-resistant.
- I. Reflector surfaces shall be finished specular, semi-specular, diffuse or painted as indicated. Specular finish materials shall have a minimum reflectance value of 83%. Semi-specular or diffuse finish shall have reflectance of 75% and white painted finish materials shall have reflectance of 88%.
- J. Luminaire support wires shall be zinc-coated, soft temper ASTM A641/A641M steel, 12 gage.
- K. Luminaires with aircraft cable suspension system shall use 1/16" diameter (minimum) stainless steel aircraft cable and adjustable cable gripper with swaged cable stop at ceiling canopy. Cable size shall be selected by luminaire manufacturer to provide adequate support.

2.2 LEDS:

- A. Components: UL 8750 recognized or listed as applicable.
- B. Tested in accordance with IES LM-79 and IES LM-80
- C. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance,
- D. All LED's shall be sorted and provided to have ANSI McAdam Ellipse standard deviation color matching (SDCM) of 2 or better.

2.3 EMERGENCY LIGHTING:

- A. Provide luminaires and exit signs with self-contained battery power supplies as indicated. All equipment shall conform to UL924-Emergency Lighting and Power Equipment.
- B. Battery shall be sealed, maintenance-free lead-acid type (indoors) or nickel-cadmium (outdoors or unconditioned spaces) with 10-year nominal life. Unit shall incorporate a fully-automatic solid state charger and automatic transformer relay to transformer to backup battery power supply upon failure of normal power.
- C. All emergency lighting equipment shall be equipped with means to test operation and an LED indicating battery status.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Support luminaires from structure of the building, independent from the ceiling membrane or finish material. Luminaire shall be set level, plumb, and square with ceilings and walls.

- B. Recessed lay-in luminaires in suspended grid ceilings shall be supported from the ceiling grid. Provide devices for securing the luminaire to the ceiling grid to comply with the National Electrical Code ("earthquake clips"). Luminaires heavier than 30 pounds shall have supplemental support wires anchored to the structure above the ceiling. Provide independent support wires, anchored to structure above and attached to fixture at each corner.
- C. Recessed luminaires in fire-rated ceiling assemblies shall be installed in accordance with the UL listing of the assembly.
- D. Recessed luminaires (non lay-in or hard ceiling types) shall be supported by $\frac{3}{4}$ " steel ceiling channel, or factory-supplied hanger bars one on each side of the luminaire, anchored to ceiling structure. Recessed luminaires heavier than 20 pounds shall have supplemental support anchored to the structure above the ceiling. Do not use conduit to support luminaire.
- E. Provide recessed luminaires with appropriate frames, hardware and trim for the ceiling installed.
- F. Install luminaires free and clear of structural and mechanical interferences above the ceiling. If location indicated on the drawing conflicts with other elements, notify the Architect for directions for remedial action.
- G. Attach surface and pendant mounted luminaires to $\frac{3}{16}$ " fixture stud in outlet box. Luminaires in excess of 20 pounds shall have supplemental support anchored to the structure above the ceiling.
- H. Luminaires surface mounted to grid-type ceilings shall be mounted with Caddy IDS type clips anchored to structure above.
- I. Wall mounted luminaires shall be anchored to wall structure. Luminaire shall fully conceal the outlet box.
- J. Wiring to luminaires shall be with flexible metallic conduit to junction box. Do not wire luminaire to luminaire unless noted otherwise, or if using manufactured wiring systems.
- K. Individual flexible connections under 6 feet in length shall consist of 2#14 and 1#14 (ground) in $\frac{3}{8}$ " flexible metallic conduit (for circuits 20A or less). Bond ground wire and conduit at each end.
- L. Recessed luminaires in insulated ceilings shall be installed so that insulation is no less than 3 inches away from the fixture enclosure unless the luminaire is listed for direct contact with insulation (IC rated).
- M. Provide equipment, labor and materials, as needed for final aiming of adjustable luminaires. Aiming shall take place immediately before final occupancy by the Owner.
- N. Reflectors, trim cones, and other visible trim of luminaires shall not be installed until completion of ceiling work, and shall be clean and free of dust, fingerprints, scratches, dents etc. upon substantial completion.

END OF SECTION 16510

SECTION 16703 FIRE DETECTION AND ALARM

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Fire alarm system design and installation, including all components, wiring, and conduit.
- B. Transmitters for communication with supervising station.
- C. Circuits from protected premises to supervising station, including conduit.
- D. Replacement and removal of existing fire alarm system components, wiring, and conduit indicated.
- E. Maintenance of fire alarm system under contract for specified warranty period.

1.02 RELATED REQUIREMENTS

- A. Section 07840 - Firestopping: Materials and methods for work to be performed by this installer.
- B. Designed using manufacturer's product-specific design software or based on manufacturer's pre-engineered design suitable for the application.
- C. Section 08710 - Door Hardware: Electrically operated locks and door holder devices to be monitored and released by fire alarm system.
- D. Section 15311 - Fire-Suppression Sprinkler Systems: Supervisory, alarm, and actuating devices installed in sprinkler system.
- E. Section 15350 - Fire Pumps: Supervisory devices.
- F. Section 15820 - Air Duct Accessories: Smoke dampers monitored and controlled by fire alarm system.
- G. Section 16010- Common Work Results for Electrical Systems
- H. Section 16120- Low-Voltage Electrical Power Conductors and Cables
- I. Section 16121- Grounding and Bonding for Electrical Systems
- J. Section 16110 Conduit for Electrical Systems
- K. Section 16030 Boxes for Electrical Systems
- L. Section 16014 – Identification for Electrical Systems.

1.03 REFERENCE STANDARDS

- A. 36 CFR 1191 - Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities; Architectural Barriers Act (ABA) Accessibility Guidelines current edition.
- B. ADA Standards - 2010 ADA Standards for Accessible Design 2010.
- C. IEEE C62.41.2 - IEEE Recommended Practice on Characterization of Surges in Low-Voltage (1000 V and less) AC Power Circuits 2002 (Corrigendum 2012).
- D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. NFPA 72 - National Fire Alarm and Signaling Code Most Recent Edition Cited by Referring Code or Reference Standard.
- F. NFPA 76 - Standard for the Fire Protection of Telecommunications Facilities 2020.
- G. NFPA 99: Health Care Facilities Code.
- H. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. NFPA 601 - Standard for Security Services in Fire Loss Prevention 2020.
- J. NFPA 1221- Standard for the Installation, Maintenance, and Use of Emergency Services Communications Systems.
- K. UL 38 – Standard for Manual Signaling Boxes for Fire Alarm Systems

- L. UL 268 - Standard for Smoke Detectors for Fire Alarm Systems Current Edition, Including All Revisions.
- M. UL 1480 - Speakers for Fire Alarm and Signaling Systems

1.04 SUBMITTALS

- A. See Section 01300 - Administrative Requirements, for submittal procedures.
- B. Proposal Documents: Submit the following with cost/time proposal:
 - 1. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 2. Manufacturer's detailed data sheet for each control unit, initiating device, and notification appliance.
 - 3. Certification by Contractor that the system design will comply with Contract Documents.
 - 4. Proposed maintenance contract.
- C. Drawings must be prepared using AutoCAD Release 2010 or Newer.
 - 1. Owner will provide floor plan drawings for Contractor's use; verify all dimensions on Owner-provided drawings.
- D. Evidence of designer qualifications.
- E. Design Documents: Submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, riser diagrams, and description of operation:
 - 1. Copy (if any) of list of data required by authority having jurisdiction.
 - 2. NFPA 72 "Record of Completion", filled out to the extent known at the time.
 - 3. Clear and concise description of operation, with input/output matrix like that shown in NFPA 72 Appendix A-7-5-2.2(9), and complete listing of software required.
 - 4. System zone boundaries and interfaces to fire safety systems.
 - 5. Location of all components, circuits, and raceways; mark components with identifiers used in control unit programming.
 - 6. Circuit layouts; number, size, and type of raceways and conductors; conduit fill calculations; spare capacity calculations; notification appliance circuit voltage drop calculations.
 - 7. List of all devices on each signaling line circuit, with spare capacity indicated.
 - 8. Manufacturer's detailed data sheet for each component, including wiring diagrams, installation instructions, and circuit length limitations.
 - 9. Air-Sampling Smoke Detection Systems: Include air-sampling pipe network layout with sampling ports identified; include calculations demonstrating compliance with specified requirements.
 - 10. Description of power supplies; if secondary power is by battery include calculations demonstrating adequate battery power.
 - 11. Detailed drawing of graphic annunciator(s).
 - 12. Certification by either the manufacturer of the control unit or by the manufacturer of each other component that the components are compatible with the control unit.
 - 13. Certification by the manufacturer of the control unit that the system design complies with Contract Documents.
 - 14. Certification by Contractor that the system design complies with Contract Documents.
 - 15. Do not show existing components to be removed.
- F. Manufacturer's equipment seismic qualification certification.
- G. Evidence of installer qualifications.
- H. Evidence of instructor qualifications; training lesson plan outline.
- I. Evidence of maintenance contractor qualifications, if different from installer.
- J. Inspection and Test Reports:
 - 1. Submit inspection and test plan prior to closeout demonstration.
 - 2. Submit documentation of satisfactory inspections and tests.

