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DIVISION 21 – FIRE PROTECTION

WARD C. CONNORS LICENSE No. 45839 STATE OF FLORIDA PROFESSIONAL ENGINEER

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Date: 2023.02.23 17:26:41 -05'00'

DIVISION 22 – PLUMBING

DIVISION 23 – MECHANICAL

DIVISION 26 – ELECTRICAL

RUBEN ORTEGA BLANCO LICENSE No. 90645 STATE OF FLORIDA PROFESSIONAL ENGINEER

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Ruben Ortega Blanco

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Date: 2023.02.23 17:27:33 -05'00'

RUBEN ORTEGA BLANCO
LICENSE
No. 90645
STATE OF
FLORIDA
PROFESSIONAL ENGINEER

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ELECTRICAL

DIVISION 27 – DATA COMMUNICATIONS

DIVISION 28 – ELECTRONIC SAFETY AND SECURITY

SECTION 21 00 00
FIRE SUPPRESSION

PART 1 GENERAL

1.1 SCOPE

A. The work under this section of the specifications consists of furnishing all materials, equipment, labor, testing, appurtenances, engineering and performing all operations in conjunction with all fire protection work indicated on drawings and specified herein.

B. This is a performance base specification with the Sprinkler Contractor providing professional design services of an Engineer.

1. The intent of the information in this Section is solely to set forth the minimum engineering, material and installation requirements used as basic prerequisites applied to the work in this Section.

1.2 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.3 REFERENCES, CODES AND REGULATIONS

A. Sprinkler system design, equipment, materials, devices, and installation shall conform to NFPA Codes and Requirements of Governmental Bodies, and Bureaus as listed below.

1. ANSI B16.3 – Malleable Iron Threaded Fittings: Classes 150 and 300
2. ANSI B16.4 – Gray Iron Threaded Fittings Classes 125 and 250
3. ANSI B16.9 – Factory-Made Wrought Buttwelding Fittings
4. ASTM A53/A53M _ Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated Welded and Seamless
5. ASTM A135/A135M – Standard Specification for Electrical Resistance Welded Steel Pipe
6. ASTM A395/A395M – Standard Specification for Ferritic Ductile Iron Pressure Retaining Casting for Use at Elevated Temperatures
7. ASTM A449 – Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
8. ASTM A536 – Standard Specification for Ductile Iron Castings
9. ASTM A795/A795M _ Standard Specification for Black and Hot Dipped Zinc Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use
10. NFPA 13 – Standard for Installation of Sprinkler Systems
11. NFPA 24 – Standard for the Installation of Private Fire Service Mains and Their Appurtenances
12. NFPA 25 – Standard for the inspection, testing, and maintenance of water based for protection systems.
13. NFPA 72 – National Fire Alarm and Signaling Code
14. UL - Underwriters Laboratory
15. FM - Factory Mutual
16. Department of Professional Regulation, State of Florida, Law and Rules, Chapter 471, Florida Statutes and Rules Chapter 61G15, Florida Administrative Code
17. FBC - Florida Building Code
18. FFPC - Florida Fire Protection Code.

1.4 SUBMITTALS

A. Prior to commencing the work, the Sprinkler Contractor shall submit a complete set of detailed signed and sealed working drawings prepared by an Engineer in accordance with NFPA 13, showing equipment, underground fire service lines, risers, piping, and heads.

1. These drawings shall be coordinated with structural steel, mechanical ductwork, and piping shop drawings prior to submission.
2. Drawings shall indicate cut length of piping, elevation of lines, location of piping from columns, and/or other fixed building elements.
3. If using grooved couplings show the joint coupling and fittings on drawings and provide product submittals, specially identified with the applicable manufacturer' style number.

B. Sprinkler drawings shall be coordinated with the mechanical, electrical, and the Project Consultant's reflective ceiling plans.

1. The Sprinkler Contractor shall locate the sprinkler heads to avoid interference with such items as lighting, ductwork, and air outlets.
2. Locations for mechanical and electrical items shall have priority over sprinkler piping and head locations.
3. When installing the sprinkler heads in modular ceiling panels, locate in a symmetrical pattern acceptable to the Architect.
4. The Contractor shall include in his base bid the cost of providing such material and labor as required coordinating his work with that of the other trades and providing same at no additional cost to the Owner.

C. Identify sprinklers on drawings, submittals, and other documentation, by the sprinkler identification or Model number as specifically published in the appropriate agency listing approval.

1. Do not use trade names or other abbreviated designations.

D. Submit material and equipment data sheets, test certificates, instructions, and similar information to demonstrate compliance with the specification.

1.5 TESTS AND CERTIFICATION

A. Sprinkler Contractor shall test system in accordance with NFPA 13, NFPA 14, NFPA 24 and NFPA 25.

1. Conduct tests in the presence of the authority having jurisdiction and the Owners' representative.
2. The Contractor shall have available at the site, a copy of the prescribed test.
3. Contractor shall give ample notice as to time for conducting tests.

B. Should any component of the system fail the prescribed test, Contractor shall replace such component of increased strength as required to withstand test.

C. Upon completion of installation and test, Contractor shall prepare "Contractor's Material and Test Certificate for Aboveground Piping", as prescribed in NFPA 13, and "Contractor's Material and Test Certificate for Private Fire Service Mains" as prescribed in NFPA 24.

1. Contractor and Owners' representative shall sign the certificate.
2. Contractor shall furnish copies of the signed Certificate to the Owner, and Project Consultant.

1.6 SCOPE

A. The scope of work involves relocating sprinkler heads into the new ceilings, along with the associated sprinkler piping modifications.

1.7 DESIGN CRITERIA

A. Hydraulically design the sprinkler system.

B. If constructing the project in phases, size the sprinkler system to serve the completed and future phases.

C. The general sprinkler system design parameters are as follows:

1. Administrative: Consider as light hazard occupancy minimum application density of 0.10 gpm/sq ft over 1500 square feet.
2. Kitchen/Food Service Area: Ordinary Hazard, Group I minimum application density of 0.15 gpm/sq ft over 1500 square feet.

PART 2 PRODUCTS

2.1 PIPE MATERIAL

A. All pipe materials and fittings shall be of a domestic manufacture.

B. Provide underground piping as shown and specified on civil drawings.

C. Interior Piping:

1. Branch piping up to 2” in size shall be Schedule 40 black steel ASTM A135/A135M, ASTM A53/A53M, or ASTM A795/A795M with screwed, welded, or cut grooved ends.
2. Main piping 2½” and larger shall be Schedule 10, ASTM A135/A135M, ASTM A53/A53M, or ASTM A795/A795M, with welded or roll grooved ends.

D. Screwed fittings shall be cast iron Class 125 ANSI B16.4, or malleable iron conforming to ANSI B16.3, 150 pounds.

E. Flanged fittings shall be Cast iron, 175-psi cold-water pressure, ANSI B16.1, butt weld fittings ANSI B16.9.

F. Grooved fittings shall be cast of ductile iron (ASTM A395/A395M and A536) forged steel (ASTM A-234) or fabricated from carbon steel pipe (ASTM A53/A53M) approved for use by the coupling manufacturer with flow characteristics equal to or better than standard fittings equal to Grinnell, Starr or Victaulic.

G. Mechanical couplings shall be UL listed and FM Global approved for fire protection service, ductile or iron housing, rust inhibiting no-lead painted coating, zinc electroplated heat-treated bolts and heavy hex carbon steel nuts meeting ASTM A 449 equal to Grinnell, Starr, or Victaulic.

1. Rigid type shall provide system rigidity; use coupling housings cast with offsetting, angle-pattern bolt pads, support, and hang in accordance with NFPA 13, Victaulic 005 or 07.
2. Flexible type use in locations where vibration attenuation and stress relief are required.
   a. May use flexible couplings in lieu of flexible connectors at equipment connections.
   b. Place three couplings in close proximity to the vibration source, Victaulic Style 75 or 77.

3. Flange adapters shall be flat face, for direct connection to ANSI Class 125 or 150-flanged components, Victaulic Style 744.

H. Locking Lug Fittings: UL listed and FM Global approved for fire protection service, ductile iron housings with self-contained synthetic rubber gaskets, internal pipe stop, plated ¼-turn positive locking lugs with externally visible locked position indicator.

I. Hangers shall be UL listed and FM approved plated or galvanized finish equal to Grinnell, B-Line, or Michigan Hanger.

J. Do not use non-grooved products such as “Pressfit”, “Snap-Let” outlets or “Fit” plain end products.

K. Bolted branch outlets (Victaulic style 920/920N and similar) when approved by the Engineer.

L. Do not use adjustable nipples using an O-ring design.

1. Head outlets shall be preformed tee pipefittings, welded, thread-o-lets or grooved couplings, similar or equal to Victaulic Style 073.

M. Do not use reducing bushings/couplings.

2.2 EQUIPMENT

A. All equipment listed herein shall be Grinnell, Central, Star, Reliable, or Viking, System Sensor, or Victaulic, all components shall be UL listed and FM Global approved.

2.3 SPRINKLER HEADS

A. Sprinkler heads shall be UL listed, FM Global approved, and from a single manufacturer, equal to Grinnell, Star, Viking, Reliable Central or Victaulic of the following types:

1. Provide sprinkler heads of the ordinary temperature range, 155ºF, except where subject to high temperatures caused by unit heaters, hot pipes, radiant ceiling, or other heat source, and then provide heads of high temperature type, 250ºF.
2. For areas with finished ceilings, provide heads of semi-recessed pedant type, chrome finish with escutcheon, fusible metal alloy link, or glass bulb tube.
   a. Body shall be die cast brass with hex-shaped wrench boss cast into the body to facilitate installation and reduce the risk of damage during installation.
3. For areas without ceilings: heads shall be of upright style, brass finish, fusible metal alloy link, or glass bulb tube.
4. Heads shall be nominal ½” orifice type unless otherwise required by hydraulic calculations.
5. Provide escutcheons and guards listed, supplied, and approved for use with the sprinkler by the sprinkler manufacturer.

PART 3 EXECUTION

3.1 DESIGN

A. Provide services of the Licensed Professional Engineer in the State of Florida to design a complete wet pipe sprinkler system in accordance with NFPA 13, NFPA 24 and other applicable code requirements.

B. Engineers shall provide signed and sealed engineering documents suitable for fabrication including cut lengths of pipe.

3.2 INSTALLATION

A. Install new fire service line and sprinkler system generally as indicated and coordinate with work of other trades.

   1. Exact requirements and installation shall be in accordance with working shop drawings.

B. Hydrostatically pressure test above ground piping for two hours at pressure as required by NFPA-13 and 14, with no observable leakage allowed.

   1. Pressure test below ground piping in accordance with NFPA 24, with leakage not to exceed that allowed by NFPA 24.

C. Test system in presence of Owner in accordance with NFPA 13 and NFPA 24 requirements.

D. Paint exposed piping red.

   1. Provide red head guards for heads subject to damage.

E. Provide rigid couplings at connection to valves in riser, use flexible couplings at building expansion joints and similar locations subject to movement.

F. Provide auxiliary drains for trapped sections of piping.

G. Install hangers at branch and main line locations as required by NFPA 13.

   1. Securely fasten hangers to the structure-utilizing offset or center loading beam clamps, or “C” clamps with retainer clip.
   2. Provide miscellaneous support steel where required to span across structural members.
   3. Attach hangers to concrete structures using drilled-in concrete inserts or self-tapping studs.

H. Provide heads above ceilings where combustible construction is present.

I. Label exposed piping with snap-on type plastic labels at no less than 20 feet on-center, but at least one label on each exposed section of piping.

J. Grooved Joints:

   1. All grooved couplings, fittings, valves, and specialties shall be the products of a single manufacturer, and the grooving tools shall be of the same manufacturer.
   2. Use gaskets molded and produced by the groove-coupling manufacturer.
   3. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove.
   4. Grooved coupling manufacturer’s factory trained representative shall provide on-site training for contractor’s field personnel in the proper use of grooving tools, application of groove, and installation of grooved piping products.
   5. Contractor shall remove and replace any improperly installed products.
   6. Contractor shall certify the Pipe for use with the manufacturer's system.

K. Locking Lug Joints:

   1. Pipe ends shall be square cut and thoroughly clean on the outside edge for 1” from the pipe end to remove pipe coatings, mill scale, rust and raised weld beads.
   2. Remove all burrs and sharp edges on the pipe inside and outside edge.

3. Pipe shall be marked 1 ½” from the end and pipe end configuration shall be in conformance with manufacturer's specifications.

END OF SECTION

SECTION 22 00 01
PLUMBING SYSTEMS

PART 1 - GENERAL

1.1 GENERAL CONDITIONS

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

B. Refer to Division 1 for all requirements pertaining to General Provisions.

C. Provide all the plumbing work in accordance with the Contract Documents.

D. Contractor shall provide adequate training to school personal on the use, operation, and maintenance of plumbing systems.

1.2 RELATED WORK SPECIFIED ELSEWHERE

A. Outside utilities 5'-0" beyond the building wall.

B. Final connections to heating, ventilating and air conditioning equipment.

C. Cutting and patching.

D. All concrete foundations or bases.

E. Mounting of all starters, except those specified to be factory-mounted and wired as part of the equipment. All wiring necessary to supply power to electric motors and remote operating valves, including connections from the disconnect switches and starters to the motors.

F. Providing the wiring of all plumbing alarm devices excluding house pump controls from the alarm devices to an alarm panel.

G. Motor disconnects switches and circuit breakers, except in combination starters and where otherwise noted.

H. All finished painting of exposed pipes and apparatus.

I. Domestic water meters and detector fire meters.

J. Concrete pits for sump pumping units.

K. Installation of access doors in finished construction furnished as the work of this section.

L. Flashing of roof drains and pipes penetrating the roof.

M. Flashing of floor drains in membrane waterproofed floors.

N. Excavation and backfilling.

O. Extension of fire protection from valved outlets.

P. Bracing and supports for hot water heaters.

Q. Toilet accessories.

R. Contractor shall provide adequate training to school personal on the use and maintained of plumbing systems.

1.3 WORK INCLUDED

A. Plumbing Fixtures and Trim.

B. Sanitary Waste and Vent Systems.

C. Water Supply System.

D. Storm Drainage System.

1.4 DESCRIPTION OF SYSTEMS

A. Provide all plumbing fixtures and trim as indicated on the drawings and as specified elsewhere herein. All fixtures shall be connected to the plumbing systems as indicated and required for proper operation. Piping materials, accessories, and equipment shall be as specified elsewhere in Division 22.

B. Sanitary Waste and Vent Systems:

1. Provide a complete sanitary, waste and vent system for all fixtures and equipment in the building requiring connections.
2. All waste from the building shall discharge by gravity from the building to 5 ft. outside of building as shown on the drawings.

C. Water Supply System:

1. Provide a complete water supply system for all fixtures and equipment in the building including domestic water heaters.
2. The domestic water system shall connect to 5’-0” outside of building as shown on the plans.
3. Local connections to fixtures and equipment shall be not less than full size of the fittings on the fixtures and equipment, and runouts and risers serving same shall be as shown and not less than one pipe size larger than the fittings on the fixtures and equipment.
4. Provide a ball valve at every branch off water mains where accessible and provide approved gate or compression stops at every connection to fixtures and equipment.
5. Provide shock arresters in accordance with the Plumbing and Drainage Institute Standard PDI-WH201. Provide access doors at each location of shock arrester. All shock arresters shall comply with ANSI A112.26.1-1969 (R1975). Coordinate access door locations with the architect.
6. Pressure gauges shall be provided, on the inlet and outlet of all pumps, at the connection to each piece of equipment connected to by the plumbing contractor and at the main service valve in the building. Gauges shall be as specified herein.
7. Thermometers shall be provided, on the inlet and outlet of each water heater, HWR pipe at the discharge of the circulator pump. Thermometers shall be as specified herein.

D. Storm Drainage System:

1. All drain connections to the building storm water system at the lower levels subject to backflow shall be equipped with backwater valves.
2. Insulate floor drains receiving cold condensate for a minimum distance of 20'-0" to the vertical stack.

PART 2 - PRODUCTS

2.1 SHOCK ARRESTERS

A. Shock arresters shall be stainless steel, welded nesting type expansion bellows as manufactured by Sioux Chief, Zurn, or Josam. Provide access panels.

2.2 BACKFLOW PREVENTERS

A. 3/4" through 2" reduced pressure zone backflow preventers shall be equal to Watts 909 Series with 900AG air gap piped to drain.

B. 2-1/2" through 10" reduced pressure zone backflow preventers shall be equal to Watts 909 Series with 909AG air gap piped to drain.

C. Double check valve assembly shall be equal to Watts 709 with UL/FM resilient seated OS&Y valves.

PART 3 - EXECUTION

3.1 PIPING WORK - INSTALLATION

A. The drawings shall be followed where they are definite and provided such procedure causes no objectionable conditions or does not conflict with other trades, laws, regulations, or recommendations of equipment manufacturers. The drawings are intended to indicate the sizes of piping connections, and if certain sizes are omitted or unclear, obtain additional information before proceeding.

3.2 STERILIZATION OF PIPING AND EQUIPMENT

A. After all domestic cold water and hot water supply and return piping has been flushed free of foreign matter, and within 30 days prior to turning the building over to the Owner, this piping shall be sterilized in accordance with Section 22 11 17 – Disinfection of Domestic Water Lines.

END OF SECTION

SECTION 22 02 00
BASIC MATERIALS AND METHODS FOR PLUMBING SYSTEMS

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.

B. Refer to Division 1 for all requirements pertaining to General Provisions.

1.2 WORK INCLUDED

A. Piping and equipment identification.

B. Electrical requirements.

C. Painting.

D. Concrete work.

E. Fabricated steel supports.

F. Excavation, trenching and backfilling.

G. Placing of equipment.

1.3 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced.

1. American Institute of Steel Construction (AISC) Publications
2. American National Standards Institute (ANSI) Standards
3. American Society for Testing and Materials (ASTM) Publications
4. American Welding Society (AWS) Publications
5. Underwriters Laboratories, Inc. (UL) Standards

1.4 SUBMITTALS

A. Where submittals are required, comply with Division 1.

B. Shop Drawings: Submit drawings of fabricated steel supports where proposed supports are not in accordance with details on drawings, or where drawings do not detail supports. Submittal for acceptance is required.

C. Product Data: Submittal for other than fabricated steel supports is not required. Product data for the following shall be included in the operation and maintenance manuals. Submittal for acceptance is not required.