3. Submit NFPA 72 "Inspection and Test Form," filled out.
- K. Operating and Maintenance Data: See Section 017800 for additional requirements; revise and resubmit until acceptable; have one set available during closeout demonstration:
 1. Original copy of NFPA 72 with portions that are not relevant to this project neatly crossed out by hand; label with project name and date.
 2. Complete set of specified design documents, as approved by authority having jurisdiction.
 3. Additional printed set of project record documents and closeout documents, bound or filed in same manuals.
 4. Contact information for firm that will be providing contract maintenance and trouble call-back service.
 5. List of recommended spare parts, tools, and instruments for testing.
 6. Replacement parts list with current prices, and source of supply.
 7. Detailed troubleshooting guide and large scale input/output matrix.
 8. Preventive maintenance, inspection, and testing schedule complying with NFPA 72; provide printed copy and computer format acceptable to Owner.
 9. Detailed but easy to read explanation of procedures to be taken by non-technical administrative personnel in the event of system trouble, when routine testing is being conducted, for fire drills, and when entering into contracts for remodeling.
- L. Project Record Documents: See Section 017800 for additional requirements; have one set available during closeout demonstration:
 1. Complete set of floor plans showing actual installed locations of components, conduit, and zones.
 2. "As installed" wiring and schematic diagrams, with final terminal identifications.
 3. "As programmed" operating sequences, including control events by device, updated input/output chart, and voice messages by event.
- M. Closeout Documents:
 1. Certification by manufacturer that the system has been installed in compliance with manufacturer's installation requirements, is complete, and is in satisfactory operating condition.
 2. NFPA 72 "Record of Completion", filled out completely and signed by installer and authorized representative of authority having jurisdiction.
 3. Certificate of Occupancy.
 4. Maintenance contract.
 5. Report on training results.
- N. Maintenance Materials, Tools, and Software: Furnish the following for Owner's use in maintenance of project.
 1. See Section 016000 - Product Requirements, for additional provisions.
 2. Furnish spare parts of same manufacturer and model as those installed; deliver in original packaging, labeled in same manner as in operating and maintenance data and place in spare parts cabinet.
 3. In addition to the items in quantities indicated in PART 2, furnish the following:
 - a. All tools, software, and documentation necessary to modify the fire alarm system using Owner's personnel; minimum modification capability to include addition and deletion of devices, circuits, and zones, and changes to system description, operation, and evacuation and instructional messages.
 - b. One copy, on CD-ROM, of all software not resident in read-only-memory.
 - c. Extra Fuses: Two for each installed fuse; store inside applicable control cabinet.

1.05 QUALITY ASSURANCE

- A. Copies of Design Criteria Documents: Maintain at the project site for the duration of the project, bound together, an original copy of NFPA 72, the relevant portions of applicable codes, and instructions and guidelines of authorities having jurisdiction; deliver to Owner upon completion.

- B. Designer Qualifications: NICET Level III or IV (3 or 4) certified fire alarm technician or registered fire protection engineer, employed by fire alarm control panel manufacturer, Contractor, or installer, with experience designing fire alarm systems in the jurisdictional area of the authorities having jurisdiction.
- C. Installer Qualifications: Firm with minimum 3 years documented experience installing fire alarm systems of the specified type and providing contract maintenance service as a regular part of their business.
 - 1. Authorized representative of control unit manufacturer; submit manufacturer's certification that installer is authorized; include name and title of manufacturer's representative making certification.
 - 2. Installer Personnel: At least 2 years of experience installing fire alarm systems.
 - 3. Supervisor: NICET level III or IV (3 or 4) certified fire alarm technician; furnish name and address.
 - 4. Contract maintenance office located within 50 miles (80 km) of project site.
 - 5. Certified in the State in which the Project is located as fire alarm installer.
- D. Maintenance Contractor Qualifications: Same entity as installer or different entity with specified qualifications.
- E. Instructor Qualifications: Experienced in technical instruction, understanding fire alarm theory, and able to provide the required training; trained by fire alarm control unit manufacturer.
- F. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.06 WARRANTY

- A. See Section 017800 - Closeout Submittals, for additional warranty requirements.
- B. Provide control panel manufacturer's warranty that system components other than wire and conduit are free from defects and will remain so for 1 year after date of Substantial Completion.
- C. Provide installer's warranty that the installation is free from defects and will remain so for 1 year after date of Substantial Completion.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Fire Alarm Control Units and Accessories:
 - 1. Honeywell Security & Fire Solutions/Notifier.
 - 2. Siemens Building Technologies, Inc.
 - 3. Edwards
 - 4. Provide control units made by the same manufacturer.
- B. Initiating Devices and Notification Appliances:
 - 1. Provide initiating devices and notification appliances made by the same manufacturer, as the control unit.
- C. Substitutions: See Section 016000 - Product Requirements.
 - 1. For other acceptable manufacturers of control units specified, submit product data showing equivalent features and compliance with Contract Documents.
 - 2. For substitution of products by manufacturers not listed, submit product data showing features and certification by Contractor that the design will comply with Contract Documents.

2.02 FIRE ALARM SYSTEM

- A. Fire Alarm System: Provide a new fire detection and alarm system:
 - 1. Provide all components necessary, regardless of whether shown in Contract Documents or not.
 - 2. Protected Premises: Entire building shown on drawings.

3. Comply with the following; where requirements conflict, order of precedence of requirements is as listed:
 - a. ADA Standards.
 - b. The requirements of the State Fire Marshal.
 - c. The requirements of the local authority having jurisdiction.
 - d. Applicable local codes.
 - e. Contract Documents (drawings and specifications).
 - f. NFPA 101.
 - g. NFPA 72; where the word "should" is used consider that provision mandatory; where conflicts between requirements require deviation from NFPA 72, identify deviations clearly on design documents.
 4. Evacuation Alarm and Zones: Multiple smoke zones; allow for evacuation notification of any individual zone or combination of zones, in addition to general evacuation of entire premises. Entire building shall be programmed as one evacuation zone.
 5. Initiation: Manual and Automatic.
 6. Notification: Provide one-way intelligible voice and visual alarm communications with multichannel capability; digital.
 7. Program notification zones and voice messages as directed by Owner.
 8. Hearing Impaired Occupants: Provide visible notification devices in all common public areas. Comply with the requirements of the ADA.
 9. Fire Alarm Control Unit: Location indicated on the Drawings.
 10. Reporting to Supervising Station: Dedicated leased telephone lines for connection to a monitoring company service via digital alarm communication transmitter (DACT)
- B. Supervising Stations and Fire Department Connections:
1. Public Fire Department Notification: By on-premises supervising station.
 2. Coordinate with AHJ and State Fire Marshal and provide as required:
 - a. Means of Transmission to Remote Supervising Station: Digital alarm communicator transmitter (DACT), 2 dedicated leased telephone lines.
 - b. Means of Transmission to Remote Supervising Station: Via cellular dialer.
 - c. Means of Transmission to Remote Supervising Station: Primary: Over CAT 6e over to the via ethernet to the IP network. Secondary: Digital alarm communicator transmitter (DACT), with cellular telephone dialer. Provide auxiliary contacts for connection of the DACT and cellular dialer with connections to the battery backup system
- C. Circuits:
1. Initiating Device Circuits (IDC): Class A.
 2. Signaling Line Circuits (SLC) Within Single Building: Class A.
 3. Signaling Line Circuits (SLC) Between Buildings: Class A, Style 2.
 4. Notification Appliance Circuits (NAC): Class A.
- D. Spare Capacity:
1. Initiating Device Circuits: Minimum 25 percent spare capacity.
 2. Notification Appliance Circuits: Minimum 25 percent spare capacity.
 3. Speaker Amplifiers: Minimum 25 percent spare capacity.
 4. Fire Alarm Control Units: Capable of handling all circuits utilized to capacity without requiring additional components other than plug-in control modules.
- E. Power Sources:
1. Primary: Dedicated branch circuits of the facility power distribution system.
 2. Secondary: Storage batteries.
 3. Capacity: Sufficient to operate entire system for period specified by NFPA 72 for minimum 24 hours standby condition and 15 minutes of alarm condition.
 4. Each Computer System: Provide uninterruptible power supply (UPS).

- F. Seismic Qualification: Provide fire alarm system and associated components suitable for application.

2.03 FIRE SAFETY SYSTEMS INTERFACES

- A. Supervision: Provide supervisory signals in accordance with NFPA 72 for the following:
 - 1. Sprinkler water control valves.
 - 2. Sprinkler water storage tank low level.
 - 3. Sprinkler water storage tank low temperature.
 - 4. Fire pump(s).
- B. Alarm: Provide alarm initiation in accordance with NFPA 72. See drawing for matrix.
- C. HVAC:
 - 1. Duct Smoke Detectors: Close dampers indicated; shut down air handlers indicated.
- D. Doors:
 - 1. Smoke Barrier Door Magnetic Holders: Release upon activation of smoke detectors in smoke zone on either side of door, upon alarm from manual pull station on same floor, and upon sprinkler activation on same floor. Refer to Section 087100.
 - 2. Electromagnetic Door Locks on Egress Doors: Unlock upon activation of any alarm initiating device or suppression system in smoke zone that doors serve as egress from. Refer to Section 087100.

2.04 COMPONENTS

- A. General:
 - 1. Provide flush mounted units where installed in finish areas; in unfinished areas, surface mounted unit are acceptable.
 - 2. Provide legible, permanent labels for each control device, using identification used in operation and maintenance data.
- B. Fire Alarm Control Units: Analog, addressable type; listed, classified, and labeled as suitable for the purpose intended.
- C. Addressable Fire Alarm Control Unit:
 - 1. System Capacity: 4,064 addresses; six notification appliance circuits (NACs), expandable to 192; four input/output (I/O) circuits; 1,500 software zones.
 - 2. Voice Integration:
 - a. Support two hours of message storage; internal library of predefined messages and tones; 255 customizable audio patterns; text-to-speech custom text translation.
 - b. Provide supervised low-level auxiliary input to interface with external audio sources and support background music applications.
 - c. Provide eight programmable push buttons for speaker and emergency communication system (ECS) zone assignment, expandable to 104 pushbuttons.
 - d. Support connection of up to 31 single-channel amplifiers (SCA) or dual-channel amplifiers (DCA), 30 Model LOC-1000 local operator consoles, and one Model FFT-1000 firefighter telephone system supporting 24 phone circuits, expandable to 96.
 - 3. Features: Strobe synchronization; dedicated alarm, supervisory and trouble relays; 4,000 event history buffer; built-in IP communicator; Ethernet port for programming and network connectivity; e-mail system status, reports and event information.
 - 4. Features: Strobe synchronization; dedicated alarm, supervisory and trouble relays; 4,000 event history buffer; built-in IP communicator; Ethernet port for programming and network connectivity; e-mail system status, reports and event information.
- D. Addressable Modules:
 - 1. Provide addressable modules suitable for connection to fire alarm control unit signaling line circuits.
 - 2. Unless otherwise indicated, use addressable modules only in clean, dry, indoor, nonhazardous locations.

3. Monitor Modules: Unless devices are explicitly permitted to be connected together as zone, provide separate addressable monitor module for each conventional dry-contact input device in order to be individually identifiable by addressable fire alarm control unit.
 4. Control Modules: Provide as indicated or as required for selective control of notification appliances.
 5. Releasing Control Modules: Provide as indicated or as required for control of listed solenoids in releasing applications.
 6. Relay Modules: Provide as indicated or as required to perform necessary functions via dry-contact interface. Where load exceeds module contact rating, provide accessory power isolation relays suitable for load as required.
 7. Signaling Line Circuit (SLC) Isolating Modules: Provide as indicated or as required to automatically isolate short circuits on connected sections of SLC loops and allow other sections to continue to function normally. Provide automatic reset upon correction of short circuit.
 8. Products:
 - a. Ruskin Company; ADC105 Addressable Damper Controller for Simplex Panels: www.ruskin.com/#sle.
 - b. Substitutions: See Section 016000 - Product Requirements.
- E. Initiating Devices:
1. Addressable Systems:
 - a. Addressable Devices: Individually identifiable by addressable fire alarm control unit.
 - b. Provide suitable addressable interface modules as indicated or as required for connection to conventional (non-addressable) devices and other components that provide a dry closure output.
- F. Manual Pull Stations: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.
1. Single-action mechanism, pull lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 2. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral or attached addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
 3. Station Reset: Key- or wrench-operated switch.
 4. Indoor Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm. Lifting the cover actuates an integral battery-powered audible horn intended to discourage false-alarm operation.
 5. Weatherproof Protective Shield: Factory-fabricated, clear plastic enclosure hinged at the top to permit lifting for access to initiate an alarm.
- G. System Smoke Detectors
1. General Requirements for System Smoke Detectors:
 - a. Comply with UL 268, current accepted edition operating at 24-V dc, nominal.
 - b. Detectors shall be two-wire type,
 - c. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - d. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
 - e. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
 - f. Integral Visual-Indicating Light: LED type, indicating detector has operated and communication status.

- g. Remote Control: Unless otherwise indicated, detectors shall be digital-addressable type, individually monitored at fire-alarm control unit for calibration, sensitivity, and alarm condition and individually adjustable for sensitivity by fire-alarm control unit.
 - h. Rate-of-rise temperature characteristic of combination smoke- and heat-detection units shall be selectable at fire-alarm control unit for 15 or 20 deg F (8 or 11 deg C) per minute.
 - i. Fixed-temperature sensing characteristic of combination smoke- and heat-detection units shall be independent of rate-of-rise sensing and shall be settable at fire-alarm control unit to operate at 135 or 155 deg F (57 or 68 deg C).
 - j. Multiple levels of detection sensitivity for each sensor.
 - k. Sensitivity levels based on time of day.
 - l. If any specialized equipment must be used to program any function of the smoke detector devices, then one must be furnished as part of the system.
- H. Photoelectric Smoke Detectors
- 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector including primary status, device type, present average value, present sensitivity selected, and sensor range (normal, dirty, etc).
- I. Duct Smoke Detectors: Photoelectric type complying with UL 268A
- 1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
 - 2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector including primary status, device type, present average value, present sensitivity selected, and sensor range (normal, dirty, etc),
 - 3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector for smoke detection in HVAC system ducts.
 - 4. Each sensor shall have multiple levels of detection sensitivity.
 - 5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions where applied.
 - 6. Auxiliary function control is to be by discrete addressable control relay.
- J. Carbon Monoxide Detectors
- 1. General: Carbon monoxide detector listed for connection to fire-alarm system.
 - 2. Mounting: Adapter plate for outlet box mounting.
 - a. Testable by introducing test carbon monoxide into the sensing cell.
 - b. Detector shall provide alarm contacts and trouble contacts.
 - c. Detector shall send trouble alarm when nearing end-of-life, power supply problems, or internal faults.
 - d. Comply with UL 2075.
 - e. Locate, mount, and wire according to manufacturer's written instructions.
 - f. Provide means for addressable connection to fire-alarm system.
 - g. Test button simulates an alarm condition.
- K. Multi-Criteria Detectors
- 1. Mounting: Adapter plate for outlet box mounting or Twist-lock base interchangeable with smoke-detector bases.
 - 2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - 3. Automatically adjusts its sensitivity by means of drift compensation and smoothing algorithms. The detector shall send trouble alarm if it is incapable of compensating for existing conditions.
 - 4. Test button tests all sensors in the detector.

5. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector including primary status, device type, present sensitivity selected, and sensor range (normal, dirty, etc.).
6. Sensors: The detectors shall comply with UL 268 7th edition.

L. Heat Detectors

1. General Requirements for Heat Detectors: Comply with UL 521.
 - a. Temperature sensors shall test for and communicate the sensitivity range of the device.
 - b. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.
 - 1) Adapter plate for outlet box mounting or Twist-lock base interchangeable with smoke-detector bases.
 - 2) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - c. Heat Detector, Fixed-Temperature Type: Actuated by temperature that exceeds a fixed temperature of 190 deg F (88 deg C).
 - 1) Mounting: Adapter plate for outlet box mounting or Twist-lock base interchangeable with smoke-detector bases.
 - 2) Integral addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
 - d. Continuous Linear Heat-Detector System:
 - 1) Detector Cable: Rated detection temperature 155 deg F (68 deg C). Listed for "regular" service and a standard environment. Cable includes two steel actuator wires twisted together with spring pressure, wrapped with protective tape, and finished with PVC outer sheath. Each actuator wire is insulated with heat-sensitive material that reacts with heat to allow the cable twist pressure to short circuit wires at the location of elevated temperature.
 - 2) Control Unit: Two-zone or multizone unit as indicated. Provide same system power supply, supervision, and alarm features as specified for fire-alarm control unit.
 - 3) Signals to Fire-Alarm Control Unit: Any type of local system trouble shall be reported to fire-alarm control unit as a composite "trouble" signal. Alarms on each detection zone shall be individually reported to central fire-alarm control unit as separately identified zones.
 - 4) Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

M. Notification Appliances

1. General Requirements for Notification Appliances: Individually addressed, connected to a signaling-line circuit, equipped for mounting as indicated, and with screw terminals for system connections.
2. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated, and with screw terminals for system connections.
3. Visible Notification Appliances: visuals complying with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.
 - a. Rated Light Output: 15/30/5/110/177 per drawings and field selectable.
 - b. Mounting: Wall mounted unless otherwise indicated.
 - c. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
 - d. Flashing shall be in a temporal pattern, synchronized with other units.
 - e. Visuals Leads: Factory connected to screw terminals.
 - f. Mounting Faceplate: Factory finished, [red] [white].

4. Voice/Tone Notification Appliances:
 - a. Comply with UL 1480.
 - b. Speakers for Voice Notification: Locate speakers for voice notification to provide the intelligibility requirements of the "Notification Appliances" and "Emergency Communications Systems" chapters in NFPA 72.
 - c. Speakers:
 - 1) The speaker shall be listed to UL 1480 for Fire Protective Signaling Systems. It shall be a dual-voltage transformer speaker capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.
 - 2) A universal mounting plate shall be used for mounting ceiling and wall speaker products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate.
 - 3) Speakers shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker design shall isolate speaker components to reduce ground fault incidents.
 - 4) The speaker shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction.
 - 5) All notification appliances shall be backward compatible.
5. Speaker Strobes:
 - a. The speaker strobe shall be listed to UL 1971 and UL 1480 and be approved for fire protective signaling systems. It shall be a dual-voltage transformer speaker strobe capable of operation at 25.0 or 70.7 nominal Vrms. The speaker shall have a frequency range of 400 to 4,000 Hz and shall have an operating temperature between 32°F and 120°F. It shall mount to a 4 x 4 x 2 1/8-inch back box.
 - b. A universal mounting plate shall be used for mounting ceiling and wall speaker strobe products. The notification appliance circuit and amplifier wiring shall terminate at the universal mounting plate. If the notification appliances are not UL 9th edition listed with the corresponding panel or power supply being used, then refer to the compatibility listing of the panel to determine maximum devices on a circuit.
 - c. Speaker strobes shall be plug-in and shall have the ability to check wiring continuity via a shorting spring on the universal mounting plate. The shorting spring shall also provide tamper resistance via an open circuit if the device is removed. Speaker strobe design shall isolate speaker components to reduce ground fault incidents.
 - d. The speaker strobe shall have power taps (from ¼ watt to 2 watts) and voltage that are selected by rotary switches. All models shall have a maximum sound output of 86 dB at 10 feet and shall incorporate an open back construction. The strobe shall consist of a xenon flash tube with associated lens/reflector system and operate on either 12V or 24V. The strobe shall also feature selectable candela output, providing options for 15 or 15/75 candela when operating on 12V and 15, 15/75, 30, 75, 110, or 115 when operating on 24V. The strobe shall comply with NFPA 72 and the Americans with Disabilities Act requirement for visible signaling appliances, flashing at 1 Hz over the strobe's entire operating voltage range

N. Remote Annunciator

1. Description: Annunciator functions shall match those of fire-alarm control unit for alarm, supervisory, and trouble indications. Manual switching functions shall match those of fire-alarm control unit, including acknowledging, silencing, resetting, and testing.
 - a. Mounting: Flush or Surface as indicated on the Drawings cabinet, NEMA 250, Type 1.