1. Piping and equipment identification.

PART 2: PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Piping and Equipment Identification:

1. Communications Technology Corp.
2. Craftmark Identification Systems, Inc.
3. EMED Co., Inc.
4. Florida Marking Products, Inc.
5. Marking Services, Inc.
6. Seton Name Plate Corp.
7. W.H. Brady Co., Signmark Division

2.2 FABRICATION

A. Piping and Equipment Identification:

1. Pipe markers: Sub-surface printed plastic, with protective undercoating. Markers shall be permanently curled for snap-on installation for pipe sizes (including insulation) up to 6" diameter. For external diameters above 8". Marker shall be secured using cable ties for indoor use and stainless-steel banding or ultraviolet resistant plastic for exterior use. Markers for outdoor installation shall be over-laminated with Tedlar™ on polyester ultraviolet to avoid damage and fading. Markers shall identify the pipe contents and direction of flow through 360-degree visibility range. Marker size, letter size, letter color, wording and background color shall be in accord with ANSI A13.1 – Scheme for the Identification of Piping Systems. Based on Marking Services Inc. Model MS-970 Coiled Plastic Markers for indoor use and Model MS-995 Maxilar Marker for exterior use.
2. Valve tags: Contractors Option:
   a. Indoor:
      1) 19-gauge brass, 1-1/2-inch round, with 1/4-inch-high black pipe service letter abbreviation above 1/2-inch-high black valve number. Pipe service letter abbreviation shall be in accord with legend on drawings. Valve tag attachment shall be 4 ply 0.018 copper wire meter seal or #6 solid brass bead chain with locking link. Based on Marking Services Inc.
      2) 1/16-inch-thick plastic, 1-1/2" round, with ¼ inch high black pipe service abbreviation above 1/2-inch-high black valve number. Pipe service letter abbreviation shall be in accord with legend on drawings. Color of valve tag shall match pipe marker color. Valve tag attachment shall be 4 ply 0.018 copper wire meter seal or #6 solid brass bead chain with locking link. Based on Marking Services Inc.
   b. Outdoor Service:
      1) 19-gauge `brass, 1-1/2-inch round, with 1/4-inch-high black pipe service letter abbreviation above 1/2-inch-high black valve number. Pipe service letter abbreviation shall be in accord with legend on drawings. Valve tag attachment shall be 4 ply 0.018 copper wire meter seal or #6 solid brass bead chain with locking link. Based on Marking Services Inc.
      2) 19-gauge Type 304 stainless steel, 1-1/2" round, with ¼ inch high pipe service abbreviation above 1/2-inch-high black valve number. Pipe service letter abbreviation shall be in accord with legend on drawings. Color of valve tag shall match pipe marker color. Valve tag attachment shall be 4 ply 0.018 stainless wire meter seal or #6 Type 304 stainless steel bead chain with locking link. Based on Marking Services, Inc.
3. Valve chart frame: Self-closing, satin-finished, extruded aluminum with glass window, 8-1/2 inch by 11-inch chart size.

4. Equipment nameplates:
   a. Indoor: Shall be 1/16-inch-thick plastic with black satin surface and white core. Lettering shall be engraved through the surface color to expose the core color. Plate size shall be a minimum of 2-1/2 inch by 4 inch, with 3/4-inch-high lettering for equipment and 3/4 inch by 2-1/2 inch, with 3/16-inch-high lettering for ceiling grid labeling. Equipment identifying name and number shall be in accord with schedules on the Contract Documents. Plate manufacturer shall furnish pre-drilled hole locations for pop riveting. Where pop riveting is not suitable, a suitable adhesive for permanently attaching plates to equipment shall be provided.
   b. Outdoor: Shall be 125 Mil rigid plastic constructed of printed legend sealed between two layers of chemically resistant plastic to resist ultraviolet damage. Plate size shall be a minimum of 2-1/2 inch by 4 inch, with 3/4-inch-high lettering for equipment. Equipment identifying name and number shall be in accord with schedules on the Contract Documents. Plate manufacturer shall furnish pre-drilled hole locations for pop riveting. Where pop riveting is not suitable, a suitable adhesive for permanently attaching plates to equipment shall be provided.
   c. Based on Marking Services Inc. Model MS-215 Max-Tex.

B. Electrical Requirements: Refer to Division 26 for requirements.

C. Painting: Product specified in Division 9 - Finishes.

D. Concrete Work:

1. Concrete is provided under Division 3 - Concrete.
2. This contractor to provide detailed dimension drawings, including anchor bolt locations where required for all bases and pads required for equipment furnished under this Division.
3. Concrete for equipment bases and pads shall be 3000 psi. design mix prepared in accord with ASTM C94. Cement shall be in accord with ASTM C150. Aggregate shall be fine sand in accord with ASTM C33. Water shall be clean, fresh, and drinkable.

E. Fabricated Steel Supports:

1. Steel angles, channels, and plate shall be in accordance with ASTM A36.
2. Steel members, including fasteners, exposed to weather shall be galvanized.

F. Excavation, Trenching, and Backfilling: Product description not applicable.

G. Placing of Equipment: Product description not applicable.

PART 3: EXECUTION

3.1 GENERAL

A. Installation of materials and equipment shall be in accord with the manufacturer's written instructions, except as specified.

3.2 INSTALLATION

A. Piping and Equipment Identification:

1. Install pipe markers adjacent to each valve and fitting, at each branch connection, on each side of wall, floor, and ceiling penetrations, where entering and leaving underground areas, and at minimum 40 foot spacing on horizontal and vertical pipe runs. Markers shall be arranged for easy reading at eye level.
2. Provide valve tags on all valves exposed or concealed unless otherwise noted.

3. Attach valve tag to stem of each valve to be tagged. Valve numbers shall follow in sequence the Owner's existing valve numbers, where applicable.
4. Provide a marker for each valve and equipment to be tagged, located above lift-out tile ceilings. The marker shall be 1/16-inch-thick plastic with a satin surface and white core. Color of the marker shall match color of piping identification system. Lettering shall be engraved through the surface color to expose the core color. Plate size shall be ¾ inch by 2-1/2 inch, with 3/16-inch-high lettering for ceiling grid labeling. Plate manufacturer shall furnish suitable adhesive for permanently attaching plate to ceiling grid.
5. Provide a minimum of 4 valve charts. Chart information shall indicate job name, Contractor name, date of installation, valve number, valve location, valve type, valve purpose, and system in which installed. Mount framed chart in equipment room and insert copy of chart in each operating and maintenance manual under separate tabbed section labeled "Valve Chart". Where project drawings include a piping flow schematic, request AutoCAD file from Engineer and label all of the valves according to the valve chart and frame in an 18” x 24” frame in main mechanical or pump room.
6. Permanently affix nameplate to each item of equipment using stainless steel pop rivets. Where irregular surface impedes direct attachment of plates, affix plate to sheet metal bracket and attach bracket to equipment with screws, bolts, or suitable adhesive from nameplate manufacturer.

B. Electrical Requirements: All work as provided under Division 26.

C. Painting:

1. All equipment shall be furnished with a factory applied galvanized, prime paint, or finish paint finish. Touch-up damaged surfaces of equipment immediately.
2. Paint for galvanized surfaces shall be in accordance with ASTM A780 using zinc rich compound.
3. Paint wooden mounting backboards with two coats of gray enamel prior to making attachments to the board.
4. For quality control refer to Division 9 - Finishes.
5. Remove all dirt, rust, scale, grease, pipe dope, solder flux, and welding slag from all surfaces to be painted.
6. Paint immediately, under this Division, all damaged galvanized surfaces. Paint galvanized metal surfaces behind grilles with two coats of flat black paint.
7. Apply rust inhibitive primer to ferrous surfaces of shop fabricated steel supports.
8. Paint immediately under this division all field and shop welded joints in piping or equipment supports with 2 coats of grey metal primer.

D. Concrete Work: All work as provided by Division 3.

E. Fabricated Steel Supports:

1. Because of the small scale of the drawings, details of equipment support are not always shown. It shall be the responsibility of the contractor to provide support as required for safe and adequate support.
2. Fabricated steel supports and ladders may be shop or field-fabricated and shall be in accord with details on drawings.
3. When details are not indicated, the contractor shall submit proposed support details for review. The contractor shall bear all costs in producing this detail in the bid. This includes but is not limited to structural engineering support.
4. Steel members shall be saw cut, with corners ground smooth, and shall be assembled with welded or bolted connections at Contractor's option. Connections shall be in accord with specified AISC Publications.

F. Excavation, trenching, and backfilling: Excavation, trenching, and backfilling for site utility piping systems specified in Division 31.

G. Placing of Equipment:

1. Coordinate setting of equipment with the requirements of other trades so as to avoid conflicts and to insure compatibility. Equipment shall not block access for installation of other equipment.
2. Set base mounted equipment on permanent and finished supports. Temporary support, if any, shall be removed prior to making final pipe, duct, or electrical connections to equipment.
3. Adjust suspended equipment to final elevation prior to making pipe, duct, or electrical connections.
4. Exercise caution during equipment placing operations to ensure that structure is not overloaded.
5. Do not move heavy equipment across floor or roof of insufficient load bearing capacity to support such equipment. Provide bracing or shoring as required or use crane to place equipment directly on permanent and finished support.
6. Secure all roof mounted equipment to the structure adequately to resist overturning, uplift and sliding forces for basic wind speeds indicated for this location in Figure 1609 of the Florida Building Code, Latest Edition.

END OF SECTION

SECTION 22 05 00
COMMON WORK RESULTS FOR PLUMBING SYSTEMS

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.

B. Comply with Sections 01 33 00 – Submittal Procedures and 01 60 00 – Material Equipment and Approved Equals.

1.2 ARTICLES INCLUDED

A. Definitions.

B. Permits, Fees, and Notices.

C. Applicable Publications.

D. Code Compliance.

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L. Transportation and Handling.

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N. Cutting, Patching and Demolition.

O. Cleaning Up/Removal of Debris.

P. Operating and Maintenance Manuals.

Q. Training of Owners Operators.

R. Guarantee of Work.

S. System Testing.

1.3 ARTICLES

A. Definitions

1. The term "As indicated" means as shown on drawings by notes, graphics, or schedules, or written into other portions of contract documents. Terms such as "shown", "noted", "scheduled" and "specified" have same meaning as "indicated" and are used to assist the reader in locating particular information.
2. The term "Provide", means furnish and install as part of the work covered in Division 22.
3. The term "Furnish" means furnish only, for installation, as part of this contract, by other Divisions.
4. The term "Install only" means to install under the work of Division 22 equipment furnished by other Divisions, or by the Owner.
5. The term "Owner's Representative" when referenced herein shall be the Architect or the Engineer acting as his designated representative unless otherwise noted.
6. The term "design" as it pertains to the work of this division shall describe the basic intent, component sizing, component relationships and overall architecture of the Plumbing system. The design is generally schematic in nature and will require specific detailing after the accepted products are determined.
7. The term "detail" as it pertains to the work of this division shall describe the work required by the contractor to assure a fully coordinated installation of the material and equipment supplied. When requested, the contractor shall produce detailed shop drawings or sketches indicating the actual placement of the equipment or material supplied; also including how the equipment or material interfaces with work of other sections or divisions within the contract documents.
8. The term "workman-like manner" as it pertains to the work of this division shall describe a neat well-organized high-quality installation system (piping, etc.). Routing shall be well thought out providing adequate service clearance and maximum use of space. Equipment placement shall exhibit proper clearances for service. All lines (piping, etc.) shall be run straight and true, parallel, or perpendicular to building structure neatly supported.
9. For additional definitions refer to the General Conditions.

B. Permits, Fees and Notices: Comply with the General Conditions.

C. Applicable Publications

1. Publications listed in each Section form a part of that Section to the extent referenced.
2. When a standard is specified by reference, comply with requirements of that standard, except when requirements are modified by the Contract Documents, or applicable codes establish stricter standards.
3. The Publication or Standard is the publication in effect as of the bid date, except when a specific date is listed.

D. Code Compliance

1. Life Safety Code - NFPA 101
2. Florida Building Code 7th Edition (2020)
3. Florida Accessibility Code, 7th Edition (2020)
4. National Electrical Code 2017
5. Florida Plumbing Code 7th Edition (2020)
6. NFPA Standards, Latest Edition.

E. Scope of Work: The work to be performed under this Division consists of the satisfactory completion of all PLUMBING as indicated in the Contract Documents.

F. Record Drawings: Comply with the General Conditions.

G. Intent of Drawings and Specifications

1. The intent of the drawings and specifications is to establish minimum acceptable quality standards for materials, equipment, and workmanship, and to provide operable plumbing systems complete in every respect.
2. The drawings are diagrammatic, intending to show general arrangement, capacity, and location of system components, and are not intended to be rigid in detail. Final placement of equipment, other system components, and coordination of all related trades shall be the contractor's responsibility.
3. Due to the small scale of the drawings, and to unforeseen job conditions, all required offsets and fittings may not be shown but shall be provided at no additional change in contract cost.
4. In the event of a conflict, the Owner's Representative will render an interpretation in accordance with the General Conditions.

H. Quality Assurance

1. All equipment furnished under this Division shall be listed and labeled by U.L., ETL or a nationally recognized testing laboratory (NRTL).
2. Material furnished under this Division shall be standard catalogued products of recognized manufacturers regularly engaged in the production of such material and shall be the latest design.
3. Materials shall be the best of their respective kinds. Materials shall be new except where the specifications permit reuse of certain existing materials.
4. Work provided for in these specifications shall be constructed and finished in every part in a workmanlike manner.
5. All items necessary for the completion of the work and the successful operation of a product shall be provided even though not fully specified or indicated on the drawings.
6. All work to be performed by qualified and experienced personnel specifically trained in their respective field.
7. All work of this division shall be carefully interfaced with the work of other divisions to assure a complete, functioning system or systems.

I. Submittals

1. In addition to all other submittal requirements elsewhere in the contract documents, the contractor shall comply with the following.
2. Submittal for acceptance is required only on those items specifically requested in the specification section that applies.
3. For products and equipment that do not require a submittal for acceptance, submit a separate letter for each specification section certifying that all products and equipment will be provided in compliance with the contract documents.
4. Provide submittal data in accordance with the General Conditions and/or as listed below.
5. Designate in the construction schedule, or in a separate coordinated schedule, the dates for submission and the dates that the submittals will be needed in order to meet construction schedule. This schedule shall be submitted prior to or in conjunction with the first submittal. Processing of submittals may be delayed pending the receipt of this schedule at the reviewer’s discretion.
6. Submittal data shall be presented in a clear and thorough manner and referenced to the specification section.
   a. Where applicable, data shall be identified by reference to sheet and detail, schedule or room numbers, equipment or unit number as shown on Contract Drawings.

7. Prepare performance and product data as follows:
   a. Clearly mark each copy to identify pertinent products or models, delete non-pertinent data.
   b. Show performance characteristics and capacities.
   c. Show dimensions and clearances required.
   d. Show wiring or piping diagrams and controls.
   e. Clearly list any deviation in the submittals from the requirements of the contract documents.
   f. Include installation requirements.
8. Manufacturer's standard schematic drawings and diagrams:
   a. Modify drawings and diagrams to delete information not applicable to the work of this project.
   b. Supplement standard information to provide information specifically applicable to the work of this project.
9. Prohibition of Asbestos and PCB:
   a. The use of any process involving asbestos or PCB, and the installation of any product, insulation, compound of material containing or incorporating asbestos or PCB, is prohibited. The requirements of this specification for complete and operating mechanical systems shall be met without the use of asbestos or PCB.
   b. Prior to the Final Review field visit the Contractor shall certify in writing that the equipment and materials installed in this Project under this Division 22 contain no asbestos or PCB. Additionally, all manufacturers shall provide a statement with their submittal that indicates that their product contains no asbestos or PCB. This statement shall be signed by a duly authorized agent of the manufacturer.
10. Letter of Certification: Where a submittal is not required, provide a letter certifying that the work will be completed in strict accordance with the specified requirements. In the event the contractor wishes to alter the requirements of the specification for whatever reason, this should be clearly explained in this letter noting that this alteration may require additional submittal requirements.
11. Schedules: Where schedules are called for, submit schedules indicating which products will be used and to what extent by system, location, size, etc.
12. Where samples are requested, samples shall be of sufficient size and quantity to clearly illustrate:
    a. Functional characteristics of the product, with integral related parts and attachment devices.
    b. Full range of color, texture, and pattern.
    c. Where a mock-up is specified, erect at the Project site, in a location acceptable to the Owner's Representative. Size or area shall be that specified or as agreed upon during pre-construction or other job site meetings.
    d. Where mock-up is not a permanent part of the installation, remove mock-ups at conclusion of work or when acceptable to the Owner's Representative.
13. The Contractor shall:
    a. Review Shop Drawings, Product Data and Samples prior to submission.
    b. Determine and verify:
       1) Field measurements.
       2) Field construction criteria.
       3) Catalog numbers and similar data.
       4) Conformance with specifications.
       5) All submittals have been properly interfaced with the requirements of this and other divisions of work so as to assure a complete, functioning system in accordance with the contract documents.
    c. Coordinate each submittal with requirements of the work and of the Contract Documents.
    d. Clearly identify any deviations in the submittals from requirements of the Contract Documents. Any deviations not specifically disclosed in the submittal shall be solely at the risk of the Contractor and shall be subject to discovery at any time. Any

undisclosed deviations shall be corrected by the Contractor to comply with the requirements of the Contract Documents at no cost to the Owner regardless of the action code accorded the submittal by the Owner's Representative.

e. Do not release equipment for shipment, begin fabrication or work on any items requiring submittals for acceptance until all submittals are returned with the Owner's Representative acceptance.

f. Make submittals promptly, and in such sequence as to cause no delay in the work or in the work of any other contractor.

14. Number of Submittals: Comply with the Division 1, Specification Section 01 33 00 – Submittal Procedures.

15. Submittals shall contain:
    a. The date of submission and the dates of any previous submissions.
    b. The Project title and number.
    c. Contract identification.
    d. The names and phone numbers including personal contact of:
        1) Contractor.
        2) Supplier.
        3) Manufacturer.
    e. Identification of the product, with the specification section number and contract document description clearly indicated.
    f. Field dimensions clearly identified as such.
    g. Relation to adjacent or critical features of the work or materials.
    h. Applicable standards.
    i. Identification of deviations from Contract Documents.
    j. Identification of revisions on re-submittals.
    k. Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the work and of Contract Documents.
    l. Each submittal shall be limited to a single specification section. Submittals shall not be grouped with other sections in common binders or under common control sheets except as defined in paragraph m. below. Each submittal shall have a cover/control sheet containing the information listed above (a through k) and have a minimum of 8" x 3" clear space for the general contractors, engineers, and architects review stamp.
    m. The first group of submittals shall be sent in a minimum of one (or if required) two hard cover view type 3-ring binder(s) White, sized to hold 8-1/2” x 11” sheets:
        1) Binder is to be adequately sized to comfortably hold required submittals. Minimum spline size to be 1”, maximum spline size to be 3” (provide additional binders if 3” size is not sufficient to properly hold submittals).
        2) Binder cover and spline to have outer clear vinyl pockets. Provide correct designation of project in each pocket. Description sheets are to be white with black letters, minimum of 11” high and full width of pocket. Description is to describe project and match project drawing/project manual description.
    n. Submittals not complying with these requirements may be returned with no action taken at the reviewer’s discretion.

16. Re-submittals shall contain:
    a. The date of re-submission and the dates of all previous submissions.
    b. A copy of the Engineer's comments from the previous submittal.
    c. An itemized response to each of the Engineer's comments specifically outlining the changes or corrections being made. As an example, this could be either noting the page(s) of the previous submission that are affected and what changes have been made or noting specific additional information being provided.
    d. Submittals not complying with these requirements may be returned with no action taken at the reviewer’s discretion.
    e. Turnaround time and copies as indicated in Section 01 33 00 – Submittal Procedures.