- b. Display Type and Functional Performance: Alphanumeric display and LED indicating lights shall match those of fire-alarm control unit. Provide controls to acknowledge, silence, reset, and test functions for alarm, supervisory, and trouble signals.
- O. DIGITAL ALARM COMMUNICATOR TRANSMITTER
 - 1. Digital alarm communicator transmitter shall be acceptable to the remote central station and shall comply with UL 632.
 - 2. Functional Performance: Unit shall receive an alarm, supervisory, or trouble signal from fire-alarm control unit and automatically connect to a communications path and dial a preset number for a remote central station. When contact is made with central station(s), signals shall be transmitted. If service on the path is interrupted for longer than 45 seconds, transmitter shall initiate a local trouble signal and transmit the signal indicating loss of path to the remote alarm receiving station over the remaining path. Transmitter shall automatically report service restoration to the central station. If service is lost on both communication paths, transmitter shall initiate the local trouble signal.
 - 3. Local functions and display at the digital alarm communicator transmitter shall include the following:
 - a. Verification that all paths are available.
 - b. Programming device.
 - c. LED Display.
 - d. Manual test report function and manual transmission clear indication.
 - 4. Communications failure with the central station or fire-alarm control unit.
 - 5. Digital data transmission shall include the following:
 - a. Address of the alarm-initiating device.
 - b. Address of the supervisory signal.
 - c. Address of the trouble-initiating device.
 - d. Loss of ac supply.
 - e. Loss of power,
 - f. Low battery.
 - g. Abnormal test signal.
 - h. Communication bus failure.
 - 6. Secondary Power: Integral rechargeable battery and automatic charger.
 - 7. Self-Test: Conducted automatically every 24 hours with report transmitted to central station.
- P. Radio Alarm Transmitter
 - 1. Transmitter shall comply with NFPA 1221 and 47 CFR 90.
 - 2. Description: Manufacturer's standard commercial product; factory assembled, wired, and tested; ready for installation and operation.
 - a. Packaging: A single, modular, NEMA 250, Type 1 metal enclosure with a tamper-resistant flush tumbler lock.
 - b. Signal Transmission Mode and Frequency: VHF or UHF 2-W power output, coordinated with operating characteristics of the established remote alarm receiving station designated by Owner.
 - c. Normal Power Input: 120-V ac.
 - d. Secondary Power: Integral-sealed, rechargeable, 12-V battery and charger. Comply with NFPA 72 requirements for battery capacity; submit calculations.
 - e. Antenna: Omnidirectional, coaxial half-wave, dipole type with driving point impedance matched to transmitter and antenna cable output impedance. Wind-load strength of antenna and mounting hardware and supports shall withstand 100 mph (160 km/h) with a gust factor of 1.3 without failure.
 - f. Antenna Cable: Coaxial cable with impedance matched to the transmitter output impedance.
 - g. Antenna-Cable Connectors: Weatherproof.

- h. Alarm Interface Devices: Circuit boards, modules, and other auxiliary devices, integral to the transmitter, matching fire-alarm and other system outputs to message-generating inputs of the transmitter that produce required message transmissions.
- 3. Functional Performance: Unit shall receive alarm, supervisory, or trouble signal from fire-alarm control unit or from its own internal sensors or controls and shall automatically transmit signal along with a unique code that identifies the transmitting station to the remote alarm receiving station. Transmitted messages shall correspond to standard designations for fire-reporting system to which the signal is being transmitted and shall include separately designated messages in response to the following events or conditions.
 - a. Transmitter Low-Battery Condition: Sent when battery voltage is below 85 percent of rated value.
 - b. System Test Message: Initiated manually by a test switch within the transmitter cabinet, or automatically at an optionally preselected time, once every 24 hours, with transmission time controlled by a programmed timing device integral to transmitter controls.
 - c. Transmitter Trouble Message: Actuated by failure, in excess of one-minute duration, of the transmitter normal power source, derangement of the wiring of the transmitter, or any alarm input interface circuit or device connected to it.
 - d. Local Fire-Alarm-System Trouble Message: Initiated by events or conditions that cause a trouble signal to be indicated on the building system.
 - e. Local Fire-Alarm-System Alarm Message: Actuated when the building system goes into an alarm state. Identifies device that initiated the alarm.
 - f. Local Fire-Alarm-System, Supervisory-Alarm Message: Actuated when the building alarm system indicates a supervisory alarm.
- Q. Network Communications
 - 1. Provide network communications between FACP / FACU for fire-alarm system according to fire-alarm manufacturer's written requirements.
 - 2. Provide network communications pathway per manufacturer's written requirements and requirements in NFPA 72 and NFPA 70.
 - 3. Provide integration gateway using BACnet or Modbus for connection to building automation system as required.
- R. MAGNETIC DOOR HOLDERS
 - 1. Description: Units are equipped for wall or floor mounting as indicated and are complete with matching doorplate.
 - 2. Electromagnets: Require no more than 3 W to develop 25-lbf (111-N) holding force.
 - 3. Wall-Mounted Units: Flush mounted unless otherwise indicated.
 - 4. Rating: 24-V dc.
 - 5. The electromagnets shall be controlled by the FACU. Individual smoke detector auxiliary contacts shall not be used to release door holders.
 - 6. Material and Finish: Match door hardware
- S. Device Guards
 - 1. Description: Welded wire mesh of size and shape for the manual station, smoke detector, gong, or other device requiring protection.
 - 2. Factory fabricated and furnished by device manufacturer.
 - 3. b. Finish: Paint of color to match the protected device.
- T. Circuit Conductors:
 - 1. Building wire - 14 AWG copper minimum. NAC circuits for speakers shall use conductors 14 AWG minimum, shielded and jacketed, plenum rated; provide 500 feet (60 m) extra; color code and label or each IDC and NAC conductor type.
 - 2. MC-FPLP Cable-Type THHN/THWN Insulated Copper #14 AWG minimum stranded and/or Type TFN Insulated 16/2 AWG minimum copper. Green insulated or tinned copper grounding conductor. UL Listed as Type MC and Type FPLP. 600 Volt Type MC and 300 Volt Type FPLP. Rated VW-1. Red Lightweight Aluminum Interlocked Armor.

- U. Surge Protection: In accordance with IEEE C62.41.2 category B combination waveform and NFPA 70; except for optical fiber conductors.
 - 1. Equipment Connected to Alternating Current Circuits: Maximum let through voltage of 350 V(ac), line-to-neutral, and 350 V(ac), line-to-line; do not use fuses.
 - 2. Initiating Device Circuits, Notification Appliance Circuits, and Communications Circuits: Provide surge protection at each point where circuit exits or enters a building; rated to protect applicable equipment; for 24 V(dc) maximum dc clamping voltage of 36 V(dc), line-to-ground, and 72 V(dc), line-to-line.
 - 3. Signaling Line Circuits: Provide surge protection at each point where circuit exits or enters a building, rated to protect applicable equipment.
- V. Locks and Keys: Deliver keys to Owner.
 - 1. Provide the same standard lock and key for each key operated switch and lockable panel and cabinet; provide 5 keys of each type
 - 2. Provide a different standard lock and key for each key operated alarm initiating device; provide 25 keys of each type.
- W. Instruction Charts: Printed instruction chart for operators, showing steps to be taken when a signal is received (normal, alarm, supervisory, and trouble); easily readable from normal operator's station.
 - 1. Frame: Stainless steel or aluminum with polycarbonate or glass cover.
 - 2. Provide one for each control unit where operations are to be performed.
 - 3. Obtain approval of Owner prior to mounting; mount in location acceptable to Owner.
 - 4. Provide extra copy with operation and maintenance data submittal.
- X. Storage Cabinet for Documentation: Steel with baked enamel finish, size appropriate to quantity of paper. Provide as required by NFPA 70.
 - 1. Locate and clearly label within room of FACP.
 - 2. Locate as directed by Edmonds Engineering, Inc.
- Y. Storage Cabinet for Spare Parts and Tools: Steel with baked enamel finish, size appropriate to quantity of parts and tools.
 - 1. Padlock eye and hasp for lock furnished by Owner.
 - 2. Locate as directed by Owner.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Examine areas and conditions for compliance with requirements for ventilation, temperature, humidity, and other conditions affecting performance of the Work.
- B. Verify that manufacturer's written instructions for environmental conditions have been permanently established in spaces where equipment and wiring are installed, before installation begins.
- C. Examine roughing-in for electrical connections to verify actual locations of connections before installation.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.02 EQUIPMENT INSTALLATION

- A. Comply with NFPA 72, NFPA 101, and requirements of authorities having jurisdiction for installation and testing of fire-alarm equipment. Install all electrical wiring to comply with requirements in NFPA 70 including, but not limited to, Article 760, "Fire Alarm Systems".
- B. Devices placed in service before all other trades have completed cleanup shall be replaced.
- C. Devices placed in service before all other trades have completed cleanup shall be replaced.
- D. Connecting to Existing Equipment: Verify that existing fire-alarm system is operational before making changes or connections.
 - 1. Connect new equipment to existing control panel in existing part of the building.

2. Connect new equipment to existing control panel in existing part of the building
 3. Expand, modify, and supplement existing control or monitoring equipment as necessary to extend existing control or monitoring functions to the new points. New components shall be capable of merging with existing configuration without degrading the performance of either system.
- E. Install wall-mounted equipment, with tops of cabinets not more than 78 inches (1980 mm) above the finished floor and in accordance to manufacturer installation instructions.
- F. Manual Fire-Alarm Boxes:
1. Install manual fire-alarm box in the normal path of egress within 60 inches (1520 mm) of the exit doorway.
 2. Mount manual fire-alarm box on a background of a contrasting color.
 3. The operable part of manual fire-alarm box shall be between 42 inches (1060 mm) and 48 inches (1220 mm) above floor level. All devices shall be mounted at the same height unless otherwise indicated.
- G. Smoke- or Heat-Detector Spacing
1. Comply with the "Smoke-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for smoke-detector spacing.
 2. Comply with the "Heat-Sensing Fire Detectors" section in the "Initiating Devices" chapter in NFPA 72, for heat-detector spacing.
 3. Smooth ceiling spacing shall not exceed 30 feet (9m).
 4. Spacing of detectors for irregular areas, for irregular ceiling construction, and for high ceiling areas shall be determined according to Annex A or Annex B in NFPA 72.
 5. HVAC: Locate detectors not closer than 36 inches (910 mm) from air-supply diffuser or return-air opening.
 6. Lighting Fixtures: Locate detectors not closer than 12 inches (300 mm) from any part of a lighting fixture and not directly above pendant mounted or indirect lighting.
 7. When installed in a room, detectors shall be oriented, so their alarm light is visible from the nearest door to the corridor.
- H. Install a cover on each smoke detector that is not placed in service during construction. Cover shall remain in place except during system testing. Remove cover prior to system turnover.
- I. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct. Tubes more than 36 inches (9100 mm) long shall be supported at both ends. All air duct/plenum detectors must have a RAIL located in the nearest corridor or public area and identified by an engraved label affixed to the wall or ceiling. The label shall have the device address, function, and room location. These detectors shall be installed in a manner that provides suitable access for required periodic cleaning and calibration.
1. Do not install smoke detector in duct smoke-detector housing during construction. Install detector only during system testing and prior to system turnover.
- J. Duct detector sampling tubes shall extend the full width of the duct. Those over 36 inches long must be provided with rear support. The preferred method for doing this is to have the tube go through the far side of the duct, with the point of penetration tightly sealed to prevent air leakage around the tube. This facilitates smoke testing and tube cleaning. Duct smoke detector mounting position and air sampling tube orientation, are critical for proper operation. The Manufacturer's detailed installation instructions must be followed. The Contractor shall mark the direction of air flow on the duct at each duct detector location. Each duct detector installation shall have a hinged or latched access panel, 12"x12" minimum, for sampling tube inspection and cleaning. Coordinate with Mechanical Contractor.
- K. Remote Status and Alarm Indicators: Install in a visible location near each smoke detector, sprinkler water-flow switch, and valve-tamper switch that is not readily visible from normal viewing position.

- L. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille. Install all devices at the same height unless otherwise indicated.
- M. Remote Alarm Indicating Light (RAIL): Visible Alarm-Indicating Devices: Install as indicated on drawings and at least 6 inches (150 mm) below the ceiling. Install all devices at the same height unless otherwise indicated.
 - 1. Remote Alarm Indicating Lights (RAIL): Locate in public space near the device they monitor. RAILS shall be labeled with device address, function and room location of device monitored.
 - 2. RAILS shall be provided with a key switch for testing of the duct detectors.
- N. Antenna for Radio Alarm Transmitter: Mount to building structure where indicated. Use mounting arrangement and substrate connection that resists [100-mph (160-km/h)] wind load with a gust factor of 1.3 without damage.
- O. Auxiliary Function defeat switches: Provide supervised "Auxiliary Function Defeat" toggle switches in the FACU for AHU, doors, elevators, notification, off premise reporting and others as owner requests. NOTE: Water flow bells are not to be defeated. Provide an informative label at switch indicating "Normal" position. The switch must cause a system "trouble" indication when it is placed in the off ("Function Defeated") position. An Auxiliary Function defeat shall cause defeat, or when released allow restoral of the function at any point prior to or during the alarm event.
- P. Surge Protection Device (SPD): The system shall be equipped with the following protective devices to prevent damage or nuisance alarms by nearby lightning strikes, stray currents, or voltage transients. The devices are to be provided by the fire alarm equipment supplier:
 - 1. On AC Input of all panels: A feed-through (not a shunt-type) branch circuit transient arrestor. The SPD shall meet current electrical code for use on fire alarm equipment and have NRTL listings. Install in a listed enclosure near the electrical panelboard and trim excess lead lengths. Wind small coil in the branch circuit conductor, within panelboard, downstream of the suppressor connection. Coil is to be about 1" diameter, 5 to 10 turns, and tie-wrapped.
 - 2. On DC Circuits Extending Outside Building: Adjacent to the FACU, and also near point of entry to outlying building, provide "pi"-type filter on each leg, consisting of a primary arrestor, series impedance, and a fast-acting secondary arrestor which clamps between 30 and 40 Volts. Use models recommended by the Original Equipment Manufacturer (OEM).
- Q. FIRE ALARM SYSTEM INSTALLATION AND CONFIGURATION
 - 1. Installation of the FACU and connection of all circuits shall be performed by persons meeting requirements listed in the Quality Assurance paragraph. All connections at the FACU must be made by the Manufacturer's authorized, factory trained representative (rather than by the electrical contractor).
 - 2. All equipment and components shall be installed in strict compliance with manufacturers' recommendations. Consult the manufacturer's installation manuals for all wiring diagrams, schematics, physical equipment sizes, etc., before beginning system installation.
- R. The installing contractor will submit programmed point descriptors for owner preliminary approval. The approved descriptors will be programmed into the system before system testing to allow field verification. Final descriptor updates will be based on final testing review.

3.03 FIELD DEVICE LABELING

- A. Labels shall be neatly applied black lettering on a clear background. Handwritten labels or labels made from embossed tape are not acceptable.
- B. The location of all End of Line devices shall be labeled on the device, with NAC panel number and NAC circuit number. All notification devices shall be labeled.
- C. The label will be permanently mount on each device so that it's readable standing on the floor below.

- D. Devices above ceilings will have labels attached to the ceiling at location of access.
- E. If the device is an isolator, then ISO will be a part of the label.
- F. Pull stations will have the address on the top or front face.
- G. Connections or cables in the FATC (FAJB) will be labeled with circuit numbers. Raceways feeding the FATC will be labeled with function / area served. 5th floor north, FATC 4th floor etc. Wires may be numbered with a printed schedule mounted in the FATC.

3.04 PATHWAYS

- A. Pathways shall be installed concealed above accessible ceilings. Pathways in non-accessible locations may be routed exposed where noted or routed in Type MC-FPLP cable to assist in installation. Splices shall not be made between devices.
- B. Circuit conductor pathways for building wire shall be installed in EMT.
- C. Exposed pathways located less than 96 inches (2440 mm) above the floor shall be installed in EMT.
- D. New EMT shall be identified as described in Section 16014. Existing raceway that is reused shall be marked every 10 feet with a red band or label stating fire alarm.
- E. Class A SLC riser shall be run in two (2) separate conduits. Each leg of the circuit of the circuit shall be separated by a minimum of two (2) hour fire resistance rated construction, as shown on the drawings, and arranged such that severing one of the conduits will not put any portion of the system out of service. Should a two hour (2) separation be determined impractical by the COR or appointed representative, a physical separation distance of not less than 1 foot on a vertical plane and not less than 4 feet on a horizontal plane shall be achieved.

3.05 CONNECTIONS

- A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section 087100 "Door Hardware." Connect hardware and devices to fire-alarm system.
- B. Verify that hardware and devices are listed for use with installed fire-alarm system before making connections.
- C. Cable Splices: Any and all cable splices shall be in hinged terminal cabinets only. No splicing of conductors in outlet or junction boxes. There shall be NO splices in the system other than at terminal blocks. "Wire nuts," crimp splices, or insulation piercing type connectors are not acceptable. All terminal block screws shall have pressure wire connectors of the self-lifting or box lug type. Permanent wire markers shall be used to identify all splices and terminations for each circuit. For splices, use markers or other means to indicate which conductors leads to the FACU.
- D. Detection or alarm circuits shall not be installed in raceways containing AC power or AC control wiring. Within the FACP, any 120 VAC control wiring or other circuits with an externally supplied AC/DC voltage above the nominal 24 VDC system power must be properly separated from other circuits and the enclosure must have an appropriate warning label to alert service personnel to the potential hazard.
- E. Provide an engraved label on FACP and all notification appliance circuit expansion panels identifying its 120 VAC power source. This label shall include panelboard identification and circuit number and panelboard location. This information shall also be provided inside panels.
- F. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 36 inches (910 mm) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device and shown in system drawings.
 - 1. Alarm-initiating connection to smoke-control system (smoke management) at firefighters' smoke-control system panel.
 - 2. Alarm-initiating connection to stairwell and elevator-shaft pressurization systems.
 - 3. Smoke dampers in air ducts of designated HVAC duct systems.

4. Magnetically held-open doors.
5. Electronically locked doors and access gates.
6. Alarm-initiating connection to activate emergency lighting control.
7. Supervisory connections at valve supervisory switches.
8. Data communication circuits for connection to building management system.
9. Data communication circuits for connection to mass notification system.
10. Supervisory connections at fire-pump power failure including a dead-phase or phase-reversal condition.
11. Supervisory connections at fire-pump engine control panel.

3.06 IDENTIFICATION

- A. Identify system components, wiring, cabling, and terminals.
- B. Install framed instructions in a location visible from fire-alarm control unit.

3.07 GROUNDING

- A. Ground fire-alarm control unit and associated circuits; comply with IEEE 1100. Install a ground wire from main service ground to fire-alarm control unit.

3.08 FIELD QUALITY CONTROL

- A. Field tests shall be witnessed by [Architect] [authorities having jurisdiction]
- B. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect components, assemblies, and equipment installations, including connections
- C. Perform tests and inspections.
- D. Perform the following tests and inspections:
 1. Visual Inspection: Conduct visual inspection prior to testing.
- E. Inspection shall be based on completed record Drawings and system documentation that is required by the "Completion Documents, Preparation" table in the "Documentation" section of the "Fundamentals" chapter in NFPA 72.
 1. Comply with the "Visual Inspection Frequencies" table in the "Inspection" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.
 2. System Testing: Comply with the "Test Methods" table in the "Testing" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
 4. Test visible appliances for the public operating mode according to manufacturer's written instructions.
 5. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" section of the "Fundamentals" chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" section of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 6. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.
 7. Fire-alarm system will be considered defective if it does not pass tests and inspections.
 8. Prepare test and inspection reports.
 9. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.
 10. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

3.09 DEMONSTRATION

- A. Train owner's maintenance personnel to adjust, operate, and maintain fire-alarm system. Multiple training sessions will be provided to meet owner's needs for multiple shift training. Training sessions will include testing for retention of training.