17. The Owner's Representative will (if they so desire):
    a. Review submittals promptly and where special attention is requested, review in accordance with the schedule required.
    b. Review the submittal for general compliance with the contract documents. The contractor is responsible for quantities, dimensions, placement of the product, coordination with all other trades occupying the space, maintain service clearance, function, and compliance with the written installation instructions.
    c. Determine the appropriate action for the submittal. Action codes will be as follows:
        - "NO EXCEPTIONS TAKEN" - Copies will be distributed as indicated under above schedule.
        - "FURNISH AS CORRECTED" - Final but Restricted Release; General Contractor may proceed with fabrication, taking into account the necessary corrections on submittal and with Contract Documents. General Contractor must submit a confirmation letter to remove restriction and allow shop drawings on the project site. A sample of a confirmation letter is enclosed herein.
        - "REVISE AND RESUBMIT" - General Contractor may proceed with fabrication, taking into account the necessary corrections. Corrected shop drawings shall be resubmitted before fabrication of this work is complete to obtain a different action marking. Do not allow drawings marked "Resubmit" to be used in connection with installation of the Work.
        - "REJECTED " - General Contractor will be required to resubmit shop drawings in their entirety. No fabrication or installation shall be started until shop drawings so marked have been completely revised, resubmitted, and marked by Architect according to preceding Paragraphs a. or b.
    d. Turnaround time will be per Division 1.
    e. Review comments will be per Division 1.
18. Resubmission requirements for "as specified" products.
    a. Make any corrections or changes in the submittals required by the Owner's Representative and resubmit until accepted.
    b. A submittal shall only be reviewed a maximum of 3 times. If upon the second resubmission an accepted action cannot be rendered (No Exceptions Noted or Make Corrections as Noted), the contractor shall supply the basis of design product and bear all costs incurred by the Engineer during the review process until an accepted submittal is achieved.
19. The Contractor shall maintain one copy of all accepted submittal data including letters of compliance in a job site file.

J. Product Requirements, Equals and Substitutions

1. In addition to all other requirements for submittals, equals and substitutions elsewhere in the contract documents, the contractor shall comply with the following.
2. Product Requirements:
    a. The specifications sections under Article 2.1 "ACCEPTABLE MANUFACTURER", lists suppliers found acceptable for this project. The names listed are manufacturers who meet the minimum acceptable standards that this project dictates. The list is furnished as a guide. Even though a manufacturer is named, he must still provide the type and quality of equipment specified as well as equipment that will fit within the allotted space and within the design weight allowance, etc. Being named does not imply permission for that manufacturer to provide an alternative product or design. Other manufacturers not named will be considered to be equal providing they furnish a product of the type and quality specified.
    b. In certain cases, foundations and/or structural supports or electrical requirements for equipment specified in this Division are provided under other divisions of the specifications. Where an alternate acceptable manufacturer's product is provided, this contractor shall coordinate the revised requirements and include an allowance for any cost differential.

c. If the list, under Article 2.1 "ACCEPTABLE MANUFACTURERS" names only one manufacturer followed by "No Substitutions" that product shall be supplied.

3. Substitutions: *Comply with the General Conditions, but the following are in addition to:*
   a. A substitution is defined as any product not meeting the requirements as outlined in PART 2 - PRODUCTS. A different design accomplishing the same result will be considered a substitution. The same design requiring a larger motor, or more space or a structural change to accommodate larger weight, etc., will be considered a substitution. If a manufacturer who is not listed as an "ACCEPTABLE MANUFACTURER" wants to have his product considered as an equal or as a substitution, he shall submit details to the Engineer 10 days in advance of bid date and a decision will be rendered. If necessary, a clarification will be issued in the form of an Addendum. No substitution requests shall be considered after the Bid.
   b. Submit a separate request for each product, supported with complete data, with drawings and samples as appropriate, including.
      1) Comparison of the qualities of the proposed substitution with that specified in tabulated format.
      2) Changes required in other elements of the work because of the substitution.
      3) Effect on the construction schedule.
      4) Cost, extra credit or statement of no change in contract price.
      5) Any required license fees or royalties.
      6) Availability of maintenance service, and source of replacement materials.
   c. The Engineer shall be the judge of the acceptability of the proposed substitution.
   d. A request for a substitution constitutes that the Contractor:
      1) Has investigated the proposed product and determined that it is equal to or superior in all respects to that specified.
      2) Will provide the same warranties for the substitution as for the product specified.
      3) Will coordinate the installation of the substitution into the work and make such other changes as may be required to make the work complete in all respects.
      4) Waives all claims for additional costs, under his responsibility, which may subsequently become apparent.
      5) Will absorb all costs incurred by the substitution when affecting other trades including but not limited to electrical, structural, architectural, etc.
      6) Will absorb any cost incurred by the Engineer in review of the substituted product if the acceptance of the substituted item creates the need for system modification and/or redesign, or if the substituting contractor exhibits negligence in his substituting procedure thus submitting inferior, misapplied or miss-sized equipment. In the event of additional engineering costs, the billing structure shall be agreed upon prior to review by all involved parties.
4. Engineer will review requests for substitutions with reasonable promptness, and will issue an addendum or notify Contractor, in writing, of the decision to accept or reject the requested substitution.
5. Substitutions <u>will not</u> be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or if acceptance requires revision to the contract documents.
6. The engineer will review substitution submittals for compliance a maximum of two times. If the submittal or substituted product does not comply with the contract documents on the second submittal, the submittal and product will be rejected and the specified product will be required.
7. The contractor may request further review of the substitution after the second submittal rejection if the contractor agrees in writing to accept responsibility for the cost of additional review time and expenses by the Engineer.
8. In the event a substitution is rejected, supply the products which constituted the basis of design at no change in the contract price.
9. Installation of substitutions without the Owners approval shall be cause of immediate rejection and removal without extra cost to the Owner.

K. Manufacturer's Instructions

1. Installation of work shall comply with manufacturer's printed instructions.
2. Should job conditions or specified requirements conflict with manufacturer's instructions, consult with Engineer for clarification. Do not proceed with work without clear instructions.

L. Transportation and Handling: Comply with General Conditions.

M. Storage and Protection

1. Store products in accord with manufacturer's instructions, with seals and labels intact and legible.
2. Store products to prevent damage by the elements. Space temperature shall be controlled as required to prevent condensation and metal corrosion or damage to electrical or electronic parts are the result of condensation.
3. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration.
4. Provide protection as necessary to prevent damage after installation.
5. Products which suffer damage due to improper storage shall not be installed and if found in place, shall be removed, and replaced at the contractors expense.

N. Cutting and Patching: Comply with the General Conditions.

O. Cleaning Up/Removal of Debris

1. Comply with the General Conditions.
2. Maintain a clean work area. Construction debris shall be immediately removed from all newly erected work.

P. Operating and Maintenance Manuals: *Comply with the General Conditions, but the following are in addition to:*

1. Quantity: Comply with the General Conditions.
2. Format: Adequately sized for contents, minimum 1" and maximum 3" spline size, hard cover, view type, 8-1/2" x 11 loose leaf binders. Binder covers to have outer clear vinyl pocket on front cover and spline. Provide correct project designation and contents description in each pocket. Use as many as required. Do not overload binders.
3. Content:
   a. Cover sheet.
   b. Table of contents (as follows):
      1) Description of systems.
      2) Design parameters.
   c. Point by Point System Check-out: Provide tabulated results indicating compliance with contract document requirements.
4. Detailed Preparation Requirements:
   a. The cover sheet shall list project name, location, architect, structure engineer, mechanical engineer and electrical engineering firm name with address, telephone number and project manager’s name for this project.
   b. Each major heading in the table of contents shall have a large distinctive, clearly marked, non-erasable, plastic encased tab.
   c. The description of systems will be provided by the design engineer for insertion at the time of review and turn-over to owner. This description of systems will be an updated version of the narrative included in this Section and will be an overview of the entire system. It will be the basis for the starting of the owners instruction program.

d. Each section shall have the following sub-tabs. Sub-tabs shall be similar to the main tabs but of a different color.
   1) Specifications: The specification shall be copied and inserted complete with all addenda.
   2) Submittal: This section shall include all accepted submittal data. If submittal was not required, include technical data as specified.
   3) Installation Instructions: If the product, such as pipe, etc., does not have any written installation instructions, include a statement "Manufacturer's Written Installation Instructions not Available - Product Installed in Accordance with Specifications and Good Practice".
   4) Operation and Maintenance Instructions: These shall be the written manufacturer's data edited to omit reference to products or data not applicable to this installation.
   5) Parts List: These shall be edited to omit reference to items not applying to this installation.
   6) Equipment Supplier: This section shall include the name, address, and telephone number of the manufacturer's agent and/or service agency supplying or installing and starting up of the equipment.
   7) System Description: This section shall include that portion of the overall description included in the beginning of the manual as it applies to each sub-section. In sections such as pipe, valves and fittings, a statement shall be included "Not Applicable to this Section." Data for this section will be added by the design engineer when the manuals are submitted for review and forwarded to the owner.

Q. Training of Owners Operators

1. The manufacturer shall provide a comprehensive training outline for the Owner & Engineer to review within 90 days of final completion.
2. The manufacturer & contractor shall provide training on the plumbing system, plumbing fixtures and all water heating systems, per the table below.
3. The owners shall be given comprehensive training in understanding the systems and the operation and maintenance of each major piece of equipment.
4. The contractor shall be responsible for scheduling the training which shall start with classroom sessions followed by hands on training on each piece of equipment. Hands on training shall include start-up, operation in all modes possible, shutdown and any emergency procedures.
5. The manufacturer's representative shall provide the instructions on each major piece of equipment. These sessions shall use the printed installation, operation and maintenance instruction material included in the O&M manuals and shall emphasize safe and proper operating requirements and preventative maintenance.

R. Guarantee of Work

1. Comply with the General Conditions.
2. Where applicable, furnish manufacturer's written warranty for materials and equipment.
3. Insert warranties in appropriate locations in operating and maintenance manuals.
4. Materials and equipment having seasonal operation limitations, shall be guaranteed for a minimum of one year from date of seasonally appropriate test, and acceptance in writing by the Owner, unless specific Division 22 specifications specify a longer period.

S. System Testing

1. Provide all necessary labor, materials, and equipment to successfully complete all system testing necessary for building occupancy and owner acceptance.
2. Provide all necessary labor, materials, and equipment to assist contractors of other division to complete system testing necessary for building occupancy and owner acceptance, wherever an inter-relationship between Division 22 and the work of other divisions exists.

3. Tests shall be repeated as necessary until all occupancy and operation permits are granted and the owner accepts the project.
4. Testing schedule requirements per the Table below:

Training Schedule							
Div.	**Training Description**	**Subcontractor**	**Demo. Date**	**Time**	**Hours**	**Comments**	**Personnel to attend training**
	Plumbing				4 hours	Demonstrate to owner selected personnel the interior plumbing system, to include grease traps, shutoff valves, trap primers, metered faucets, hot water heaters, etc.	

PART 2 – PRODUCTS (Not Applicable)

PART 3 – EXECUTION (Not Applicable)

END OF SECTION

SECTION 22 05 29
HANGERS AND SUPPORTS FOR PLUMBING PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Division 1 for all requirements pertaining to General Provisions.

1.2 WORK INCLUDED

A. Inserts, Shells and Upper Attachments.

B. Pipe Hangers, Rods, Supports and Accessories.

C. Pipe Sleeves.

D. Pipe Seals.

E. Fabricated Steel Support.

1.3 QUALITY ASSURANCE

A. Design of pipe supporting elements shall be in accordance with ANSI B31.1.

B. Fabrication and installation of pipe hangers and supports shall be in accordance with the following Manufacturers Standardization Society (MSS) Standards.

1. SP-58 Pipe Hangers and Supports: Materials, Design and Manufacture.
2. SP-69 Pipe Hangers and Supports: Selection and Application.
3. SP-89 Pipe Hangers and Supports: Fabrication and Installation Practices.

C. Steel angles, channels and plate shall be in accordance with ASTM A36, red primed or hot dipped galvanized for interior applications, and hot galvanized for exterior applications.

D. Bolts, including nuts and washers, used for fabricating steel members shall be in accordance with ASTM A325 and shall be stainless steel or plated for corrosion protection. Plain steel components are unacceptable.

E. Welding of steel members shall be in accordance with AWS D1.1.

F. Steel supports for pipe anchors, pipe guides, and piping supported from below shall be fabricated in accordance with AISC Specification for the Design, Fabrication and Erection of Structural Steel for buildings. If required, the contractor shall include the cost of the services of a structural engineer to design or review the system.

1.4 APPLICABLE PUBLICATIONS

A. Applicable sections of the publications listed below form a part of this Section. The publications are referenced in the text by the basic designation only.

1. American Institute of Steel Construction (AISC)
2. American National Standards Institute (ANSI)

3. American Society for Testing and Materials (ASTM)
4. American Welding Society (AWS)
5. The Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS)
6. National Fire Protection Association (NFPA)
7. Sheet Metal and Air Conditioning Contractor's National Association, Inc. (SMACNA)

1.5 SUBMITTALS

A. Submit schedule indicating type of hanger to be used by system and pipe size. Include rod size for each hanger size.

B. Product data, along with installation operation and maintenance instructions, shall be included in the operation and maintenance manuals.

C. Refer to Division 1 for submittal requirements.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Inserts, Shells and Upper Attachments

1. Anvil International, Inc.
2. Carpenter Paterson, Inc.
3. Cooper B-Line®, Inc.
4. Elcen Metal Products
5. Hilti
6. Michigan Hanger Company
7. PHD Manufacturing, Inc.
8. Unistrut®

B. Pipe Hangers, Rods, Supports and Accessories

1. Anvil International, Inc.
2. Carpenter Paterson, Inc.
3. Cooper B-Line®, Inc.
4. Elcen Metal Products
5. Hilti
6. Michigan Hanger Company
7. PHD Manufacturing, Inc.
8. Unistrut®

C. Pipe Sleeves

1. Metraflex – Metraseal
2. Thunderline Corporation - Link Seal
3. Approved Equal.

D. Pipe Seals

1. Metraflex – Metraseal
2. Thunderline Corporation - Link Seal
3. Approved Equal.

E. Fabricated Steel Support: Detailed Drawings.

2.2 FABRICATION

A. Inserts, Shells and Upper Attachments

1. Inserts; MSS Type 18; malleable iron body and nut, galvanized finish, opening in top of insert for reinforcing rod, lateral adjustable. Rated for 1,140 lbs. Based on Anvil Fig. 282.
2. Shells: Steel shell and expander plug, snap off end fastener. Based on Phillips Concrete Fasteners Red Head.
3. Upper Attachments:
   a. Top beam clamps; MSS Type 19: Malleable iron galvanized finish clamp, hardened steel cup point set screw and locknut. Rating is contingent on rod and bolt size. Based on Anvil Fig. 94.
   b. Bottom Beam Clamp; MSS Type 23: Malleable iron galvanized finish clamp, hardened steel cup point set screw and locknut, and retaining clip. Rating is contingent on rod and bolt size. Based on Anvil Fig. 86 Clamp and Fig. 89 Retaining Clip (or Fig. 87).
   c. Welded Beam Attachment; MSS Type 22: Carbon steel suitable for eye rod or rod and locknut, rating is contingent on rod and bolt size. Based on Anvil Fig. 66.
   d. Center Beam Clamp; MSS Type 21: Malleable iron jaw and square head bolt and nut with galvanized finish. Rating is contingent on rod and bolt size. Based on Anvil Fig. 134.
   e. Center Beam clamp; MSS Type 29: Forged steel, weldless eye nut, tie rod to secure clamp to beam all with galvanized finish, rating is contingent on rod and bolt size. Based on Anvil Fig. 292 or 292L.

B. Pipe Hangers, Rods, Supports and Accessories:

1. Pipe Hangers:
   a. Clevis Hanger; MSS Type 1: Carbon steel, galvanized for interior and exterior use, sized to accommodate required insulation. Rating is contingent on rod and bolt size. Based on Anvil Fig. 260 or 300.
   b. Pipe Rings; MSS Type 10: Carbon steel, galvanized for black steel and insulated pipe copper or copper plated or rubber coated for copper pipe. Threaded swivel, sized to accommodate required insulation. Rating is contingent on rod and bolt size. Based on Anvil Fig. 69 or Fig. 97C for copper pipe.
   c. Adjustable Roller Hanger; MSS Type 43: Cast iron roll, carbon steel yoke rod roll and hex nut with galvanized finish. Sized to accommodate insulation. Rating is contingent on rod and bolt size. Based on Anvil Fig. 181.
2. Rods:
   a. Size 3/8" and up: All thread steel rod electro galvanized. Sizing for pipe or equipment support as follows:

Copper Tube, Plastic Fiberglass Reinforced Pipe Size	Steel, Cast Iron or Glass Pipe Size	Rod Size	Max Equip. Load
¼” to 2”	¼” to 2”	3/8”	730 lbs.
2-1/2” to 5”	2-1/2” to 3”	½”	1350 lbs.
6”	4” to 5”	5/8”	2160 lbs
8” to 12”	6”	¾”	3230 lbs.
14”	8” to 12”	7/8”	4480 lbs.
16”	14” to 16”	1”	5900 lbs.
18” to 20”	18” to 20”	1-1/4”	9500 lbs.
22” to 42”	22” to 42”	1-1/2”	13,800 lbs.

b. Rods may be reduced one size for double rod hangers with 3/8” minimum diameter, or when other paragraphs require a minimum of 2 hangers per section provided the minimum diameter of 3/8” in maintained. Based on Anvil Fig. 146.

3. Supports:
   a. Pipe Saddle; MSS Type 38: Cast iron saddle, black steel lock nut nipple, cast iron reducer all with galvanized finish. Suitable for standard field cut and threaded galvanized steel pipe. Cast iron floor flange. Based on Anvil Fig. 264 Saddle, Fig. 63 Floor Flange.
   b. Pipe Saddle Cold Piping: MSS Type 40. Single bonded unit consisting of a galvanized metal shield and a molded section of rigid polyurethane foam insulation. Rigid urethane foam shall have a density of 4 pounds per cubic foot, a thermal conductivity of 0.13 Btu.in/sq.ft./hr.°F at 75°F mean temperature. Insulation thickness to be equal to thickness specified for pipe being supported.
   c. Adjustable Pipe Roll and Base; MSS Type 46: Cast iron base plate steel stand and roll, adjusting screws with galvanized finish. Based on Anvil Fig. 274.
   d. Welded Steel Bracket; MSS Type 32: Welded carbon steel rate for 1500 lbs., with galvanized finish. Rating is contingent on rod and bolt size. Based on Anvil Fig. 195.
   e. Riser Clamps; MSS Type 8: Carbon steel, galvanized finish for black steel or galvanized pipe, plastic coated for cold steel, copper, glass or brass pipe rated for a minimum of 220 lbs. at 3/4" size. Based on Anvil Fig. 261.
4. Accessories:
   a. Protective Shields; MSS Type 40: Carbon steel, galvanized minimum of 12" length sized for required insulation. Based on Anvil Fig. 167.
   b. Protective Saddles; MSS Type 39: Carbon steel plate, minimum of 12" length, sized for required insulation. Based on Anvil Fig. 160 through 165.
   c. Steel Turnbuckle; MSS Type 13: Forged steel, galvanized finish with locknuts. Rated at a minimum of 730 lbs. at 3/8" size. Based on Anvil Fig. 230.
   d. Steel Clevis; MSS Type 14: Forged steel, galvanized finish with steel pin and cotter pin. Rated for a minimum of 730 lbs. at 3/8" size. Based on Anvil Fig. 299.
   e. Weldless Eye Nut; MSS Type 17: Forged steel, galvanized finish. Rated for a minimum of 730 lbs. at 3/8" size. Based on Anvil Fig. 290 or 290L.

C. Pipe Sleeves

1. Wall: Schedule 40 carbon steel pipe sized to accommodate pipe. If sleeves are field cut, coat cut edges with cold galvanizing spray, ZRC or equivalent.
2. Floor or Exterior Walls below Grade: Schedule 40 steel pipe with anchor and water stop hot dip galvanized after fabrication. Sized to accommodate pipe. Sleeve length will be sized to allow a minimum of 1/2" extension below floor or exterior side of a wall below grade and 1-1/2" extension above floor and 1/2" extension on interior side of an exterior wall below grade.
3. Roof: All penetrations of roof to be in accordance with requirements of Division 7 - Thermal and Moisture Protection.
4. Based on Thunderline Corp. Link Seal Wall Sleeve.

D. Pipe Seals: Composition Plastic Pressure Plates, zinc coated bolts, nuts and metal parts, composition rubber sealing element designed for long term stability rated for temperatures of 40°F to +250°F. Based on Thunderline Corp. Link Seal LS Series.

E. Fabricated Steel Supports

1. Field or shop fabricated. See details on drawings.
2. If not detailed on drawings the contractor is to provide suitable support as required.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Where applicable install in accordance with the manufacturer's written installation instructions.

B. Where supports are in contact with copper pipe provide copper plated support or wrap pipe with sheet lead.

C. Where supports are in contact with glass, aluminum or brass pipe provide plastic coating on supports, or wrap pipe with sheet plastic.

D. General interior supports, including attachments and pipe supports that are plain steel shall be cleaned of all rust, primed, and painted black within one week of installation. At substantial completion all supports shall be free of rust and in a "like new condition".

E. Hangers and supports, including attachments & pipe support, exposed to weather, or located in utility tunnels or accessible utility trenches or subject to spillage shall be hot dip galvanized after fabrication. At substantial completion all supports shall be free of rust and in a "like new condition".

F. Fabricated steel supports exposed to weather (including pipe supports) or located in utility tunnels and accessible utility trenches or subject to spillage shall be hot dipped galvanized after fabrication, primed and painted black within one week of installation. Cut, welded, drilled, or otherwise damaged surfaces of galvanized coating shall be repaired in accordance with Section 22 02 00. At substantial completion all supports shall be free of rust and in a "like new condition".

3.2 INSTALLATION

A. Inserts, Shells and Upper Attachments

1. Inserts
   a. Contractor shall have inserts at site and dimensioned location drawings ready at the beginning of the involved concrete work.
   b. Install inserts by securing to concrete forms and inserting reinforcing rod thru the opening provided in the insert in accordance with shop drawings.
   c. Provide necessary supervision while concrete is being poured to correct any misalignment caused by the concrete.
2. Shells: Size shell length to assure a minimum of 1" solid concrete remaining from shell end to concrete face.
3. Upper Attachment
   a. Select proper attachment for building construction.
   b. For plain steel devices, prime with black paint prior to installation.
   c. Adjust attachment location for proper alignment and no more than 4 deg. offset from a perpendicular alignment.
   d. If proper alignment cannot be achieved from the existing building structure provide a trapeze type support size to handle the design load with a minimum safety factor of 5.

B. Pipe Hanger, Rods, Supports and Accessories

1. Select proper hanger for piping systems.
2. The location of hangers and supports shall be coordinated with the structural work to ensure that the structural members will support the intended load.

3. Provide hex head nut on rod at top and bottom of clevis hanger yoke, and at each rod connection to intermediate and upper attachment. Rod nuts shall be securely locked in place.
4. Hanger rods shall be subject to tensile loading only. Where lateral or axial movement is anticipated, use suitable linkage in hanger rod to permit swing.
5. Hangers shall be fabricated to permit adequate adjustment after erection while still supporting the load. Turnbuckles shall be provided where required for vertical adjustment of the piping.
6. Supports for vertical piping shall be located at each floor or at intervals of not more than 15 feet and at intervals of not more than 8 feet from end of risers. Where supports are provided on intermediate floors spaced 15 feet or less between floors, no additional supports are required other than those specified for end of risers.
7. A hanger or support shall be provided adjacent to each piece of equipment to ensure that none of the pipe weight is supported from the equipment.
8. The maximum spacing between pipe supports for straight runs shall be in accordance with the following chart. If any deviation from the table exists within the manufacturers written installation instructions, whichever spacing reflecting the smaller centerline to centerline dimension shall be used.

MAXIMUM HORIZONTAL PIPE HANGER AND SUPPORT SPACING TABLE

a. Steel Pipe (Schedule 40 & 80):
   - Up to 1": 7 ft. on center
   - 1-1/4" and greater: 10 ft. on center
b. Copper Pipe (Types L, K and M):
   - Up to 1-1/4" size: 5 ft. on center
   - 1-1/2" to 2-1/2": 6 ft. on center
   - 3" and larger: 10 ft. on center
c. Ductile Iron and Cast Iron: Two hangers per section length.
d. Polyvinyl Chloride (PVC):
   - Up to 1-1/2": 3 ft. on center
   - 2" and larger: 4 ft. on center

9. Hanger centerline spacing shall be reduced by 50% in areas of concentrated valves and/or fittings, also no more than a maximum distance of 12 inches from valves, fittings and/or couplings, or 24 inches from a change in direction.
10. Parallel piping may be supported by trapeze hangers consisting of steel angle, channel, or beam suspended by steel rods attached to upper structure. Piping may be supported above, or suspended below, the angle, channel, or beam.
11. Provide protective shields on all cold and dual temperature piping required to be insulated.
12. Provide protective saddles sized to match insulation thickness on all hot piping required to be insulated. Fill void between saddle and pipe with insulation as specified.
13. Provide turnbuckles on all hangers which require leveling or aligning.
14. Provide steel clevis where detailed and/or required.
15. Provide weldless eye nuts on hanger terminations where disassembly or swing may be required. Use in combination with steel clevis.

C. Pipe Sleeves

1. Secure sleeves to forms for concrete construction. Ensure sleeves are not disengaged or misaligned by concrete placement operations.
2. Provide temporary cap for open end of sleeves to prevent entrance of concrete.
3. Provide temporary internal bracing where required to prevent distortion of sheet metal sleeves by concrete placement operations.
4. Sleeves shall not be installed in structural members, except where indicated or approved.

5. Furnish sleeves to masonry contractor in advance of masonry work. Furnish dimensioned drawings indicating exact location of sleeves.
6. Each sleeve shall extend through its respective wall, floor, or roof, and shall be cut flush with each surface, except as indicated otherwise.
7. Sleeves passing through floors in wet areas, such as areas containing plumbing fixtures or floor drains, shall extend a minimum of 4 inches above the finished floor. Sleeves in wet areas shall be enclosed with a 4-inch concrete curb.
8. Unless otherwise indicated, sleeves shall be of a size to provide a minimum of 1/4 inch clearance all around between the pipe and inside of sleeve, or between jacket over insulation and sleeve.
9. Provide membrane clamping devices on sleeves for waterproof floors.
10. Sleeves are not required in existing structures where openings through existing concrete floors, walls, or roof are core drilled.

D. Pipe Seals

1. Provide pipe seals for all pipe sleeves used in:
   a. External walls.
   b. Floor slabs on grade.
   c. Upper floors where spillage may occur.

E. Fabricated Steel Supports: Steel for supports shall be saw cut, with sharp edges ground smooth. After fabrication remove all foreign material, including welding slag and spatter, and leave ready for painting or galvanizing, as applicable.

END OF SECTION

SECTION 22 07 00
PLUMBING INSULATION

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.

B. Refer to Division 1 for all requirements pertaining to General Provisions.

1.2 WORK INCLUDED

A. Piping Systems Insulation.

B. Accessories.

1.3 QUALITY ASSURANCE

A. All products within the conditioned air stream or active plenums shall comply with the NFPA 90A Flame/Smoke rating of 25/50 and comply with UL 181 erosion limitations. Fire hazard ratings shall be as determined by NFPA-255, "Method of Test of Surface Burning Characteristics of Building Materials" - ASTM E84 or UL 723.

B. All adhesives, cement, finishes, jackets, etc., shall be UL listed or labeled for use as applied to insulation and designed specifically for use in the installation.

C. All insulation shall be installed in accordance with National Commercial & Industrial Insulation Standards (NCIA).

1.4 SUBMITTALS

A. Submit schedule indicating type of insulation, thickness, vapor barrier or coating by system and size.

B. Product data, along with installation operation and maintenance instructions, shall be included in the operation and maintenance manuals.

C. Submit details of insulated removable covers using the actual equipment dimensions, concrete base sizes and piping arrangements.

D. Refer to Division 1 for submittal requirements.

1.5 GENERAL REQUIREMENTS

A. Factory-applied insulation is specified under the applicable equipment Section of these specifications. It is listed here for reference only.

B. Packages and standard containers of materials shall be delivered unopened to job site and shall have the manufacturer's label attached giving a complete description of the material.

C. All rainleader piping and roof drain bodies shall be insulated within the building to above grade. Materials are specified elsewhere herein.

1.5.1 DEFINITIONS

A. The term "exposed" means exposed to view in finished spaces, in equipment rooms, in fan rooms, in closets, in utility corridors, in tunnels, on roof, in storage rooms, and in other spaces as indicated.

B. The term "concealed" means concealed from view, and includes all spaces not defined as exposed.

C. The term "unconditioned" space shall mean all places where the temperature surrounding the pipe has not been conditioned consistent with conditioned spaces, and shall include mechanical equipment rooms, non-active ceiling plenums, and non-accessible chases. This term shall also include conditioned spaces where the humidity levels are allowed to rise above 70% RH.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Fiberglass Insulation

1. Owens-Corning Fiberglas
2. Knauf Fiberglass
3. CertainTeed
4. Johns Manville.

B. Closed Cell Elastomeric Insulation

1. Armacell LLC
2. Johns Manville
3. Rubatex.

2.2 PIPE INSULATION REQUIREMENTS

A. Condensate Drain (C):

	Thickness	Type
All Sizes	1/2"	Closed Cell Elast.

B. Dom. Cold Water (CW):

Up to 4”	--	Not Required
5” through 14”	--	Not Required

C. Dom. Hot Water (HW) (HWR):

Conditioned Space		
Up to 2”	1”	Rigid Fiberglass
2-1/2” through 4	1"	Rigid Fiberglass
5" through Larger	1-1/2”	Rigid Fiberglass
Unconditioned Space		
Up to 2”	1”	Rigid Fiberglass
2-1/2” through 4	1-1/2"	Rigid Fiberglass
5" through Larger	2"	Rigid Fiberglass

D. Hub Drains Receiving

Condensate – All Sizes	1/2”	Closed Cell Elast.
Condensate - All Sizes	1/2"	Closed Cell Elast.

2.3 MATERIALS

A. Pipe Insulation (to 450F):

1. Rigid Fiberglass: Resin bonded fibrous glass, flame retardant, factory applied all service jacket vapor barrier with self sealing pressure sensitive lap joints, molded to accommodate pipe, maximum vapor permeance of .02 perm/in. and a puncture resistance of 50 units, minimum density 4.0 lb./cf, maximum conductivity per 1" thickness of .23 at 75°F, .29 at 200°F and .43 at 400°F mean temperature. Based on Knauf Pipe Insulation.
2. Closed Cell Elastomeric (Small Pipe Sizes up to 5 Inches): Flexible, elastomeric, closed cellular, tubular molded to accommodate piping, smooth outer surface suitable for painting with vinyl lacquer type coating, water resistant, nonabsorbent, ozone resistant, minimum density of 4 lb./cf, maximum conductivity per 1" thickness of .27 at 75°F mean temperature. Based on Armacell LLC AP Armaflex and Self-seal Armaflex 2000.
3. Closed Cell Elastomeric (Large Pipe Sizes, 6" and Larger): Sheet type, flexible, elastomeric, closed cellular, smooth outer surface suitable for painting with vinyl lacquer type coating, water resistant, nonabsorbent, ozone resistant, minimum density of 4 lb/cf, maximum conductivity per 1" thickness of 2.7 at 75°F mean temperature. Based on Armacell LLC Armaflex II.

B. Accessories:

1. Corner angles shall be minimum 28-gauge, 1 inch by 1 inch aluminum adhered to 2 inch by 2 inch heavy kraft paper.
2. Glass tape shall be a minimum density of 1.6 ounces per square yard, 4 inch wide with a 10 x 10 thread count per inch of width. Glass cloth shall be untreated.
3. Staples shall be outward clinching type, Type 304 or 316 stainless steel in accord with ASTM A 167 or Monel® coated.
4. Wire shall be soft annealed galvanized or copper, 16 gauge, or nickel copper alloy.
5. Closed cell elastomeric insulated finish shall be a white water based flexible, acrylic latex enamel equal to WB Armaflex finish.
6. Insulation Tape: Closed cell elastomeric insulation: 2" wide x 1/8" thick.
7. Elastomeric Insulation Adhesive: Air drying contact adhesive for securing sheets to flat or curved metal surfaces and joining seams and butt joints of elastomeric insulation. Suitable for temperatures to 180F, dried film not to exceed 25 for flame spread and 50 for smoke development when tested per ASTM E 84-84A method.
8. Vapor Barrier Mastic: Air drying flexible water-based mastic used for applying a vapor barrier joint with glass cloth at insulation joints. Suitable for temperatures to 180°F, wet and dried film not to exceed 25 for flame spread and 50 for smoke development when tested per ASTM E 84-84A method. Maximum Perm rating of 0.08., Childers Products Company, Inc. CP-35 Chil Therm® WB, Foster Products Corp. Product Data 30-80 Foster Vapor Safe® Coating, Marathon Industries, Inc. 590 LO-PERM, Richard's Paint Manufacturing CO., Inc. VBM-4, Vimasco Corp. 749 Vapor-Blok, or equal.
9. Acrylic Latex Finish and Sealers:
   a. Elastomeric Insulations: Air drying flexible water-based finish used for finishing flexible elastomeric insulation. Suitable for temperatures to 180°F, wet and dried film not to exceed 25 for flame spread and 50 for smoke development when tested per ASTM E 84-84A method. Armacell LLC WB Armaflex finish.

PART 3 - EXECUTION

3.1 GENERAL REQUIREMENTS

A. Install all insulation in strict accordance with the manufacturers' written installation instructions.

B. All insulation work shall be performed by skilled mechanics regularly engaged in the insulation trade.

C. Properly coordinate the insulation work with the other trades so that installation is performed with a minimum of conflict.

D. Insulation shall not be applied on any piping system requiring testing until testing is completed and approved by Owner's Representative.

E. Insulation shall not be applied until all systems are clean, dry, free of dirt, dust, or grease.

F. The finished installation shall present a neat and acceptable appearance which includes but is not limited to all jackets smooth, all vapor barriers sealed properly, no evidence of "ballooning" of the jackets, or sagging insulation, all valves, dampers, gauges, unions, etc. accessible. The Owner's Representative shall be the final judge of acceptance of workmanship.

G. All equipment nameplates on hot equipment shall be left uncovered. All equipment nameplates on cold equipment shall have a removable section sized to expose the nameplate. This section shall be clearly marked "Nameplate".

H. If proper maintenance procedures require access to the insulated equipment removable panels, sections or covers shall be provided to accomplish this. These access devices shall be constructed in a manner to assure easy access and sturdy construction. The contractor shall assume the responsibility to coordinate all equipment requiring insulation to be either factory or field insulated.

I. Insulation and accessories shall be applied only at suitable application temperature and conditions as recommended by the manufacturer. Do not apply insulation to any surface while it is wet.

J. Insulation shall be protected from moisture and weather during storage and installation.

K. Insulation which has sustained moisture damage, torn jackets, or other damage due to improper storage or other reasons shall not be used. If evidence of this is sighted the Owner's representative reserves the right to require the insulating contractor to remove any and/or all insulation until the Owner's Representative is satisfied that there is no longer any inferior insulation installed on this project.

L. Insulation, fabric, and jacketing shall be protected from damage during construction. Damage by the insulator shall be repaired without cost to the Owner. Damage by others shall be reported in writing to the contractor.

M. The insulation subcontractor is responsible for proper material storage at the work site.

N. Work performed prior to receipt of approved documents or submittals, later proving to be incorrect or inappropriate, shall be promptly replaced by the contractor without cost to the purchaser.

O. Insulation shall not be installed until adequate access and clearances at control mechanisms, dampers, sleeves, columns, and walls have been provided.

P. All insulation at handholes, access doors or other openings, and adjacent to flanges and valves shall be neatly finished where exposed to view.

Q. All materials, accessories and methods of installation and fabrication are subject to the Owner's Representatives inspection and approval during any phase of the work.

R. The insulation subcontractor shall prevent the accumulation of insulation debris in the buildings and on the premises of the Owner.

S. The insulation subcontractor shall be responsible for his own safety program at the work site and shall provide instruction on safe practices for his workers assigned to the project. All employees are subject to the work rules at the job site.

T. The insulation subcontractor shall familiarize himself with the progress and execution of the job and notify the proper parties of interferences and any problems with the proper installation of his materials.

3.2 INSTALLATION

A. Pipe Insulation

1. General:
   a. All locations where the insulated surface is supported by hangers, the insulation shall be protected by shields or saddles properly skimmed to maintain a smooth outer surface, and proper insulation thickness. Chilled water piping, 3" and over shall have a section of foamglas insulation installed between the pipe and shield. 3 and 4" to be 12" long, 5" and 6" to be 18" long and 8" and over, 24" long. If the possibility exists that the hanger may conduct the temperature of the conveyed medium and thus cause condensation or personal injury due to high temperature, the hanger shall also be insulated. Joints between foamglas and pipe insulation shall be properly sealed.
   b. All devices connected to or in line with the piping system shall be insulated greater than or equal to the connecting piping. This includes but is not limited to valves, air separators, expansion tanks, control valves, control devices, gauge connections, thermometer stems, chemical feed equipment, piping flexible connectors, etc. This is particularly important on ice water and refrigerant lines.
   c. The insulation at threaded unions in steam and hot water piping shall be tapered and terminated with cement and glass lagging cloth and lagging adhesives.
   d. Insulate exterior surfaces of all anchors and guides for chilled water and dual temperature piping systems.
   e. A complete moisture and vapor barrier shall be installed wherever insulation is penetrated by hangers or other projections through insulation and in contact with cold surfaces for which a vapor seal is specified.
   f. Cover fittings, flanges, unions, valves, anchors, and accessories with pre-molded or segmented insulation of the same thickness and material as the adjoining pipe insulation. Where nesting size insulation is used overlap pipe insulation 2 inches or one pipe diameter. Fill voids with insulating cement and trowel smooth. Elbows shall have not less than 3 segments per elbow. Secure insulation with wire or tape until finish is applied. Blanket inserts in lieu of pre-molded or segmented insulation is not allowed. Cover fittings with preformed PVC fitting covers.
   g. Wrap all pressure gauge taps, thermometer wells and all other penetrations through insulation with closed cell insulation tape so as to prevent condensation.
   h. Seal all raw edges of insulation.
   i. For piping supported by hangers outdoors, apply a rainshield to prevent water entry.
2. Rigid Fiberglass:
   a. Provide PVC fitting covers for all fittings.
   b. Align all jacket seams.
   c. Assure all vapor barriers are properly sealed.
   d. Provide PVC jacket over all exposed insulation in the equipment room.

e. All corner angels below 6’-10” shall have padded insulation and be marked with yellow stripes.