3.10 TESTING

- A. Pretesting: After installation, align, adjust, and balance the system and perform complete pretesting. Determine, through pretesting, the compliance of the system with requirements of Drawings and Specifications. Correct deficiencies observed in pretesting. Replace malfunctioning or damaged items with new ones, and retest until satisfactory performance and conditions are achieved. Prepare forms for systematic recording of acceptance test results.
- B. Minimum System Tests: Minimum test shall be a 100% operation test including, but not limited to the following:
- C. Verify the absence of unwanted voltages between circuit conductors and ground.
- D. Test all conductors for short circuits using an insulation-testing device.
- E. With each circuit pair, short circuit at the far end of the circuit and measure the circuit resistance with an ohmmeter. Record the circuit resistance of each circuit on record drawings.
- F. Verify that the control unit is in the normal condition as detailed in the manufacturer's operation and maintenance manual.
- G. Test initiating and indicating circuits for proper signal transmission under open circuit conditions. One connection each should be opened at not less than 10 percent of initiating and indicating devices. Observe proper signal transmission according to class of wiring used.
- H. Test all initiating and indicating device for alarm operation and proper response at the control unit. Test smoke detectors with actual products of combustion.
- I. All circuits shall be tested for supervision. "Class A" Signal Line Circuits shall be tested for "Class A" operation.
- J. All sprinkler devices shall be tested for alarm, supervisory and trouble situations.
- K. All control circuits (AHU shutdown, door holders, dampers) shall be tested for proper operation on an alarm condition and for wire supervision.
- L. Check zone map for proper location of all devices. Verify that devices and wire are properly labeled. Verify that program descriptors match device location. Verify EOL locations with as built drawings.
- M. Test the system for all specified functions according to the approved operation and maintenance manual. Systematically initiate specified functional performance items at each station, including making all possible alarm and monitoring initiations and using all communications options. For each item, observe related performance at all devices required to be affected by the item under all system sequences. Observe indicating lights, displays, signal tones, and annunciator indications. Observe all voice audio for routing, clarity, quality, freedom from noise and distortion, and proper volume level.
- N. Test Both Primary and Secondary Power: Verify by test that the secondary power system is capable of operating the system for the period and in the manner specified.
- O. Report of Pretesting: After pretesting is complete, provide a letter certifying the installation is complete and fully operable, including the names and titles of witnesses to preliminary tests. Provide documentation of specific examples of the various tests via FACU event logs or other data capture means.

- P. Engineer's Test: After the pretest has been completed and the system is clear of trouble all test documentation including a printout of all custom labels and a NFPA 72 "Record of Completion" form shall be submitted to Engineer for approval. At that time Engineer may, at his discretion, perform a 100% functional test of the fire alarm system. The Contractor and the Manufacturer's authorized representative that installed the system must be present. Should the results of this test not be satisfactory, then corrections will be made, and a re-test will be required at the Contractor's expense.
- Q. Authority Having Jurisdiction Inspection/Test: Only after Engineer has approved the system the design professional will schedule the inspection. The Contractor and the Manufacturer's authorized representative must be present for test. Provide a minimum of 10 days' notice in writing to the Engineer for the Authority Having Jurisdiction Inspection/Test.
- R. Retesting: Correct deficiencies indicated by tests and completely retest work affected by such deficiencies. Verify by the system test that the total system meets Specifications and complies with applicable standards.
- S. Report of Tests and Inspections: Provide a written record of inspections, tests, and detailed test results in the form of a test log. Submit log on the satisfactory completion of tests.
- T. Closeout: After successful completion of inspections and tests, the warranty period begins. In the event of malfunctions or excessive nuisance alarms, the Contractor must take prompt corrective action. The Owner may require a repeat of the Contractor's 100% system test, or other inspections. Continued improper performance during the warranty period shall be cause to require the Contractor to remove and replace the system.
- U. All System documentation shall be provided and housed in a Documentation Cabinet at the control panel or other approved location.

3.11 OWNER PERSONNEL INSTRUCTION

- A. Provide the following instruction to designated Owner personnel:
 - 1. Hands-On Instruction: On-site, using operational system.
 - 2. Classroom Instruction: Owner furnished classroom, on-site or at other local facility.
 - 3. Factory Instruction: At control unit manufacturer's training facility.
- B. Administrative: One-hour session(s) covering issues necessary for non-technical administrative staff; classroom:
 - 1. Initial Training: 1 session pre-closeout.
 - 2. Refresher Training: 1 session post-occupancy.
- C. Basic Operation: One-hour sessions for attendant personnel, security officers, and engineering staff; combination of classroom and hands-on:
 - 1. Initial Training: 1 session pre-closeout.
 - 2. Refresher Training: 1 session post-occupancy.
- D. Detailed Operation: Two-hour sessions for engineering staff; assume NICET level I qualifications or equivalent; combination of classroom and hands-on:
 - 1. Initial Training: 1 session pre-closeout.
 - 2. Refresher Training: 1 session post-occupancy.
- E. Maintenance Technicians: Detailed training for electrical technicians, on programming, maintaining, repairing, and modifying; factory training:
 - 1. Initial Training: One 3-day session, pre-closeout.
 - 2. Refresher Training: One 1-day session post-occupancy.
- F. Furnish the services of instructors and teaching aids; have copies of operation and maintenance data available during instruction.
- G. Provide means of evaluation of trainees suitable to type of training given; report results to Owner.

3.12 CLOSEOUT

- A. Closeout Demonstration: Demonstrate proper operation of all functions to Owner.

1. Be prepared to conduct any of the required tests.
 2. Have at least one copy of operation and maintenance data, preliminary copy of project record drawings, input/output matrix, and operator instruction chart(s) available during demonstration.
 3. Have authorized technical representative of control unit manufacturer present during demonstration.
 4. Demonstration may be combined with inspection and testing required by authority having jurisdiction; notify authority having jurisdiction in time to schedule demonstration.
 5. Repeat demonstration until successful.
- B. Occupancy of the project will not occur prior to Substantial Completion.
- C. Substantial Completion of the project cannot be achieved until inspection and testing is successful and:
1. Specified diagnostic period without malfunction has been completed.
 2. Approved operating and maintenance data has been delivered.
 3. Spare parts, extra materials, and tools have been delivered.
 4. All aspects of operation have been demonstrated to Owner.
 5. Final acceptance of the fire alarm system has been given by authorities having jurisdiction.
 6. Occupancy permit has been granted.
 7. Specified pre-closeout instruction is complete.
- D. Perform post-occupancy instruction within 3 months after Substantial Completion.

3.13 SOFTWARE SERVICE AGREEMENT

- A. Comply with UL 864.
- B. Technical Support: Beginning at Substantial Completion, service agreement shall include software support for two years.
- C. Upgrade Service: At Substantial Completion, update software to latest version. Install and program software upgrades that become available within [two] years from date of Substantial Completion. Upgrading software shall include operating system and new or revised licenses for using software.
1. Upgrade Notice: At least 30 days to allow Owner to schedule access to system and to upgrade computer equipment if necessary.

3.14 MAINTENANCE

- A. See Section 017000--Execution and Closeout Requirement, for additional requirements relating to maintenance service.
- B. Provide to Owner, at no extra cost, a written maintenance contract for entire manufacturer's warranty period, to include the work described below.
- C. Initial Maintenance Service: Beginning at Substantial Completion, maintenance service shall include 12 months' full maintenance by trained employees of manufacturer's designated service organization. Include preventive maintenance, repair or replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper operation. Parts and supplies shall be manufacturer's authorized replacement parts and supplies.
- D. Provide to Owner, a proposal as an alternate to the base bid, for a maintenance contract for entire warranty period, to include the work described below; include the total cost of contract, proposal to be valid at least until 30 days after date of Substantial Completion.
- E. Perform routine inspection, testing, and preventive maintenance required by NFPA 72, including:
1. Include visual inspections according to the "Visual Inspection Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 2. Perform tests in the "Test Methods" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.

3. Perform tests per the "Testing Frequencies" table in the "Testing" paragraph of the "Inspection, Testing and Maintenance" chapter in NFPA 72.
 4. Maintenance of fire safety interface and supervisory devices connected to fire alarm system.
 5. Repairs required, unless due to improper use, accidents, or negligence beyond the control of the maintenance contractor.
 6. Record keeping required by NFPA 72 and authorities having jurisdiction.
- F. Provide trouble call-back service upon notification by Owner:
1. Provide on-site response within 2 hours of notification.
 2. Include allowance for call-back service during normal working hours at no extra cost to Owner.
 3. Owner will pay for call-back service outside of normal working hours on an hourly basis, based on actual time spent at site and not including travel time; include hourly rate and definition of normal working hours in maintenance contract.
- G. Provide a complete description of preventive maintenance, systematic examination, adjustment, cleaning, inspection, and testing, with a detailed schedule.
- H. Maintain a log at each fire alarm control unit, listing the date and time of each inspection and call-back visit, the condition of the system, nature of the trouble, correction performed, and parts replaced. Submit duplicate of each log entry to Owner's representative upon completion of site visit.
- I. Comply with Owner's requirements for access to facility and security.

END OF SECTION 16703

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PRE-CONSTRUCTION CONFERENCE AGENDA

Project: New Multi-Purpose Facility for the City of Winfield, AL

Funding: Local

Location: TBD

Date/Time: TBD

Please note that all items listed below may not be applicable to this project.