3. Closed Cell Elastomeric:
   a. All joints shall be sealed with adhesives.
   b. Where the thickness is to be obtained by use of two layers of insulation, install with staggered joints.
   c. Finish:
      1) Concealed Indoors: No additional finish.
      2) Exposed Indoors: Provide PVC jacket over all insulation.
      3) Concealed Indoors: Provide PVC jacket over fittings fabricated from insulation sections or sheet.
      4) Outdoors: Provide aluminum pipe jacket.

END OF SECTION

SECTION 22 11 16
DOMESTIC WATER PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Division 1 for all requirements pertaining to General Provisions.

1.2 WORK INCLUDED

A. Domestic Water (CW/HW/HWR) Piping.

1.3 DEFINITIONS

A. The pipe sizes given in this document shall be construed nominal.

1.4 QUALITY ASSURANCE

A. All material provided under this section shall be standard catalogued products of recognized manufacturers regularly engaged in the production of such products and shall be of the manufacturer's most recent design that is in regular production.

B. Each item provided under this section shall meet the requirements for that item as installed and used, in accordance with the following standards:

1. Metallic Piping Systems employing mechanical joints and grooved-end pipe - ASME/ANSI B-31.9.
2. All other metallic piping - ASME/ANSI B31.1.

C. Each piping system shall be in accordance with the system design pressures shown in paragraph 2.1 - Materials, this specification section.

D. All materials provided under this section shall be new, except where the specifications and/or drawings permit the reuse of certain existing materials.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referenced in the text by the basic designation only.

B. The work and materials listed in this Section shall be provided in accordance with the standards and requirements set forth in the applicable portions of the latest editions of the referenced publications.

C. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

1. American National Standards Institute (ANSI) Standards
2. American Petroleum Institute (API) Specification
3. American Society of Mechanical Engineers (ASME) Publications
4. American Society for Testing and Materials (ASTM) Publications

5. American Welding Society (AWS) Publication
6. American Water Works Association (AWWA) Standards
7. Cast Iron Soil Pipe Institute (CISPI) Standards
8. The Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS) Publications
9. National Fire Protection Association (NFPA) Standards
10. National Sanitation Foundation (NSF) Testing Laboratory Standards.
11. Plastic Pipe Institute (PPI) Manual.
12. Plumbing and Drainage Institute.
13. Underwriters Laboratories (UL).

1.6 SUBMITTALS

A. All submittals shall be made in accordance with Division 1 Requirements.

B. Submit a list identifying the specific type of material that will be used for each piping system. Include pipe, pipefittings, valves and joints. Include the basic designation of the publication applicable for each type of material and method.

C. Submit current welder qualifications for all welders proposed for this project. Welding certificates shall be for the company performing the welding at this project as directed in paragraph 3.2 - WELDING, BRAZING, AND SOLDERING.

D. Submit certified welding inspection reports as directed in paragraph 3.2 - WELDING, BRAZING, AND SOLDERING.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Domestic (Potable) Water (CW/HW/HWR) Piping System Design Pressure: 150 psig.

1. Piping, 8" and smaller - Above grade, copper tube, Type “L”, hard temper, ASTM B88. Wrought cooper or bronze fittings, solder joint, pressure rated, ASTM B16.22-95; or cast bronze fittings, solder joint, pressure rated, ASME B16.18-R94.
2. Piping, 4” and smaller – Below grade, copper tube, Type “K”, hard temper, ASTM B88. Wrought copper or bronze fittings, solder joint, pressure rated, ASTM B16.22-95; or cast bronze fittings, solder joint, pressure rated, ASME B16.18-R94.
3. One-half inch (1/2”) trap primer wastewater feed line to floor drains, same as domestic water, Type “L”, except soft-drawn copper.
4. Temperature and pressure relief lines and drain pan lines same as domestic water, Type “L” hard-drawn copper.
5. Piping above slab/grade pipe, size 1/2” to 2-1/2” may be Type “L” ASTM B-88 copper tubing.
6. Pipe Fittings, 4" and smaller - Below ground installation: Wrought Copper, ANSI B16.22.
7. Pipe fittings, 5" and larger - Below ground installation: Ductile Iron, Class 150, Cement mortar lined, with mechanical joint and/or plain ends as required. The fitting mechanical joints shall match the joints of the pipe and shall be in accordance with ANSI/AWWA C111/A21.11.
8. Solder for factory fabricated fittings: Lead-free per FPC.
9. Brazing for Mechanically formed tee fittings: Brazing may be:
   a. 5% silver, 6% phosphorus, balance copper, 1190°F melting point. AWS A5.8 number BCuP -3. J.W. Harris Stay-Silv® 5 or equal.
   b. 15% silver, 5% phosphorus, balance copper, 1190°F melting point. AWS 5.8 number BCuP-5. J.W. Harris Stay-Silv® 15 or equal.

c. 6% silver, 6.1% phosphorus, balance copper, 1190°F melting point. QQ-B-654A number BCuP -5. J.W. Harris Dynaflow® 5 or equal

10. Bolts for ductile iron mechanical joints shall be square-headed, carbon steel, ASTM A-307, Grade B. Nuts shall be heavy-duty hex type full nuts; ASTM A-194, Grade 2.

2.2 MECHANICAL JOINT SYSTEMS

A. General

1. All couplings, fittings, and gaskets shall be the products of a single manufacturer.
2. Valve ends shall be compatible with the couplings used on the connecting piping.
3. All exposed piping shall be cleaned, removing all rust, primed, and painted black. At substantial completion all exposed piping shall be free of rust and in a “like new condition”.

B. Pipe Wall Thickness (Schedule Number)

1. Where rolled groove joints are used, the pipe wall thickness may, in some cases, be decreased below that specified for the particular fluid system. In all cases, the minimum pipe wall thickness shall be in accordance with ANSI/ASME B31.9, Chapter II, using 150% of the system operating pressure as the design pressure.
2. Pipe having cut (machined) grooves shall have a nominal wall thickness of not less than the wall thickness specified for Schedule 40 pipe of the particular pipe size.
3. Non-metallic pipe shall not be joined with grooved-end pipe mechanical joints.

C. Couplings

1. Mechanical joint couplings shall be of the external type, for use with cut or rolled-groove end pipes, fittings, and valves.
2. Couplings shall be self-centering and shall engage and lock-in-place the grooved-end pipes, fittings, and gaskets.
3. All couplings shall be of the rigid style. Flexible couplings shall not be used without the written approval of the Engineer.
4. Couplings shall be Ductile Iron, ASTM A536; or malleable iron, ASTM A47, and shall be designed for not less than 250 psig at 230 Deg. F.
5. The coupling assembly shall be held together by two or more track-head, oval-neck steel bolts, ASTM A183.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Furnish and install piping, fittings and appurtenances required to complete the piping systems shown on the drawings. Elbows shall be long radius type. Tees may not be field fabricated.
2. Run piping to true alignment, generally parallel or perpendicular to building walls, floors and ceilings, and with uniform grades and spacing, so as to present a neat and workmanlike appearance.
3. Care shall be paid to the exact locations of piping with respect to equipment, ducts, conduits, slabs, beams, lighting fixtures, columns, ceiling suspension systems, etc. to provide maximum access to mechanical and electrical equipment in the building. Close coordination and cooperation shall be exercised with other trades in locating the piping in the best interests of the Owner. The drawings and specifications covering other work to be done in the building shall be carefully studied and arrangements made to avoid conflict.

4. Not all necessary pipe offsets are indicated on the drawings because of the small scale. The various runs of piping to be installed shall be studied and adjustments made in exact routings as may be required for proper installation.
5. Conflicts arising during the erection of piping shall be brought to the attention of the Owner's Representative. No improvising or field changes will be permitted without the approval of the Owner's Representative.
6. Use full lengths of pipe wherever possible. Short lengths of pipe with couplings will not be permitted. Cut to exact measurement and install without forcing or spring unless otherwise shown on the drawings or specified.
7. Avoid tool marks and unnecessary pipe threads. Burrs formed when cutting pipe shall be removed by reaming. Before installing any pipe, care shall be taken that the inside is thoroughly cleaned and free of cuttings and foreign matter. Measures shall be taken to preserve this cleanliness after erection.
8. Arrange pipe connections to valves and specialties so that there is clearance for easy removal of the valve or specialty from the line, and also for the removal of the valve bonnet and interior, and the specialty top and bottom and interior, except where otherwise approved by the Owner's Representative.
9. Erect piping in such a manner so as to obtain sufficient flexibility and to prevent excessive stresses in materials and excessive bending movements at joints or connections to equipment. Make allowances throughout for expansion and contraction of piping. Provide each riser and horizontal run of piping with expansion loops, expansion joints, or expansion compensators where indicated and required. Securely anchor and adequately guide pipe as required or where indicated to force expansion to the expansion device without bending, binding, or misalignment of pipe. Branch connections from mains to risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Where indicated, in lieu of expansion loops, expansion joints, or expansion compensators, horizontal runs of pipe shall be anchored at approximately midway of the run to force expansion, evenly divided, toward the mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining.
10. Installed piping shall not interfere with the operations or accessibility of doors or windows and shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of any equipment. Adjacent pipelines shall be grouped in the same horizontal or vertical plane.
11. Where lines are purposely pitched for drainage, an accurate grade shall be maintained. No lines shall be supported in such a manner as to permit deflection, due to gravity, sufficient to pocket the lines when full of liquid. Grade mains as indicated by arrows on the drawings and in accordance with gradient as indicated in attached Piping Schedule.
12. Piping found to have water hammer or other objectionable vibrations which cannot be eliminated by proper grading or other natural means, shall be braced, trapped, or hung with shock absorbing hangers and equipped with mechanical shock absorbers, flexible pipe connections or otherwise silenced using approved means.
13. Use building steel wherever possible for supporting pipe hangers. Main structural steel shall not be drilled, cut or burned for hangers without the approval of the Owner's Representative. Expansion bolts shall be used only upon the approval of the Owner's Representative.
14. Install unions or flanges in piping connections to equipment, regulating valves, and wherever necessary to facilitate the dismantling of piping and/or removal of valves and other items requiring maintenance.
15. Avoid bushings. Reducing fittings shall be used wherever practical.
16. The drawings indicate the size of piping and connections, and if certain sizes are omitted or unclear, obtain additional information before proceeding.
17. The piping drawings have been worked out with a view to the most economical installation, taking into consideration accessibility and appearances, and the Contractor must follow the drawings accurately and if it is found impractical to install the work in accordance with the drawings and specifications, the Contractor shall notify the Owner's Representative before

making any changes and get their approval or revised drawings before proceeding with the work. Verify all measurements on the job before cutting pipes or having piping fabricated, and be responsible for the correct location of all pipe connections, also check sizes and standard of outlets on the equipment, including the dimensions and drilling of flanges, etc.

18. Copper tubing and galvanized steel shall not be mixed in any one run of piping.
19. Change in direction shall be made with fittings, except that bending of steel and copper pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall be not less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations is not acceptable.
20. Threaded joints shall be made with tapered threads in accordance with ANSI B2.1 and made tight with an approved pipe thread joint compound or material, applied to the male threads only. Use compounds sparingly and apply with caution to ensure that compounds do not enter piping systems. When pipe joint is made up a maximum of 3 threads shall be visible.
21. Joints for plastic pipe shall be made in accordance with PPI Piping Manual.
22. Connections between ferrous and nonferrous metallic pipe shall be made with dielectric unions or flanges.
23. Connections between plastic and metallic pipe, between plastic and glass pipe, and between metallic and glass pipe, shall be made with transition fittings manufactured for the specific purpose.
24. Unions and flanges shall not be concealed in walls, partitions, or above inaccessible ceilings.

B. Plumbing Systems Additional Requirements

1. Bends, plugs, or tees in water service lines, except soldered or screwed joints, shall be braced or clamped. The connection between the water service line and the domestic water distribution line shall be anchored by means of tie rods and pipe clamps.
2. Before connecting the domestic water system to underground supply connections, each supply connection shall be thoroughly flushed of all foreign matter.
3. Vertical cast iron soil pipe hubs inside buildings shall extend 6 inches above concrete slab-on-grade floors.
4. Provide test tees with screwed plugs in waste and vent systems to isolate sections of system previously tested from section of system under test. Distance between test tees on vertical lines shall not exceed static height allowable for system pressure limitations. All joints in test tees, including plugs, shall be tested under pressure as specified for system tests.
5. Joints between cast-iron pipe and copper tube shall be made by using a brass-caulking ferrule and properly soldering the copper tube to the ferrule prior to pouring the lead.
6. Joints between cast-iron and vitrified clay piping shall be made using either hot-poured bitumastic compound, or by a preformed elastomeric ring conforming to ASTM C564. The ring shall, after ramming, completely fill the annular space between the cast-iron spigot and the vitrified clay hub.
7. Joints between copper tubing and threaded pipe shall be made by the use of brass adapters or dielectric fittings. The joint between the copper tubing and the fitting shall be soldered, and the connection between the threaded pipe and the fitting shall be a standard pipe size screw joint.
8. Joints between steel and cast-iron pipe shall be either caulked or threaded or made with approved adapter fittings.
9. Install horizontal drainage piping in uniform alignment at uniform slopes that will produce a computed velocity of not less than 2 feet per second when flowing half full, or a minimum of 1/8" per ft. unless noted otherwise.
10. The underground water service pipe and the building sewer shall be not less than 10 feet apart horizontally, and shall be separated by undisturbed, or compacted, earth, unless the following requirements are satisfied:

a. The water service pipe and the building sewer may be installed in the same trench, provided written approval is given by the plumbing official and the following conditions are met:
   1) The bottom of the water service pipe at all points shall be not less than 12 inches above the top of the sewer line at its highest point.
   2) The water service pipe shall be placed on a solid shelf excavated at one side of the common trench.
   3) The number of joints in the service pipe shall be kept to a minimum.
   4) The materials and joints in the sewer pipe shall be installed in such manner, and shall possess the necessary strength and durability, to prevent the escape of solids, liquids, and gases there from under all known adverse conditions such as corrosion, strains due to temperature changes, settlements, vibration, and super-imposed loads.
   5) Where the water service line must cross the building sewer line, the bottom of the water service line within 10 feet of the point of crossing shall be at least 12 inches above the top of the sewer line. The sewer line shall be of cast iron, with leaded or mechanical joints, within 10 feet of the point of crossing.
   6) Domestic water lines shall be disinfected.

11. Provide access panels for all valves located above non-accessible ceiling. Coordinate with Architectural plans for exact locations.
12. Installation of copper tubing shall be per FPC, ASTM B32-96, and per Copper Development Association and ASTM B828-92-E01.
13. Install plugs or caps on all openings during the construction phase. The temporary plug shall be cap of same material as pipe. Duct tape is unacceptable for use as a plug for the construction phase.
14. All penetrations of piping through walls shall be made insect proof, (i.e., penetrations of waste arms, hot and cold-water piping through walls below sinks, lavatories, water closets, etc.). The escutcheon plate does constitute an “insect proof” closure.
15. Teflon tape shall be used on threaded connections. Expansion loops on hot water system shall be installed per manufacturer’s instructions to suit temperature and pipe run.
16. Mechanically formed branch connections, commonly termed extruded outlets, shall be made in a continuous operation consisting of producing a pilot hole, drawing out the tube/pipe surface to form an outlet and facing of the outlet rim (including beveling when required). An integral pipe heating operation may be included, after the cutting of the pilot hole on Schedule 40 wall thickness. The outlet device shall be fully adjustable to insure proper tolerance and complete uniformity of the joint. Materials should have a minimum elongation of 20-25% to be acceptable for forming.
17. The extruded outlet and butt weld connection shall be in accordance with ASME Boiler and Pressure Vessel Code, as listed under ANSI B31 Standards.

C. Plastic Pipe Systems Additional Requirements

1. Joints between plastic pipe and other materials shall be subject to the following requirements:
   a. Joints between different grades of plastic pipe shall be made by use of an approved adapter fitting.
   b. Joints between the hub of cast-iron soil pipe and plastic pipe shall be made by use of a mechanical joint of the compression or mechanical sealing type.
   c. Joints between plastic pipe and cast-iron pipe, steel pipe, glass pipe, copper tube, and other piping materials shall be made by use of an approved adapter fitting.
2. Plastic pipe, fittings, and solvent cement used for domestic hot and cold-water service shall bear the NSF seal for potable water.
3. Plastic pipe, fittings, and solvent cement shall not be used in systems where temperature, and operating pressure plus system static head, exceeds materials temperature and pressure limitations.

4. Plastic vent piping shall not pass-through roofs, firewalls, or fire partitions. Plastic waste and vent piping shall be installed in fire rated pipe chases when passing through floors or approved fire stop sleeve.
5. All PVC/plastic piping in return air plenums, existing to remain or new, shall have a 2-hour fire wrap installed per NFPA and the FBC. Contractor to fully verify existing conditions prior to bid, PVC/plastic piping may not be shown on the drawings as an existing condition. Submission of a proposal will be construed as evidence that such an examination has been made and the contractor fully understands the scope of work. Later claims for labor, equipment or materials required will not be recognized.

D. Mechanical Joint System Additional Requirements: Install in strict accordance with the manufacturer's written installation instructions.

3.2 WELDING, BRAZING, AND SOLDERING

A. Operator and Procedure Qualifications: All welding and/or brazing operators and all welding and brazing procedures shall be qualified in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code.

B. Welding

1. All pipe welding performed under this division of the specifications shall be examined in accordance with ANSI B31.1 requirements for each piping system. The pipe weld examination is hereby made a part of the work of this division of the specifications. An independent outside inspection firm, regularly performing this type of examination, shall be hired by the contractor or subcontractor performing the welding as part of the work of their contract. The examination shall be performed by a representative of the Inspection Company (hereafter called the Inspector) who is qualified and certified for each examination method required.
2. The Inspection Company performing the examination shall certify in writing that all pipe welds performed under this contract conform to the requirements of ANSI B31.1 for each piping system and to all other governing codes.
3. Before final acceptance of the welded piping, certified test reports shall be submitted for review. The reports shall include the following data: name and location of project, date of test, type of piping system, working pressure and temperature, standard used for testing and applicable test method, number and location of welds tested and names of persons performing test.
4. Welders and procedures for fire protection system piping qualified in accordance with NFPA No. 13.

C. Brazing: Silver braze joints in accordance with MSS-SP-73 "Silver Brazing Joints for Wrought and Cast Solder Joint Fittings".

D. Soldering: Joints in copper tubing shall be made with solder type fittings. Outside surface of the tube where engaged in the fitting, and inside surface of the fitting in contact with the tube, shall be cleaned with an abrasive material before soldering. Self-cleaning compounds shall not be used. Care shall be taken to prevent annealing of tube and fittings when making connections. The solder joint shall be made with flux and wire form solder, except brazed joints. The flux shall be a mildly corrosive liquid, or a petroleum-based paste containing chlorides of zinc and ammonium. Solder shall be applied and drawn through the full fitting length. Excess solder shall be wiped from joint before solder hardens. Joints in copper tube sizes 2-1/2 inches and larger shall be made with heat applied uniformly around the entire circumference of the tube and fittings by a multi-flame torch. Use of oxy-acetylene cutting torch in lieu of multi-flame torch is not permitted. Disassemble valves and other accessories that may be damaged by heat before soldering.

3.3 TESTING OF PIPING SYSTEMS:

A. Each piping system, after erection, shall be subjected to a pressure test. The test requirements shall be as follows:

1. Plumbing related systems shall be tested with water at not less than a 10-foot head. The water shall be kept in the systems for a period of not less than 15 minutes prior to start of visual examination. In lieu of water test, the systems may be tested with air at a uniform pressure of 5 psig, with no loss in pressure for a period of not less than 15 minutes.
2. Domestic Water Distribution Systems shall be tested with water at the system working pressure, but not less than 100 psig. Joints will be visually examined for leaks.
3. Domestic Water Service System shall be tested with water at 150 psig. Joints will be visually examined for leaks.
4. Leaks, if any, shall be located, repaired, and retested in accordance with the test method specified for the system in which the leaks are located.

B. Prior to testing a system, the Contractor shall provide the proper Building Official and the Owner's Representative with not less than 24 hours notice of the proposed test. The Contractor shall obtain approval of the test results. Where written approval is required, the Contractor shall obtain such written approval, and submit a copy of the approval.

C. Work requiring testing shall not be covered, or otherwise concealed, until testing is completed, and approval is granted.

D. Work, or portions of work, that is altered in any way after testing and approval shall be retested, witnessed, and approval obtained.

E. Systems requiring hydrostatic tests shall be protected from damage caused by freezing. After tests are completed drain all sections of pipe, including traps, or fill undrained sections and traps with antifreeze solution. Vent all high points to release vacuum and ensure complete drainage of closed systems and blow out piping with compressed air to remove trapped water.

F. Duration of tests, unless specified otherwise, shall be the time required to examine each joint in the system being tested.

G. Systems requiring hydrostatic testing under pressure shall be vented at high points to ensure that all piping is completely filled with the testing medium.

H. Disconnect pressure boosting apparatus, or vacuum pumps, during the test time span specified for systems employing the pressure loss/time span test method.

I. During tests, isolate system components that have test pressures less than pressures specified for system tests.

J. Use clean soapy water applied to exterior of joints to locate leaks in systems using compressed air, dry carbon dioxide, or nitrogen, under positive pressure as a test medium.

3.4 CLEANING OF PIPING SYSTEMS

A. Plumbing piping systems shall be thoroughly cleaned as described in Section 22 11 17 - Disinfection of Domestic Water Lines. The chlorination and disinfections process shall be witnessed by a representative of the owner and provide a written Certification, as such.

END OF SECTION

SECTION 22 11 17
DISINFECTION OF DOMESTIC WATER LINES

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.

B. Refer to Division 1 for all requirements pertaining to General Provisions.

1.2 WORK INCLUDED

A. Provide personnel, equipment, and supplies, disinfect domestic hot and cold-water systems, and flush out systems at completion of treatment.

1.3 DEFINITIONS

A. Disinfectant Residual means the quantity of disinfectant in treated water.

B. pH Factor means the measure of alkalinity and acidity in water.

C. ppm means parts per million.

1.4 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced.

1. American Waterworks Association (AWWA) Standards.
2. Standard Methods for the Examination of Water & Wastewater (14th edition).

1.5 QUALITY ASSURANCE

A. Water Treatment Contractor: At least 5 years' experience performing work specified herein.

B. Bacteriological Laboratory: State certification.

1.6 SUBMITTALS

A. General: Submit product literature for approval in accordance with Division 1.

B. Water Treatment Contractor's evidence of experience: Submit three (3) copies.

C. Bacteriological Laboratory's evidence of certification: Submit three (3) copies.

D. Test Reports: Submit four (4) copies as follows:

1. Disinfection Report, include:
   a. Date issued.
   b. Project name and location.
   c. Treatment Contractor's name, address, and phone number.
   d. Type and form of Disinfectant used.
   e. Time and date of Disinfectant injection start.
   f. Time and date of Disinfectant injection completion.
   g. Test locations.

h. Initial and 24-hour Disinfectant Residuals in ppm for each outlet tested.
i. Time and date of flushing start.
j. Time and date of flushing completion.
k. Disinfectant Residual after flushing in ppm for each outlet tested.

2. Bacteriological Report. Include:
   a. Date issued.
   b. Project name and location.
   c. Laboratory's name, certification number, address, and phone number.
   d. Time and date of water sample collection.
   e. Name of person collecting samples.
   f. Test locations.
   g. Time and date of laboratory test start.
   h. Coliform bacteria test results for each outlet tested.
   i. Certification that water conforms or fails to conform to bacterial standards or fails to conform to bacterial standards of Federal Safe Drinking Water Act.
   j. Bacteriologist's signature.

1.7 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. Protect against damage and contamination.

B. Maintain caution labels on hazardous materials.

C. Maintain storage room dry and with temperatures as uniform as possible between 60°F and 80°F.

D. Do not store Caustic Soda directly on floor colder than 55°F.

1.8 PROTECTION

A. Provide necessary signs, barricades, and notices to prevent any person from accidentally consuming water or disturbing system being treated.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

A. Materials and equipment shall conform to the respective publications and other requirements specified herein.

B. Disinfectant: Free chlorine; liquid, powder, tablet, or gas.

C. Alkali: Caustic Soda or Soda Ash.

D. Acid: Hydrochloric (Muriatic) type.

PART 3 - EXECUTION

3.1 INSPECTION

A. Prior to starting work verify that the domestic water system is completed and cleaned.

B. Notify Contractor about defects requiring correction.

C. Do not start work until conditions are satisfactory.

3.2 PREPARATION OF WATER FOR TREATMENT

A. Verify pH factor of water to be treated.

B. If pH factor is less than 7.2, introduce sufficient Alkali during Disinfectant injection.

C. If pH factor is greater than 7.6, introduce sufficient Acid during Disinfectant injection.

3.3 SYSTEM TREATMENT

A. Injection Disinfectant throughout system to obtain 50 to 80 ppm residual.

B. Starting at outlet closest to water source, bleed water from each outlet until water produces odor of Disinfectant. Repeat process at each outlet throughout system. If odorless Disinfectant is used testing is required to determine if Disinfectant is fully dispersed throughout system.

C. Test for Disinfectant Residual at each of the following locations:

1. Ends of piping runs.
2. Remote outlets.
3. At least 15% of outlets on each floor where directed by Architect, but in no case less than 2 outlets.

D. Maintain Disinfectant in system for 24 hours.

E. If Disinfectant Residual is less than 25 ppm, repeat system treatment.

3.4 FLUSHING

A. Remove Disinfectant from system; permit no more than residual rate of incoming water or 1.0 ppm, whichever is greater.

3.5 BACTERIOLOGICAL TEST

A. Instruct Bacteriological Laboratory to take water samples no sooner than 24 hours after flushing system.

B. Take water samples at each of the following locations:
1. Where water enters system.
2. Ends of piping runs.
3. Remote outlets.
4. At least 10% of outlets on each floor other than those used for testing Disinfectant Residual, where directed by Architect, but in no case less than two (2) outlets.

C. Analyze water samples in accordance with AWWA Standard Methods for the Examination of Water & Wastewater, 14th edition.

D. If bacteriological test proves water quality to be unacceptable, repeat system treatment until water quality is acceptable.

END OF SECTION

SECTION 22 13 16
SANITARY DRAIN, WASTE AND VENT PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Division 1 for all requirements pertaining to General Provisions.

1.2 WORK INCLUDED

A. Sanitary Drain, Waste and Vent (DWV).

1.3 DEFINITIONS

A. Pipe sizes given in this document are nominal.

1.4 QUALITY ASSURANCE

A. All material provided under this section shall be standard catalogued products of recognized manufacturers regularly engaged in the production of such products and shall be of the manufacturer's most recent design that is in regular production.

B. Each item provided under this section shall meet the requirements for that item as installed and used.

C. Each piping system shall be in accordance with the system design pressures shown in paragraph 2.1 - Materials, this specification section.

D. All materials provided under this section shall be new, except where the specifications and/or drawings permit the reuse of certain existing materials.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referenced in the text by the basic designation only.

B. The work and materials listed in this Section shall be provided in accordance with the standards and requirements set forth in the applicable portions of the latest editions of the referenced publications.

C. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

1. American National Standards Institute (ANSI) Standards
2. American Petroleum Institute (API) Specification
3. American Society of Mechanical Engineers (ASME) Publications
4. American Society for Testing and Materials (ASTM) Publications
5. American Welding Society (AWS) Publication
6. American Water Works Association (AWWA) Standards
7. Cast Iron Soil Pipe Institute (CISPI) Standards
8. The Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS) Publications

9. National Fire Protection Association (NFPA) Standards
10. National Sanitation Foundation (NSF) Testing Laboratory Standards.
11. Plastic Pipe Institute (PPI) Manual.
12. Underwriters Laboratories (UL)

1.6 SUBMITTALS

A. All submittals shall be made in accordance with Division 1 requirements.

B. Submit a list identifying the specific type of material that will be used for each piping system. Include pipe, fittings, valves, hangers and supports. Include the designation of the publication applicable for each type of material and method.

C. Submit current welder qualifications for all welders proposed for this project. Welding certificates shall be for the company performing the welding at this project as directed in paragraph 3.2 - WELDING, BRAZING, AND SOLDERING.

D. Submit certified welding inspection reports as directed in paragraph 3.2 - WELDING, BRAZING, AND SOLDERING.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Sanitary Drain, Waste and Vent (DWV) Piping

1. Underground sanitary piping:
   a. No-hub cast iron pipe and fittings, CISPI Standard 301, ASTM A-888-98el.
   b. Service weight hub and spigot pipe and fittings, Fed. Spec. WW-P-401F, ASTM-A74-98, CISPI-301.
   c. No-hub couplings, CISPE Standard 310-97.
   d. Charlotte Seal Gaskets, ASTM C-564-97, CISPI-HSN.
   e. Warco-Quik-Tite Gaskets, ASTM C-564-94, CISPI-HSN.
   f. Schedule 40, PVC-DWV drainage pattern, conforming to the following standards:
      1) ASTM D-1784 – Rigid PVC Vinyl Components.
      2) ASTM D-1785 – PVC Plastic Pipe, Schedule 40.
      3) ASTM D-2665 – PVC Drain, Waste and Vent Pipe and Fittings.
      4) ASTM D-2564 – Solvent Cements for PVC Pipe and Fittings.
      5) NSF Standard 14 – Plastic Piping Components and Related Materials.
   g. Pipe Size 15” – PVC pipe and fittings, ASTM D-3034 or ASTM F-679, SDR 35 gasket.
   h. Pipe Size 18”, 21”, 24” and 27” – PVC pipe and fittings, ASTM F-679, SDR 35 gasket.
   i. PP Schedule 40 polypropylene, ASTM D635 and ASTM F1412, drainage pattern, mechanical joint stainless-steel components, ASTM B117. Polypropylene shall be used where indicated on the drawings and as specified herein.
2. Above-ground sanitary and vent piping:
   a. No-hub cast iron pipe and fittings, CISPI Standard 301, ASTM A-888-98el.
   b. Service weight hub and spigot pipe and fittings, Fed. Spec. WW-P-401F, ASTM-A74-98, CISPI-301.
   c. No-hub couplings, CISPI Standard 310.
   d. Charlotte Seal Gaskets, ASTM C-564, CISPI-HSN.
   e. Warco-Quik-Tite Gaskets, ASTM C-564-97, CISPI-HSN.
   f. 2” and smaller Type DWV hard-drawn copper tubing, ASTM B-306 with copper drainage pattern and (lead-free) solder 95-5 Tin-antimony.
3. ½” to 1”: Same as domestic water, Type “L” hard-drawn, or Schedule 40 PVC pipe and solvent joint fittings.
4. 1-1/4” to 2” copper drainage tube, DWV Kitchen (Kitchen sinks and equipment waste).

5. PVC Foam core DWV pipe, ASTM F891, is not and shall not be approved under any circumstances nor installed on this project.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Furnish and install piping, fittings and appurtenances required to complete the piping systems shown on the drawings. Elbows shall be long radius type. Tees may not be field fabricated.
2. Run piping to true alignment, generally parallel or perpendicular to building walls, floors and ceilings, and with uniform grades and spacing, so as to present a neat and workmanlike appearance.
3. Care shall be paid to the exact locations of piping with respect to equipment, ducts, conduits, slabs, beams, lighting fixtures, columns, ceiling suspension systems, etc. to provide maximum access to mechanical and electrical equipment in the building. Close coordination and cooperation shall be exercised with other trades in locating the piping in the best interests of the Owner. The drawings and specifications covering other work to be done in the building shall be carefully studied and arrangements made to avoid conflict.
4. Not all necessary pipe offsets are indicated on the drawings because of the small scale. The various runs of piping to be installed shall be studied and adjustments made in exact routings as may be required for proper installation.
5. Conflicts arising during the erection of piping shall be brought to the attention of the Owner's Representative. No improvising or field changes will be permitted without the approval of the Owner's Representative.
6. Use full lengths of pipe wherever possible. Short lengths of pipe with couplings will not be permitted. Cut to exact measurement and install without forcing or spring unless otherwise shown on the drawings or specified.
7. Avoid tool marks and unnecessary pipe threads. Burrs formed when cutting pipe shall be removed by reaming. Before installing any pipe, care shall be taken that the inside is thoroughly cleaned and free of cuttings and foreign matter. Measures shall be taken to preserve this cleanliness after erection.
8. Arrange pipe connections to valves and specialties so that there is clearance for easy removal of the valve or specialty from the line, and also for the removal of the valve bonnet and interior, and the specialty top and bottom and interior, except where otherwise approved by the Owner's Representative.
9. Erect piping in such a manner so as to obtain sufficient flexibility and to prevent excessive stresses in materials and excessive bending movements at joints or connections to equipment. Make allowances throughout for expansion and contraction of piping. Provide each riser and horizontal run of piping with expansion loops, expansion joints, or expansion compensators where indicated and required. Securely anchor and adequately guide pipe as required or where indicated to force expansion to the expansion device without bending, binding, or misalignment of pipe. Branch connections from mains to risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Where indicated, in lieu of expansion loops, expansion joints, or expansion compensators, horizontal runs of pipe shall be anchored at approximately midway of the run to force expansion, evenly divided, toward the mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining.
10. Installed piping shall not interfere with the operations or accessibility of doors or windows and shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of any equipment. Adjacent pipelines shall be grouped in the same horizontal or vertical plane.

11. Where lines are purposely pitched for drainage, an accurate grade shall be maintained. No lines shall be supported in such a manner as to permit deflection, due to gravity, sufficient to pocket the lines when full of liquid. Grade mains as indicated by arrows on the drawings and in accordance with gradient as indicated in attached Piping Schedule.
12. Piping found to have water hammer or other objectionable vibrations which cannot be eliminated by proper grading or other natural means, shall be braced, trapped, or hung with shock absorbing hangers and equipped with air chambers, mechanical shock absorbers, flexible pipe connections or otherwise silenced using approved means.
13. Use building steel wherever possible for supporting pipe hangers. Main structural steel shall not be drilled, cut, or burned for hangers without the approval of the Owner's Representative. Expansion bolts shall be used only upon the approval of the Owner's Representative.
14. Install unions or flanges in piping connections to equipment, regulating valves, and wherever necessary to facilitate the dismantling of piping and/or removal of valves and other items requiring maintenance.
15. Avoid bushings. Reducing fittings shall be used wherever practical.
16. The drawings indicate the size of piping and connections, and if certain sizes are omitted or unclear, obtain additional information before proceeding.
17. The piping drawings have been worked out with a view to the most economical installation, taking into consideration accessibility and appearances, and the Contractor must follow the drawings accurately and if it is found impractical to install the work in accordance with the drawings and specifications, the Contractor shall notify the Owner's Representative before making any changes and get their approval or revised drawings before proceeding with the work. Verify all measurements on the job before cutting pipes or having piping fabricated, and be responsible for the correct location of all pipe connections, also check sizes and standard of outlets on the equipment, including the dimensions and drilling of flanges, etc.
18. Copper tubing and galvanized steel shall not be mixed in any one run of piping.
19. Change in direction shall be made with fittings, except that bending of steel and copper pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall be not less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations is not acceptable.
20. Threaded joints shall be made with tapered threads in accordance with ANSI B2.1 and made tight with an approved pipe thread joint compound or material, applied to the male threads only. Use compounds sparingly and apply with caution to ensure that compounds do not enter piping systems. When pipe joint is made up a maximum of 3 threads shall be visible.
21. Joints for plastic pipe shall be made in accordance with PPI Piping Manual.
22. Connections between ferrous and nonferrous metallic pipe shall be made with dielectric unions or flanges.
23. Connections between plastic and metallic pipe, between plastic and glass pipe, and between metallic and glass pipe, shall be made with transition fittings manufactured for the specific purpose.
24. Unions and flanges shall not be concealed in walls, partitions, or above inaccessible ceilings.

B. Plumbing Systems Additional Requirements:

1. Bends, plugs, or tees in water service lines, except soldered or screwed joints, shall be braced or clamped. The connection between the water service line and the domestic water distribution line shall be anchored by means of tie rods and pipe clamps.
2. Before connecting the domestic water system to underground supply connections, each supply connection shall be thoroughly flushed of all foreign matter.
3. Vertical cast iron soil pipe hubs inside buildings shall extend 6 inches above concrete slab-on-grade floors.

4. Provide test tees with screwed plugs in waste and vent systems to isolate sections of system previously tested from section of system under test. Distance between test tees on vertical lines shall not exceed static height allowable for system pressure limitations. All joints in test tees, including plugs, shall be tested under pressure as specified for system tests.
5. Joints between cast-iron pipe and copper tube shall be made by using a brass-caulking ferrule and properly soldering the copper tube to the ferrule prior to pouring the lead.
6. Joints between cast-iron and vitrified clay piping shall be made using either hot-poured bitumastic compound, or by a preformed elastomeric ring conforming to ASTM C564. The ring shall, after ramming, completely fill the annular space between the cast-iron spigot and the vitrified clay hub.
7. Joints between copper tubing and threaded pipe shall be made by the use of brass adapters or dielectric fittings. The joint between the copper tubing and the fitting shall be soldered, and the connection between the threaded pipe and the fitting shall be a standard pipe size screw joint.
8. Joints between steel and cast-iron pipe shall be either caulked or threaded or made with approved adapter fittings.
9. Install horizontal drainage piping in uniform alignment at uniform slopes that will produce a computed velocity of not less than 2 feet per second when flowing half full, or a minimum of 1/8" per ft. unless noted otherwise.
10. The underground water service pipe and the building sewer shall be not less than 10 feet apart horizontally, and shall be separated by undisturbed, or compacted, earth, unless the following requirements are satisfied:
    a. The water service pipe and the building sewer may be installed in the same trench, provided written approval is given by the plumbing official and the following conditions are met:
        1) The bottom of the water service pipe at all points shall be not less than 12 inches above the top of the sewer line at its highest point.
        2) The water service pipe shall be placed on a solid shelf excavated at one side of the common trench.
        3) The number of joints in the service pipe shall be kept to a minimum.
        4) The materials and joints in the sewer pipe shall be installed in such manner, and shall possess the necessary strength and durability, to prevent the escape of solids, liquids, and gases there from under all known adverse conditions such as corrosion, strains due to temperature changes, settlements, vibration, and super-imposed loads.
        5) Where the water service line must cross the building sewer line, the bottom of the water service line within 10 feet of the point of crossing shall be at least 12 inches above the top of the sewer line. The sewer line shall be of cast iron, with leaded or mechanical joints, within 10 feet of the point of crossing.
11. Provide access panels for all valves located above non-accessible ceiling. Coordinate with Architectural plans for exact locations.
12. Provide clean-outs at the base of all sanitary waste and vent stacks.
13. Installation of copper tubing shall be per FPC, ASTM B32-96, and per Copper Development Association and ASTM B828-92-E01.
14. Install plugs or caps on all openings during the construction phase. The temporary plug shall be cap of same material as pipe. Duct tape is unacceptable for use as a plug for the construction phase.
15. All penetrations of piping through walls shall be made insect proof, (i.e., penetrations of waste arms, hot and cold-water piping through walls below sinks, lavatories, water closets, etc.). The escutcheon plate does constitute an “insect proof” closure.
16. Mechanically formed branch connections, commonly termed extruded outlets, shall be made in a continuous operation consisting of producing a pilot hole, drawing out the tube/pipe surface to form an outlet and facing of the outlet rim (including beveling when required). An integral pipe heating operation may be included, after the cutting of the pilot hole on Schedule 40 wall thickness. The outlet device shall be fully adjustable to insure

proper tolerance and complete uniformity of the joint. Materials should have a minimum elongation of 20-25% to be acceptable for forming.