1. **Introductions / Sign In**

2. **Owner's Comments**

3. **Preface / Pass Along To Others**

4. **General Contractor's Team Members (contact information)**

Project Manager: _____

Superintendent: _____

5. **Verify all alternates accepted.**

6. **E-Verify. Alabama Immigration Law. Be sure that all subcontractors comply with E-Verify requirements.**

7. **List of Sub-Contractors, submit for approval.**

A Complete list of sub-contractors must be submitted and approved by the Architect and Owner prior to any work commencing. Contractor cannot replace subs unless approved by the Architect and Owner

8. **Cost Breakdown and Progress schedule.**

Cost breakdown and progress schedule must be submitted and approved on proper state forms prior to first pay request. **GC is required to provide an updated progress schedule at each OAC.**

Start:

Completion Date:

Days:

9. **Method of approving monthly pay request.**

Due by the 25th of each month. Architect will verify, sign and forward to Owner.,

10. **Allowances.**

A. With the exception of quantity allowances, all allowances indicated are contingency allowances and therefore the Owner may transfer balances for other discretionary uses. Overhead and profit margins SHALL NOT BE ADDED to any amount drawn from original Allowance(s) regardless of the indicated use.

B. Each contingency allowance shall be a "line item" on the Schedule of Values.

C. The following allowance(s) are a part of this project:

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-
- D. If applicable, note special material/equipment delivery dates associated with allowances.
-

11. Change Orders Requests. No work prior to final approval; Architect can approve in writing if emergency.

- A. All changes in work are to be submitted via Change Order Request, regardless of monetary value.
- B. COR's must be submitted in sequential order on GC letterhead.
- C. All COR's must be broken down to the fullest degree, including breakdown of GC's cost by GC's labor, materials, subcontractor, sub-subcontractor cost and OH&P. Subcontractor and sub-subcontractor cost must be documented with copies of quotes detailing OH&P included.
- D. COR's applied to allowances cannot include OH&P.
- E. Credit COR's must include a minimum of 5% OH&P.
- F. Upon Owner and/or Architects' approval of COR's, a revised Change Order and Allowance Usage log will be sent to GC via email.
- G. GC is to maintain a COR Log and present updated copy at each OAC meeting.
- H. **NOTE: The following information is required for ALL Change Order Requests submitted:**
 - a. Each material number shall include an invoice / quote listing unit quantities, unit price, and extended total.
 - b. Each labor number shall include a breakdown showing number of laborers, hours of labor worked, hourly wage, and extended total.
 - c. Each equipment number shall have an invoice / quote listing the hours of use, hourly rate, and extended total.
- I. An official Change Order to the State **CANNOT** be prepared if all backup paperwork is not provided and accounted for.
- J. This information is required for all contractors, subcontractors, and sub-subcontractors.

12. Shop Drawings.

- A. Submittal Schedule must be submitted to Architect at or before Pre-Construction Conference. Correlate this submittal schedule with the listing of subcontractors and with list of materials as specified in contract documents. The submittal schedule should be in chronological order following the critical timing of the approval of submittals in accordance with the Work Progress Schedule.
- B. Submit all items proposed for use in work. Do not combine submittals with requests for substitutions
- C. Must bear GC's action stamp as APPROVED OR APPROVED AS NOTED. Contractor shall review and stamp approval and submit shop drawings, product data and samples far enough in advance to allow ample time for Architect review. Color selections may take longer than actual submittal approval, but in any case will not be given via phone calls. If submittals are not marked as approved by the GC, they will be returned without action.
- D. Digital Copies: Provide via email to submittals@lathanassociates.com. Do not send directly to Architect. **See attached Sample.**
- E. Submittal Preparation:

- **Include the following information on transmittal / email.**
 - Date
 - Project Name and Architect's Project Number.
 - Name of the General Contractor and Contact within company.
 - Subcontractor/Supplier.
- Clearly state **Number** and title of appropriate Specification Section and **Description** of Item and if applicable
 - Name of the Manufacturer.
 - Model / Style of Item

General Contractor must review and approve shop drawings and submittals prior to submitting to Architect. Allow the Architect no less than three (3) weeks for initial review. Allow more time if the Architect must delay processing to permit coordination with the sequence of construction, related specification divisions, engineers, consultants and owner's representatives. Allow no less than two (2) weeks for reprocessing.

NOTE: No extension of Contract Time and/or additional costs will be authorized because of failure to transmit submittals sufficiently in advance of the Work to permit processing.

- F. Material shall not be fabricated or work performed without approval of respective submittal.
- G. GC is to maintain copies of all approved shop drawings at the site and have available for architect and/or engineers at all times.
- H. **GC is to maintain a Submittal Log and present updated copy log at each OAC meeting.**
- I. **Important:** Contractor shall perform no portion of the work for which the contract documents require submittal and review of Shop Drawings, Data, Installer Qualifications, etc. until respective submittal has been approved by the Architect.
- J. **Important:** Submittals are not Contract Documents and are not used to make changes in scope of project or intent of Contract Documents, and not used to request or IMPLY substitutions or to otherwise make changes in project requirements.
- K. **Important:** The only changes that can be made to the project once it is bid, is through Change Order Requests and Approvals.
- L. **Important:** After receiving approved digital submittals, General Contractor is responsible for printing and delivering 2 hard copies of the approved shop drawings to the Architect within 10 days. Submittals are not considered complete until 2 copies have been received by the Architect. This may have a direct effect on pay requests or final payment.

13. CAD Files / PDF

- A. This project was bid under the assumption that electronic CAD files would not be available.
- B. Electronic CAD files are owned individually by each design professional according to discipline. If electronic CAD files or portions thereof are made available, be reminded that electronic CAD files can be manipulated and do not constitute the Contract Documents. The business of acquiring such files shall be between the contractor and the individual design professional. Fees may or may not be applicable. It shall be the Contractor's responsibility to investigate and procure at no added expense to the Owner.
- C. PDF files shall be made available to the General Contractor for use during construction.

14. Advanced notice of required inspections.

The contractor will contact the architect by e-mail at inspections@lathanassociates.com of the date the project will be ready for an inspection: Final, and Year End. Schedule well in advance to prevent delays.

- Inspections must be requested 14 days in advance.
- The Architect will send an e-mail confirming the inspection time and date.
- Cancellations of any scheduled inspection must be received in writing by e-mail no less than 48 hours prior to the scheduled inspection. If an inspection is cancelled, it will be rescheduled subject to availability.
- If an inspection is cancelled less than 48 hours prior to the scheduled inspection, the re-inspection fee of \$1,500 may be charged.

15. Inspection Minimum Requirements.

The following minimum requirements listed below are provided to aid the contractors and architect in determining if a project is ready for a required inspection.

- Pre-Construction Conference
 - Required Attendees: Contractor, Owner, Architect, Major Subcontractors
 - Inspection Requirements:
 - ✓ Signed construction contract
 - ✓ Verification of payment of permit fee
 - ✓ Fire Alarm Contractor's Certification (from State Fire Marshal)
 - ✓ ADEM permit, if more than 1 acre of land is disturbed
- Pre-Roofing Conference
 - Required Attendees: Contractor, Owner, Architect, Roofing Subcontractor, Roofing Manufacturer's Representative
 - Inspection Requirements:
 - ✓ Roofing submittals must be approved by the architect prior to pre-roofing conference
 - ✓ Roofing manufacturer must provide documentation that roof design and roofing materials meet code requirements for wind uplift and impact resistance
 - ✓ Copy of sample roofing warranty
- Above-Ceiling Inspections
 - Required Attendees: Contractor, Owner, Architect, MEP Engineers, Major Subcontractors, Inspector/AHJ
 - Inspection Requirements:
 - ✓ All work must be completed except for installation of ceiling tiles and/or hard ceilings
 - ✓ Space must be conditioned
 - ✓ Permanent power must be connected unless otherwise arranged with the Inspector
 - ✓ Grease duct must be inspected and approved by the Inspector prior to fire wrapping and Above-Ceiling Inspection
- Life Safety Inspections and Final Inspections
 - Required Attendees: Contractor, Owner, Architect, Engineers, Major Subcontractors, Local Fire Marshal, City Inspector
 - Inspection Requirements:
 - ✓ Fire alarm certification
 - ✓ Kitchen hood fire suppression system certification
 - ✓ General Contractor's 5-Year Roofing Warranty (ACCS Form 6-L)
 - ✓ Roofing manufacturer's guaranty
 - ✓ Above ground and below ground sprinkler certifications
 - ✓ Completed Certificate of Structural Engineer's Observations for storm shelters
 - ✓ Emergency and exit lighting tests
 - ✓ Fire alarm must be monitored

- ✓ Boiler/Vessels/Hot Water Heater exceeding 5 gallons Inspection completed and Certificate of Operation provided by State of Alabama Department of Labor
 - ✓ **Test and Balance Report previously accepted by Engineer**
 - ✓ Flush test for underground sprinkler lines (witnessed by local fire marshal, fire chief and/or Inspector)
 - ✓ Flush/pressure test for new and/or existing fire hydrants
 - ✓ Must have clear egress/access and emergency (for first responders) access to building
 - ✓ Must have ADA access completed
- Year-End Inspections
 - Required Attendees: Contractor, Owner, Architect, Engineers and /or Major subcontractors may also be required to attend
 - Inspection Requirements:
 - ✓ Owner's list of documented warranty items
16. **Above Ceiling Inspection by the Architect, Engineers and Inspector.**
 No above ceiling work is to be done after the Above Ceiling Inspection other than correction of deficiencies noted during the inspection. (Pre-Above Ceiling Inspection)
 Fire Caulking Tented fixtures Wire at Light Fixtures Debris
 Temporary Lighting Penetrations Pipe Saddles
Insulation - No Kraft - Exposed Fire-Rated FSK or FRK - Type III, Class A.
17. **Other inspections required before work is covered.**
 A. Local inspectors may require a full range of inspections on this project, footings, under-slab, etc. A wall inspection will be held before any finish paints are applied.
 B. Material testing.
18. **Observation report distribution.**
 Architect will submit field reports promptly to the Owner and GC. Architect will fill in all blanks on the field report form.
19. **Record drawings, definitions of procedures.**
 G.C. is to keep all changes made in the field red lined daily. Cut and paste all addendums onto the plans at their respected locations. One clean set of plans is to be secured at the job trailer at all times for review by all interested parties. This set with changes could be used as the record drawings. Final pay approval is subject to receipt of these as-built drawings.
20. **Project sign and other job signs.**
 State required sign is the only sign allowed on project.
 Job trailers with contractor and/or sub-contractor names are allowed.
21. **Overall phasing of project.**
 Superintendent is responsible to plan ahead in order to avoid delays and conflicts. GC is to advise Architect on delays of critical path items. Superintendent is to be on site at all times when any work is in progress; no exceptions (GCS 6A & B)
22. **Contractor's duty to coordinate work of separate contractor.**
 Contractors employed by others for installation of data, computer and etc. (GCS 40D)
23. **Use of existing site, building and access drive.**
 A. Use of existing building site for lay down is to be determined by local owner and Architect. Local owner will advise contractor on proper route to site. Material delivery times are to be made as to not interfere with the school bus schedule. Area is to be reviewed after this meeting, if necessary. Maintain traffic flow.