17. The extruded outlet and butt weld connection shall be in accordance with ASME Boiler and Pressure Vessel Code, as listed under ANSI B31 Standards.

C. Plastic Pipe Systems Additional Requirements

1. Joints between plastic pipe and other materials shall be subject to the following requirements:
   a. Joints between different grades of plastic pipe shall be made by use of an approved adapter fitting.
   b. Joints between the hub of cast-iron soil pipe and plastic pipe shall be made by use of a mechanical joint of the compression or mechanical sealing type.
   c. Joints between plastic pipe and cast-iron pipe, steel pipe, glass pipe, copper tube, and other piping materials shall be made by use of an approved adapter fitting.
2. Plastic pipe, fittings, and solvent cement used for domestic hot and cold-water service shall bear the NSF seal for potable water.
3. Plastic pipe, fittings, and solvent cement shall not be used in systems where temperature, and operating pressure plus system static head, exceeds materials temperature and pressure limitations.
4. Plastic vent piping shall not pass-through roofs, firewalls, or fire partitions. Plastic waste and vent piping shall be installed in fire rated pipe chases when passing through floors or approved fire stop sleeve.
5. Plastic piping materials shall not be installed in air plenums, air chambers, or airshafts.

3.2 WELDING, BRAZING, AND SOLDERING

A. Operator and Procedure Qualifications: All welding and/or brazing operators and all welding and brazing procedures shall be qualified in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code.

B. Welding

1. All pipe welding performed under this division of the specifications shall be examined in accordance with ANSI B31.1 requirements for each piping system. The pipe weld examination is hereby made a part of the work of this division of the specifications. An independent outside inspection firm, regularly performing this type of examination, shall be hired by the contractor or subcontractor performing the welding as part of the work of their contract. The examination shall be performed by a representative of the Inspection Company (hereafter called the Inspector) who is qualified and certified for each examination method required.
2. The Inspection Company performing the examination shall certify in writing that all pipe welds performed under this contract conform to the requirements of ANSI B31.1 for each piping system and to all other governing codes.
3. Before final acceptance of the welded piping, certified test reports shall be submitted for review. The reports shall include the following data: name and location of project, date of test, type of piping system, working pressure and temperature, standard used for testing and applicable test method, number and location of welds tested and names of persons performing test.
4. Welders and procedures for fire protection system piping qualified in accordance with NFPA No. 13.

C. Brazing: Silver braze joints in accordance with MSS-SP-73 "Silver Brazing Joints for Wrought and Cast Solder Joint Fittings".

D. Soldering: Joints in copper tubing shall be made with solder type fittings. Outside surface of the tube where engaged in the fitting, and inside surface of the fitting in contact with the tube, shall be cleaned with an abrasive material before soldering. Self-cleaning compounds shall not be used. Care shall be taken to prevent annealing of tube and fittings when making connections. The solder joint shall be made with flux and wire form solder, except brazed joints. The flux shall be a mildly corrosive liquid, or a petroleum-based paste containing chlorides of zinc and ammonium. Solder shall be applied and drawn through the full fitting length. Excess solder shall be wiped from joint before solder hardens. Joints in copper tube sizes 2-1/2 inches and larger shall be made with heat applied uniformly around the entire circumference of the tube and fittings by a multi-flame torch. Use of oxy-acetylene cutting torch in lieu of multi-flame torch is not permitted. Disassemble valves and other accessories that may be damaged by heat before soldering.

3.3 TESTING OF PIPING SYSTEMS:

A. Each piping system, after erection, shall be subjected to a pressure test. The test requirements shall be as follows:

1. General: Furnish everything required for the tests. Notify Architect/Engineer at least 48 hours before any testing is performed. Independent Agent/Owner shall verify pressure test and sign off. Report to be furnished to Architect/Engineer. Testing shall be performed at the completion of each phase of the project.
2. Plumbing-related systems shall be tested with water at not less than a 10-foot head. The water shall be kept in the systems for a period of not less than 15 minutes prior to start of visual examination. In lieu of water test, the systems may be tested with air at a uniform pressure of 5 psig, with no loss in pressure for a period of not less than 15 minutes.
3. The building sewer shall be tested by insertion of a test plug at the point of connection with the public sewer and filled with water under a head of not less than 10 feet, with no drop in water level for a period of not less than 15 minutes.
4. Domestic Water Distribution Systems shall be tested with water at the system working pressure, but not less than 100 psig. Joints will be visually examined for leaks.
5. Domestic Water Distribution Systems utilizing Viega Pro-*Press* fittings with SC Feature Contour Design shall be initially tested at a minimum of ½ psig but not more than 85 psig. Joints shall be visually examined for leaks.
6. Domestic Water Service System shall be tested with water at 150 psig. Joints will be visually examined for leaks.
7. Leaks, if any, shall be located, repaired, and retested in accordance with the test method specified for the system in which the leaks are located.

B. Prior to testing a system, the Contractor shall provide the proper Building Official and the Owner's Representative with not less than 72 hours' notice of the proposed test. The Contractor shall obtain approval of the test results. Where written approval is required, the Contractor shall obtain such written approval, and submit a copy of the approval.

C. Work requiring testing shall not be covered, or otherwise concealed, until testing is completed, and approval is granted.

D. Work, or portions of work, that is altered in any way after testing and approval shall be retested, witnessed, and approval obtained.

E. Systems requiring hydrostatic tests shall be protected from damage caused by freezing. After tests are completed drain all sections of pipe, including traps, or fill undrained sections and traps with antifreeze solution. Vent all high points to release vacuum and ensure complete drainage of closed systems and blow out piping with compressed air to remove trapped water.

F. Duration of tests, unless specified otherwise, shall be the time required to examine each joint in the system being tested.

G. Systems requiring hydrostatic testing under pressure shall be vented at high points to ensure that all piping is completely filled with the testing medium.

H. Disconnect pressure boosting apparatus, or vacuum pumps, during the test time span specified for systems employing the pressure loss/time span test method.

I. During tests, isolate system components that have test pressures less than pressures specified for system tests.

J. Use clean soapy water applied to exterior of joints to locate leaks in systems using compressed air, dry carbon dioxide, or nitrogen, under positive pressure as a test medium.

END OF SECTION

SECTION 22 14 13
FACILITY STORM DRAINAGE PIPING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Section 22 05 00 for requirements pertaining to Common Work Results for Plumbing Systems.

1.2 WORK INCLUDED

A. Storm Water (Condensate) Piping.

1.3 DEFINITIONS

A. The pipe sizes given in this document are nominal.

1.4 QUALITY ASSURANCE

A. All material provided under this section shall be standard catalogued products of recognized manufacturers regularly engaged in the production of such products and shall be of the manufacturer's most recent design that is in regular production.

B. Each item provided under this section shall meet the requirements for that item as installed and used.

C. Each piping system shall be in accordance with the system design pressures shown in paragraph 2.1 - Materials, this specification section.

D. All materials provided under this section shall be new, except where the specifications and/or drawings permit the reuse of certain existing materials.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referenced in the text by the basic designation only.

B. The work and materials listed in this Section shall be provided in accordance with the standards and requirements set forth in the applicable portions of the latest editions of the referenced publications.

C. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

1. American National Standards Institute (ANSI) Standards.
2. American Petroleum Institute (API) Specification.
3. American Society of Mechanical Engineers (ASME) Publications.
4. American Society for Testing and Materials (ASTM) Publications.
5. American Welding Society (AWS) Publication.
6. American Water Works Association (AWWA) Standards.
7. Cast Iron Soil Pipe Institute (CISPI) Standards.

8. The Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS) Publications.
9. National Fire Protection Association (NFPA) Standards.
10. National Sanitation Foundation (NSF) Testing Laboratory Standards.
11. Plastic Pipe Institute (PPI) Manual.
12. Plumbing and drainage institute.
13. Underwriters Laboratories (UL).

1.6 SUBMITTALS

A. All submittals shall be made in accordance with Section 22 05 00 requirements.

B. Submit a list identifying the specific type of material that will be used for each piping system. Include pipe, pipefittings, valves, and joints. Include the basic designation of the publication applicable for each type of material and method.

C. Submit current welder qualifications for all welders proposed for this project. Welding certificates shall be for the company performing the welding at this project as directed in paragraph 3.2 - WELDING, BRAZING, AND SOLDERING.

D. Submit certified welding inspection reports as directed in paragraph 3.2 - WELDING, BRAZING, AND SOLDERING.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Storm Water Piping

1. Underground piping:
   a. No-hub cast iron pipe and fittings, CISPI Standard 301, ASTM A-888-98el.
   b. Service weight hub and spigot pipe and fittings, Fed. Spec. WW-P-401F, ASTM-A74-98, CISPI-301.
   c. No-hub couplings, CISPE Standard 310-97.
   d. Charlotte Seal Gaskets, ASTM C-564-97, CISPI-HSN.
   e. Warco-Quik-Tite Gaskets, ASTM C-564-94, CISPI-HSN.
   f. Schedule 40, PVC-DWV drainage pattern, conforming to the following standards:
      1) ASTM D-1784 – Rigid PVC Vinyl Components.
      2) ASTM D-1785 – PVC Plastic Pipe, Schedule 40.
      3) ASTM D-2665 – PVC Drain, Waste and Vent Pipe and Fittings.
      4) ASTM D-2564 – Solvent Cements for PVC Pipe and Fittings.
      5) NSF Standard 14 – Plastic Piping Components and Related Materials.
   g. Pipe Size 15” – PVC pipe and fittings, ASTM D-3034 or ASTM F-679, SDR 35 gasket.
   h. Pipe Size 18”, 21”, 24” and 27” – PVC pipe and fittings, ASTM F-679, SDR 35 gasket.
   i. PP Schedule 40 polypropylene, ASTM D635 and ASTM F1412, drainage pattern, mechanical joint stainless-steel components, ASTM B117. Polypropylene shall be used where indicated on the drawings and as specified herein.
2. Above-ground piping:
   a. No-hub cast iron pipe and fittings, CISPI Standard 301, ASTM A-888-98el.
   b. Service weight hub and spigot pipe and fittings, Fed. Spec. WW-P-401F, ASTM-A74-98, CISPI-301.
   c. No-hub couplings, CISPI Standard 310.
   d. Charlotte Seal Gaskets, ASTM C-564, CISPI-HSN.
   e. Warco-Quik-Tite Gaskets, ASTM C-564-97, CISPI-HSN.

f. 2” and smaller Type DWV hard-drawn copper tubing, ASTM B-306 with copper drainage pattern and (lead-free) solder 95-5 Tin-antimony.

3. ½” to 1”: Same as domestic water, Type “L” hard-drawn, or Schedule 40 PVC pipe and solvent joint fittings.
4. 1-1/4” to 2” copper drainage tube, DWV Kitchen (Kitchen sinks and equipment waste).
5. PVC Foam core DWV pipe, ASTM F891, is <u>not</u> and shall not be approved under any circumstances nor installed on this project.

2.2 MECHANICAL JOINT SYSTEMS

A. General

1. All couplings, fittings, and gaskets shall be the products of a single manufacturer.
2. Valve ends shall be compatible with the couplings used on the connecting piping.

B. Pipe Wall Thickness (Schedule Number)

1. Where rolled groove joints are used, the pipe wall thickness may, in some cases, be decreased below that specified for the particular fluid system. In all cases, the minimum pipe wall thickness shall be in accordance with ANSI/ASME B31.9, Chapter II, using 150% of the system operating pressure as the design pressure.
2. Pipe having cut (machined) grooves shall have a nominal wall thickness of not less than the wall thickness specified for Schedule 40 pipe of the particular pipe size.
3. Non-metallic pipe shall not be joined with grooved-end pipe mechanical joints.

C. Couplings

1. Mechanical joint couplings shall be of the external type, for use with cut or rolled-groove end pipes, fittings, and valves.
2. Couplings shall be self-centering and shall engage and lock-in-place the grooved-end pipes, fittings, and gaskets.
3. All couplings shall be of the rigid style. Flexible couplings shall not be used without the written approval of the Engineer.
4. Couplings shall be Ductile Iron, ASTM A536; or malleable iron, ASTM A47, and shall be designed for not less than 250 psig at 230 Deg. F.
5. The coupling assembly shall be held together by two or more track-head, oval-neck steel bolts, ASTM A183.

<u>PART 3 - EXECUTION</u>

3.1 INSTALLATION

A. General

1. Furnish and install piping, fittings and appurtenances required to complete the piping systems shown on the drawings. Elbows shall be long radius type. Tees may not be field fabricated.
2. Run piping to true alignment, generally parallel or perpendicular to building walls, floors, and ceilings, and with uniform grades and spacing, so as to present a neat and workmanlike appearance.
3. Care shall be paid to the exact locations of piping with respect to equipment, ducts, conduits, slabs, beams, lighting fixtures, columns, ceiling suspension systems, etc. to provide maximum access to mechanical and electrical equipment in the building. Close coordination and cooperation shall be exercised with other trades in locating the piping in the best interests of the Owner. The drawings and specifications covering other work to be done in the building shall be carefully studied and arrangements made to avoid conflict.

4. Not all necessary pipe offsets are indicated on the drawings because of the small scale. The various runs of piping to be installed shall be studied and adjustments made in exact routings as may be required for proper installation.
5. Conflicts arising during the erection of piping shall be brought to the attention of the Owner's Representative. No improvising or field changes will be permitted without the approval of the Owner's Representative.
6. Use full lengths of pipe wherever possible. Short lengths of pipe with couplings will not be permitted. Cut to exact measurement and install without forcing or spring unless otherwise shown on the drawings or specified.
7. Avoid tool marks and unnecessary pipe threads. Burrs formed when cutting pipe shall be removed by reaming. Before installing any pipe, care shall be taken that the inside is thoroughly cleaned and free of cuttings and foreign matter. Measures shall be taken to preserve this cleanliness after erection.
8. Arrange pipe connections to valves and specialties so that there is clearance for easy removal of the valve or specialty from the line, and also for the removal of the valve bonnet and interior, and the specialty top and bottom and interior, except where otherwise approved by the Owner's Representative.
9. Erect piping in such a manner so as to obtain sufficient flexibility and to prevent excessive stresses in materials and excessive bending movements at joints or connections to equipment. Make allowances throughout for expansion and contraction of piping. Provide each riser and horizontal run of piping with expansion loops, expansion joints, or expansion compensators where indicated and required. Securely anchor and adequately guide pipe as required or where indicated to force expansion to the expansion device without bending, binding, or misalignment of pipe. Branch connections from mains to risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Where indicated, in lieu of expansion loops, expansion joints, or expansion compensators, horizontal runs of pipe shall be anchored at approximately midway of the run to force expansion, evenly divided, toward the mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining.
10. Installed piping shall not interfere with the operations or accessibility of doors or windows and shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of any equipment. Adjacent pipelines shall be grouped in the same horizontal or vertical plane.
11. Where lines are purposely pitched for drainage, an accurate grade shall be maintained. No lines shall be supported in such a manner as to permit deflection, due to gravity, sufficient to pocket the lines when full of liquid. Grade mains as indicated by arrows on the drawings and in accordance with gradient as indicated in attached Piping Schedule.
12. Piping found to have water hammer or other objectionable vibrations which cannot be eliminated by proper grading or other natural means, shall be braced, trapped, or hung with shock absorbing hangers and equipped with air chambers, mechanical shock absorbers, flexible pipe connections or otherwise silenced using approved means.
13. Use building steel wherever possible for supporting pipe hangers. Main structural steel shall not be drilled, cut or burned for hangers without the approval of the Owner's Representative. Expansion bolts shall be used only upon the approval of the Owner's Representative.
14. Install unions or flanges in piping connections to equipment, regulating valves, and wherever necessary to facilitate the dismantling of piping and/or removal of valves and other items requiring maintenance.
15. Avoid bushings. Reducing fittings shall be used wherever practical.
16. The drawings indicate the size of piping and connections, and if certain sizes are omitted or unclear, obtain additional information before proceeding.
17. The piping drawings have been worked out with a view to the most economical installation, taking into consideration accessibility and appearances, and the Contractor must follow the drawings accurately and if it is found impractical to install the work in accordance with the drawings and specifications, the Contractor shall notify the Owner's Representative before making any changes and get their approval or revised drawings before proceeding with the

work. Verify all measurements on the job before cutting pipes or having piping fabricated, and be responsible for the correct location of all pipe connections, also check sizes and standard of outlets on the equipment, including the dimensions and drilling of flanges, etc.

18. Copper tubing and galvanized steel shall not be mixed in any one run of piping.
19. Change in direction shall be made with fittings, except that bending of steel and copper pipe 4 inches and smaller will be permitted, provided a pipe bender is used and wide sweep bends are formed. The centerline radius of bends shall be not less than 6 diameters of the pipe. Bent pipe showing kinks, wrinkles, flattening, or other malformations is not acceptable.
20. Threaded joints shall be made with tapered threads in accordance with ANSI B2.1 and made tight with an approved pipe thread joint compound or material, applied to the male threads only. Use compounds sparingly and apply with caution to ensure that compounds do not enter piping systems. When pipe joint is made up a maximum of 3 threads shall be visible.
21. Joints for plastic pipe shall be made in accordance with PPI Piping Manual.
22. Connections between ferrous and nonferrous metallic pipe shall be made with dielectric unions or flanges.
23. Connections between plastic and metallic pipe, between plastic and glass pipe, and between metallic and glass pipe, shall be made with transition fittings manufactured for the specific purpose.
24. Unions and flanges shall not be concealed in walls, partitions, or above inaccessible ceilings.

B. Plumbing Systems Additional Requirements

1. Bends, plugs, or tees in water service lines, except soldered or screwed joints, shall be braced or clamped. The connection between the water service line and the domestic water distribution line shall be anchored by means of tie rods and pipe clamps.
2. Before connecting the domestic water system to underground supply connections, each supply connection shall be thoroughly flushed of all foreign matter.
3. Vertical cast iron soil pipe hubs inside buildings shall extend 6 inches above concrete slab-on-grade floors.
4. Provide test tees with screwed plugs in waste and vent systems to isolate sections of system previously tested from section of system under test. Distance between test tees on vertical lines shall not exceed static height allowable for system pressure limitations. All joints in test tees, including plugs, shall be tested under pressure as specified for system tests.
5. Joints between cast iron pipe and copper tube shall be made by using a brass-caulking ferrule and properly soldering the copper tube to the ferrule prior to pouring the lead.
6. Joints between cast iron and vitrified clay piping shall be made using either hot poured bitumastic compound, or by a preformed elastomeric ring conforming to ASTM C564. The ring shall, after ramming, completely fill the annular space between the cast iron spigot and the vitrified clay hub.
7. Joints between copper tubing and threaded pipe shall be made by the use of brass adapters or dielectric fittings. The joint between the copper tubing and the fitting shall be soldered, and the connection between the threaded pipe and the fitting shall be a standard pipe size screw joint.
8. Joints between steel and cast-iron pipe shall be either caulked or threaded or made with approved adapter fittings.
9. Install horizontal drainage piping in uniform alignment at uniform slopes that will produce a computed velocity of not less than 2 feet per second when flowing half full, or a minimum of 1/8" per ft. unless noted otherwise.
10. The underground water service pipe and the building sewer shall be not less than 10 feet apart horizontally, and shall be separated by undisturbed, or compacted, earth, unless the following requirements are satisfied:
    a. The water service pipe and the building sewer may be installed in the same trench, provided written approval is given by the plumbing official and the following conditions are met:
        1) The bottom of the water service pipe at all points shall be not less than 12 inches above the top of the sewer line at its highest point.

2) The water service pipe shall be placed on a solid shelf excavated at one side of the common trench.
3) The number of joints in the service pipe shall be kept to a minimum.
4) The materials and joints in the sewer pipe shall be installed in such manner, and shall possess the necessary strength and durability, to prevent the escape of solids, liquids, and gases there from under all known adverse conditions such as corrosion, strains due to temperature changes, settlements, vibration, and superimposed loads.
5) Where the water service line must cross the building sewer line, the bottom of the water service line within 10 feet of the point of crossing shall be at least 12 inches above the top of the sewer line. The sewer line shall be of cast iron, with leaded or mechanical joints, within 10 feet of the point of crossing.

11. Provide access panels for all valves located above non-accessible ceiling. Coordinate with Architectural plans for exact locations.
12. Provide clean-outs at the base of all sanitary waste and vent stacks.
13. When a PVC or CPVC piping system is employed, the final rough-in piping shall transition from CPVC to Type “L” copper tubing at penetration of wall construction to the fixture. the copper piping rough-in shall employ the usage of the “Hold Rite” support system to prevent movement of branch tubing. No exceptions.
14. Installation of copper tubing shall be per FPC, ASTM B32-96, and per Copper Development Association and ASTM B828-92-E01.
15. Install plugs or caps on all openings during the construction phase. The temporary plug shall be cap of same material as pipe. Duct tape is unacceptable for use as a plug for the construction phase.
16. All penetrations of piping through walls shall be made insect proof, (i.e., penetrations of waste arms, hot and cold-water piping through walls below sinks, lavatories, water closets, etc.). The escutcheon plate does constitute an “insect proof” closure.
17. Installation of CPVC tubing shall be per State of Florida Plumbing Code, “PPFA Installation Handbook for CPVC hot and cold-water piping” including Flow Guard Gold, Noveon, Inc. Contractor shall certify that has been trained by manufacturer on techniques for installation of CPVC tubing systems. Manufacturer shall warranty materials and labor for a 5-year period against all leaks using CPVC tubing. CPVC tubing shall not be installed in the laundry or in areas where piping is subject to extreme physical damage, (i.e., the kitchen).
18. Teflon tape shall be used on threaded connections. A CPVC/brass adapter nipple shall be installed where piping penetrates wall to connect to flush valves. Cast brass “drop-ear” elbows shall be secured to wall construction for copper run out to hose bibs and shower heads. CPVC stub-outs for lavatories and sinks may be used. CPVC shall not be used within 1’-0” of the gas water heater’s flue vent or for hot water supply and return piping between gas water heater and storage tank. Expansion loops on hot water system shall be installed per manufacturer’s instructions to suit temperature and pipe run.
19. Mechanically formed branch connections, commonly termed extruded outlets, shall be made in a continuous operation consisting of producing a pilot hole, drawing out the tube/pipe surface to form an outlet and facing of the outlet rim (including beveling when required). An integral pipe heating operation may be included, after the cutting of the pilot hole on Schedule 40 wall thickness. The outlet device shall be fully adjustable to insure proper tolerance and complete uniformity of the joint. Materials should have a minimum elongation of 20-25% to be acceptable for forming.
20. The extruded outlet and butt weld connection shall be in accordance with ASME Boiler and Pressure Vessel Code, as listed under ANSI B31 Standards.

C. Plastic Pipe Systems Additional Requirements:

1. Joints between plastic pipe and other materials shall be subject to the following requirements:
   a. Joints between different grades of plastic pipe shall be made by use of an approved adapter fitting.
   b. Joints between the hub of cast iron soil pipe and plastic pipe shall be made by use of a mechanical joint of the compression or mechanical sealing type.

c. Joints between plastic pipe and cast-iron pipe, steel pipe, glass pipe, copper tube, and other piping materials shall be made by use of an approved adapter fitting.

2. Plastic pipe, fittings, and solvent cement used for domestic hot and cold-water service shall bear the NSF seal for potable water.
3. Plastic pipe, fittings, and solvent cement shall not be used in systems where temperature, and operating pressure plus system static head, exceeds materials temperature and pressure limitations.
4. Plastic vent piping shall not pass-through roofs, firewalls, or fire partitions. Plastic waste and vent piping shall be installed in fire rated pipe chases when passing through floors or approved fire stop sleeve.
5. Plastic piping materials shall not be installed in air plenums, air chambers, or airshafts.

D. Mechanical Joint System Additional Requirements: Install in strict accordance with the manufacturer's written installation instructions.

3.2 WELDING, BRAZING, AND SOLDERING

A. Operator and Procedure Qualifications: All welding and/or brazing operators and all welding and brazing procedures shall be qualified in accordance with the requirements of Section IX of the ASME Boiler and Pressure Vessel Code.

B. Welding:

1. All pipe welding performed under this division of the specifications shall be examined in accordance with ANSI B31.1 requirements for each piping system. The pipe weld examination is hereby made a part of the work of this division of the specifications. An independent outside inspection firm, regularly performing this type of examination, shall be hired by the contractor or subcontractor performing the welding as part of the work of their contract. The examination shall be performed by a representative of the Inspection Company (hereafter called the Inspector) who is qualified and certified for each examination method required.
2. The Inspection Company performing the examination shall certify in writing that all pipe welds performed under this contract conform to the requirements of ANSI B31.1 for each piping system and to all other governing codes.
3. Before final acceptance of the welded piping, certified test reports shall be submitted for review. The reports shall include the following data: name and location of project, date of test, type of piping system, working pressure and temperature, standard used for testing and applicable test method, number and location of welds tested and names of persons performing test.
4. Welders and procedures for fire protection system piping qualified in accordance with NFPA No. 13.

C. Brazing: Silver braze joints in accordance with MSS-SP-73 "Silver Brazing Joints for Wrought and Cast Solder Joint Fittings".

D. Soldering: Joints in copper tubing shall be made with solder type fittings. Outside surface of the tube where engaged in the fitting, and inside surface of the fitting in contact with the tube, shall be cleaned with an abrasive material before soldering. Self-cleaning compounds shall not be used. Care shall be taken to prevent annealing of tube and fittings when making connections. The solder joint shall be made with flux and wire form solder, except brazed joints. The flux shall be a mildly corrosive liquid, or a petroleum-based paste containing chlorides of zinc and ammonium. Solder shall be applied and drawn through the full fitting length. Excess solder shall be wiped from joint before solder hardens. Joints in copper tube sizes 2-1/2 inches and larger shall be made with heat applied uniformly around the entire circumference of the tube and fittings by a multi-flame torch. Use of oxy-acetylene cutting torch in lieu of multi-flame torch is not permitted. Disassemble valves and other accessories that may be damaged by heat before soldering.

3.3 TESTING OF PIPING SYSTEMS:

A. Each piping system, after erection, shall be subjected to a pressure test. The test requirements shall be as follows:

1. Plumbing related systems shall be tested with water at not less than a 10-foot head. The water shall be kept in the systems for a period of not less than 15 minutes prior to start of visual examination. In lieu of water test, the systems may be tested with air at a uniform pressure of 5 psig, with no loss in pressure for a period of not less than 15 minutes.
2. The building sewer shall be tested by insertion of a test plug at the point of connection with the public sewer and filled with water under a head of not less than 10 feet, with no drop in water level for a period of not less than 15 minutes.
3. Leaks, if any, shall be located, repaired, and retested in accordance with the test method specified for the system in which the leaks are located.

B. Prior to testing a system, the Contractor shall provide the proper Building Official and the Owner's Representative with not less than 72 hours notice of the proposed test. The Contractor shall obtain approval of the test results. Where written approval is required, the Contractor shall obtain such written approval, and submit a copy of the approval.

C. Work requiring testing shall not be covered, or otherwise concealed, until testing is completed, and approval is granted.

D. Work, or portions of work, that is altered in any way after testing and approval shall be retested, witnessed, and approval obtained.

E. Systems requiring hydrostatic tests shall be protected from damage caused by freezing. After tests are completed drain all sections of pipe, including traps, or fill undrained sections and traps with antifreeze solution. Vent all high points to release vacuum and ensure complete drainage of closed systems and blow out piping with compressed air to remove trapped water.

F. Duration of tests, unless specified otherwise, shall be the time required to examine each joint in the system being tested.

G. Systems requiring hydrostatic testing under pressure shall be vented at high points to ensure that all piping is completely filled with the testing medium.

H. Disconnect pressure boosting apparatus, or vacuum pumps, during the test time span specified for systems employing the pressure loss/time span test method.

I. During tests, isolate system components that have test pressures less than pressures specified for system tests.

J. Use clean soapy water applied to exterior of joints to locate leaks in systems using compressed air, dry carbon dioxide, or nitrogen, under positive pressure as a test medium.

END OF SECTION

SECTION 22 16 00
GAS PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

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

B. Refer to Section 22 05 00 for requirements pertaining to Common Work Results for Plumbing Systems.

1.2 WORK INCLUDED

A. Propane (P) & Natural Gas (G) Piping.

1.3 DEFINITIONS

A. The pipe sizes given in this document are nominal.

1.4 QUALITY ASSURANCE

A. All material provided under this section shall be standard catalogued products of recognized manufacturers regularly engaged in the production of such products and shall be of the manufacturer's most recent design that is in regular production.

B. Each item provided under this section shall meet the requirements for that item as installed and used, in accordance with the following standards:

1. Metallic Piping Systems employing mechanical joints and grooved-end pipe - ASME/ANSI B-31.9
2. All other metallic piping - ASME/ANSI B31.1.

C. Each piping system shall be in accordance with the system design pressures shown in paragraph 2.1 - Materials, this specification section.

D. All materials provided under this section shall be new, except where the specifications and/or drawings permit the reuse of certain existing materials.

1.5 APPLICABLE PUBLICATIONS

A. The publications listed below form a part of this Section to the extent referenced. The publications are referenced in the text by the basic designation only.

B. The work and materials listed in this Section shall be provided in accordance with the standards and requirements set forth in the applicable portions of the latest editions of the referenced publications.

C. All cast iron soil pipe and fittings shall be marked with the collective trademark of the Cast Iron Soil Pipe Institute (CISPI) and be listed by NSF International.

1. American National Standards Institute (ANSI) Standards.
2. American Petroleum Institute (API) Specification.
3. American Society of Mechanical Engineers (ASME) Publications.
4. American Society for Testing and Materials (ASTM) Publications.

5. American Welding Society (AWS) Publication.
6. American Water Works Association (AWWA) Standards.
7. Cast Iron Soil Pipe Institute (CISPI) Standards.
8. The Manufacturer's Standardization Society of the Valve and Fittings Industry (MSS) Publications.
9. National Fire Protection Association (NFPA) Standards.
10. National Sanitation Foundation (NSF) Testing Laboratory Standards.
11. Plastic Pipe Institute (PPI) Manual.
12. Underwriters Laboratories (UL).

1.6 SUBMITTALS

A. All submittals shall be made in accordance with Section 22 05 00 Requirements.

B. Submit a list identifying the specific type of material that will be used for each piping system. Include pipe, pipefittings, valves, and joints. Include the basic designation of the publication applicable for each type of material and method.

C. Submit current welder qualifications for all welders proposed for this project. Welding certificates shall be for the company performing the welding at this project as directed in paragraph 3.2 - WELDING, BRAZING, AND SOLDERING.

D. Submit certified welding inspection reports as directed in Section 22 14 13, Facility Storm Drainage Piping, paragraph 3.2 - WELDING, BRAZING, AND SOLDERING.

PART 2 – PRODUCTS

2.1 MATERIALS

A. Propane (P) Piping:

1. Natural gas system shall be in accordance with the Florida Fuel Gas Code 2010 and NFPA 54
2. CSST Piping - Above Ground: Corrugated stainless steel tubing manufactured from ASTM A240, type 304 stainless steel with a minimum nominal wall thickness of 0.010". System shall comply with ANSI LC-1/CSA 6.26 "Standard for Fuel Gas Piping Using Corrugated Stainless-Steel Tubing (CSST). CSST shall have a extruded fire-retarded yellow polyethylene jacket meeting the flame spread and smoke density requirements of ASTM E-84.
3. CSST Piping - Underground: Underground piping shall be manufactured and shall be in accordance with standards noted above. Underground piping shall consist of CSST sleeved with a black integral polyethylene sleeve. The external polyethylene sleeve shall be designed to withstand the superimposed loads. The external protective sleeve shall have internal vent channels lengthwise to direct any leakage along the pipe the end fittings. The construction of the pre-sleeved system shall provide the encasement and venting capabilities required by the code. Underground fittings may be used within the system. All metallic parts of the buried fittings shall be wrapped in a code-approved manner as recommended by manufacturer. **UNDERGROUND FITTINGS ARE NOT PERMITTED UNDER THE SLAB OF A BUILDING**.
4. Gas pipe venting shall be in accordance with Florida Fuel Gas Code 2010 and NFPA 54.
5. Acceptable Manufacturers:
   a. TracPipe
   b. Gastite.

PART 3 - EXECUTION

3.1 INSTALLATION

A. General

1. Furnish and install piping, fittings and appurtenances required to complete the piping systems shown on the drawings. Elbows shall be long radius type. Tees may not be field fabricated.
2. Run piping to true alignment, generally parallel or perpendicular to building walls, floors and ceilings, and with uniform grades and spacing, so as to present a neat and workmanlike appearance.
3. Care shall be paid to the exact locations of piping with respect to equipment, ducts, conduits, slabs, beams, lighting fixtures, columns, ceiling suspension systems, etc. to provide maximum access to mechanical and electrical equipment in the building. Close coordination and cooperation shall be exercised with other trades in locating the piping in the best interests of the Owner. The drawings and specifications covering other work to be done in the building shall be carefully studied and arrangements made to avoid conflict.
4. Not all necessary pipe offsets are indicated on the drawings because of the small scale. The various runs of piping to be installed shall be studied and adjustments made in exact routings as may be required for proper installation.
5. Conflicts arising during the erection of piping shall be brought to the attention of the Owner's Representative. No improvising or field changes will be permitted without the approval of the Owner's Representative.
6. Use full lengths of pipe wherever possible. Short lengths of pipe with couplings will not be permitted. Cut to exact measurement and install without forcing or spring unless otherwise shown on the drawings or specified.
7. Avoid tool marks and unnecessary pipe threads. Burrs formed when cutting pipe shall be removed by reaming. Before installing any pipe, care shall be taken that the inside is thoroughly cleaned and free of cuttings and foreign matter. Measures shall be taken to preserve this cleanliness after erection.
8. Arrange pipe connections to valves and specialties so that there is clearance for easy removal of the valve or specialty from the line, and also for the removal of the valve bonnet and interior, and the specialty top and bottom and interior, except where otherwise approved by the Owner's Representative.
9. Erect piping in such a manner so as to obtain sufficient flexibility and to prevent excessive stresses in materials and excessive bending movements at joints or connections to equipment. Make allowances throughout for expansion and contraction of piping. Provide each riser and horizontal run of piping with expansion loops, expansion joints, or expansion compensators where indicated and required. Securely anchor and adequately guide pipe as required or where indicated to force expansion to the expansion device without bending, binding, or misalignment of pipe. Branch connections from mains to risers shall be made with ample swing or offset to avoid undue strain on fittings or short pipe lengths. Where indicated, in lieu of expansion loops, expansion joints, or expansion compensators, horizontal runs of pipe shall be anchored at approximately midway of the run to force expansion, evenly divided, toward the mains and risers to provide for expansion and contraction of piping. Flexibility shall be provided by installing one or more turns in the line so that piping will spring enough to allow for expansion without straining.
10. Installed piping shall not interfere with the operations or accessibility of doors or windows and shall not encroach on aisles, passageways, and equipment, and shall not interfere with the servicing or maintenance of any equipment. Adjacent pipelines shall be grouped in the same horizontal or vertical plane.
11. Where lines are purposely pitched for drainage, an accurate grade shall be maintained. No lines shall be supported in such a manner as to permit deflection, due to gravity, sufficient to pocket the lines when full of liquid. Grade mains as indicated by arrows on the drawings and in accordance with gradient as indicated in attached Piping Schedule.

12. Use building steel wherever possible for supporting pipe hangers. Main structural steel shall not be drilled, cut or burned for hangers without the approval of the Owner's Representative. Expansion bolts shall be used only upon the approval of the Owner's Representative.
13. Install unions or flanges in piping connections to equipment, regulating valves, and wherever necessary to facilitate the dismantling of piping and/or removal of valves and other items requiring maintenance.
14. Avoid bushings. Reducing fittings shall be used wherever practical.
15. The drawings indicate the size of piping and connections, and if certain sizes are omitted or unclear, obtain additional information before proceeding.
16. The piping drawings have been worked out with a view to the most economical installation, taking into consideration accessibility and appearances, and the Contractor must follow the drawings accurately and if it is found impractical to install the work in accordance with the drawings and specifications, the Contractor shall notify the Owner's Representative before making any changes and get their approval or revised drawings before proceeding with the work. Verify all measurements on the job before cutting pipes or having piping fabricated, and be responsible for the correct location of all pipe connections, also check sizes and standard of outlets on the equipment, including the dimensions and drilling of flanges, etc.

B. Gas Systems Additional Requirements

1. Installation shall be in accordance with NFPA No. 54 and ANSI Z 223.1 unless specified otherwise herein.
2. Provide a capped 6" dirt leg at the base of main risers.
3. Valves in natural gas service shall be lubricated plug cocks.
4. Horizontal pipe shall slope upward, in the direction of flow, at not less than 1/4 inch in 15 feet.
5. Where piping is concealed, all plugged or capped openings shall be exposed and accessible. Bushings and unions shall not be used in concealed work.
6. Branch connections shall be made on the side or top of the main for both up-feed and down-feed applications.
7. Vent gas pressure regulator and safety shut-off reverse vent valve relief lines to outside the building individually. Relief lines from pressure switches may be combined in another line, or run separate, for venting to the outside.
8. After testing is completed, and before connecting any appliances, all piping shall be fully purged. Piping shall not be purged into the combustion chamber of an appliance. The open end of piping systems being purged shall not discharge into confined spaces or areas where there are ignition sources unless the safety precautions recommended in NFPA No. 54, or ANSI Z 223.1 are followed.
9. After the piping has been placed in operation, all equipment shall be purged and then placed in operation, as necessary.

3.2 TESTING OF PIPING SYSTEMS:

A. Each piping system, after erection, shall be subjected to a pressure test. The test requirements shall be as follows:

1. Gas Piping Systems shall be tested with air at not less than 25 PSIG for a period of not less than 15 minutes without showing