- B. No workmen are allowed in existing building, unless prior approval is granted by the Owner and arranged by the General Contractor. There is to be no communication between workers and faculty/staff or students; through vocal, looks, stares or body language.
 - C. Since most projects are hard hat areas, the worker's name will be on his/her hat for identification purposes.
 - D. If a faculty/staff member or student is causing a problem with a worker, the worker is to report the incident to the Project Superintendent. The Superintendent should then report the incident to the Owner. Under no circumstances should the Worker try and handle the problem by him/herself.
 - E. There is to be no profanity on the job site.
 - F. School Lunchroom is off limits to workers.
 - G. Use of existing site, building and access drive.
 - H. Workmen are expected to dress appropriately. Tee-shirts are expected to be non-offensive to all parties.
 - I. State school properties are tobacco free areas. No smoking, chewing, or dipping of tobacco products are allowed.
 - J. State school properties are drug free areas. Vehicles are subject to search and seizure by law enforcement authorities.
 - K. Firearms are not allowed on school property. Cased, uncased, loaded, or unloaded.
- 24. Use of existing toilets.**
There will be no use of existing toilets. G.C. is to provide proper number of toilets for all workers. School telephone is off limits.
- 25. Coordinate any utilities supplied by the Owner / New equipment.**
- A. Existing sites, normally water only.
 - B. Coordination - OAC /Sub Meetings
 - C. New equipment utilities may be different than those existing utilities that the design is based upon. Coordinate with actual equipment cut sheets submitted and approved.
- 26. Coordinate outages with Owner.**
Provide as much notice as possible. Superintendent is to verify that coolers and freezers are back on line. Coordinate with key testing date, do not disrupt on-going school operations. *Roofing fumes must be minimized with afterburner.*
- 27. Keeping existing exit paths open.**
Required exits are to be maintained at all times.
- 28. Routine job clean up.**
Debris is to be removed daily/weekly from building and site. Do not allow dumpster to spill over. Burning of trash on site is not allowed. (GCS 48)
- 29. Safety is General Contractor's responsibility.**
As a courtesy, advise the Architect if there has been a problem.
- 30. Project limits.**
Defined on drawings.
- 31. Building location relative to critical property line. Easements, Setbacks, etc.**
Review with Architect before starting work.

32. **Location of property lines, corners, etc.**
Review with Architect before starting work.
33. **Verify sanitary outfall before committing to floor level.**
Plumber is to advise Superintendent ASAP and Superintendent is to notify Architect if there is a problem.
34. **Procedure if bad soil is encountered.**
Contact Architect immediately.
35. **Stockpiling top soil.**
On existing sites, location is to be approved by the Architect and Owner.
36. **Protect existing trees, shrubbery, landscaping, sidewalks, curbs and etc. that is intended to remain.**
GC is to leave existing site in same condition as when project started.
***If disturbing more than 1 acre, discuss ADEM requirements.*
37. **Soil compaction, type soil, lab test, etc.**
Testing Engineer is to approve compaction. Soil type is listed in the specs. For lab tests, refer to the specs. Testing disclosure.
38. **Soil Treatment.**
Soil treatment provider is to come to the site with empty tank. Use on site water. Superintendent is to witness the treatment container seals broken and mix prepared. No pre-mixed material is to be brought to the site.
39. **Surveyor to check foundation wall. Location is critical.**
40. **Ready mix plant, file delivery tickets, slump and cylinder test.**
Protect cylinders until tested. Superintendent is to have on file, at all times, the delivery tickets, slump and cylinder test results.
41. **Quality of concrete work. Concrete testing.**
Concrete is to be free of hollows and humps. Finish floor areas are to be no more than 1/8" in 10'. Review specs for slump requirements. Do not add water to concrete without approval of Geotechnical personnel.
42. **Materials Testing / Re-testing**
Retesting will be at Contractor's expense.
43. **Inspection before pouring concrete.**
Two (2) day notice is required before you pour footings. Architect must approve all concrete placement. Pictures are not acceptable. Prior to footing inspection, all footings will be cleaned of loose soil, debris, and water. Steel is to be properly tied and supported.
44. **What is expected of masonry work, mortar additive.**
All masonry work shall be as stated in the specs. Full head and bed bull-nose outside corners. Joints are expected on both sides of the units. Pre-formed corner tees, durowall and flashing are required. Mortar mix shall be made with same proportions everyday throughout entire project, using appropriate measuring devices. For tooling of brick or block, refer to specs. No brick or block less than a half unit is allowed at any opening. Full head weeps at 32" on center. All substandard masonry will be removed. Cull blocks; do not lay chipped blocks. Cut holes for electrical outlet boxes the proper size; caulking and oversized plates are not allowed.

45. **Problems with hollow metal (install proper fire labels).**
Do not paint fire labels. Labels will be attached; rating is to be embossed in minutes and/or hours. Specs require coating the interior of the frames. Grout frames solid.
46. **Pre-roofing conference. No roofing materials installed prior to conference.**
Contractor, manufacturer and applicable suppliers are required to be present.
Verify with DCM Inspector if underlayment installation is acceptable prior to pre-roofing conference.
47. **Where new work is indicated to interface with an existing roofing system or other systems potentially under current warranty, the Contractor shall coordinate as required to verify and provide new work in such manner and with such resources as to maintain the Owners current warranty accordingly without compromise.**
48. **G.C. is to have copies of all required roofing warranties in hand at the final inspection.** i.e. Manufacturers' and Five Year warranty issued by the General Contractor and the Roofing Subcontractor, (which is to be dated the date of the substantial completion), or final cannot be held.
49. **Potential conflict of mechanical and electrical equipment.**
It is the responsibility of the GC to coordinate the installation of all equipment where a conflict may occur. G.C., HVAC, Plumbing and Electrical subs are to read their sections of specs. Each foreman is to sign their section on the master copy, which is kept in the job trailer.
50. **Problems with fire damper installations.**
Installation of the dampers will be as shown on the plans. All other installation procedures will be unacceptable.
A. Fire stop material; workmen must be certified to install firestop material. Firestop system must be a UL approved assembly. (See manufactures' manual).
B. Stencil all fire walls, both sides every 20ft.
51. **Certificate of Substantial Completion.**
Architect will provide at the final inspection, provided contractor has copies of all roof warranties and the fire alarm certification.
52. **Project Closeout Procedures / Final payment.**
A. Warranties must be effective the Date of Substantial Completion. All warranties must identify the product covered.
B. Operating and maintenance manuals. All training required for the MPE fields will be completed prior to the final request being released.
C. As-built drawings.
D. Other requirements. G.C. is to make a list of all over-stocks that are required by specs and have at final for B.O.E. signature and acceptance.
E. Final Payment. Punch list items must be completed to the Architect's satisfaction, all close out documents must be received by the Architect, all change orders must be fully executed and Certificate of Substantial Completion must be fully executed before final payment is made. (GCS, 34A & B)
53. **Advertisement of Completion. Start ad after substantial completion.**
A. 1 week for projects valued less than \$50,000.00.
B. 4 consecutive weeks for projects exceeding \$50,000.00.
C. General Contractor is responsible for placement and payment of advertisement.
54. **Time Extensions.**

The GC can submit time extension request to the Architect on a weekly basis, with reasons for extension. Delays caused by rain, must exceed the five year average. (GCS 23).

55. Quality Control.

Urinals 17" A.F.F. Flush valves at wide side. Rigid conduit under slab. Fire strobes 80" to bottom, within 15' of exits.

56. Requests For Information (RFI'S)

- A. All RFI's must be numbered and made in writing to the Architect's email rfi@lathanassociates.com by the General Contractor. Please include your name, company name, telephone number, and fax number so that we may respond appropriately. Verbal RFI's will not be answered. All RFI's must be in writing.
- B. The Architect will not accept RFI's directly from subcontractors or vendors.
- C. The Team List provided within the Specification Manual is for informational purposes only and should not be used to contact Engineers and/or Consultants directly with questions regarding the project.
- D. All questions that need to be directed to an Engineer / Consultant must be routed through the Architect's office. If applicable, the Architect will contact the appropriate Engineer / Consultant for information.
- E. Bids shall be based upon the official Contract Documents consisting of Plans, Specifications and Addenda. Architect assumes no responsibility for information used by Contractors outside the official Contract Documents.
- F. **A RFI Log shall be kept by the Contractor and reviewed at each OAC Meeting.**
It will be the contractor's responsibility to inform Architect of any outstanding RFI's in a timely manner.

57. Liquidated Damages

Liquidated damages will be strictly enforced for not reaching substantial completion by the scheduled completion date. Liquidated damages will be deducted from the General Contractors final payment.

58. Miscellaneous: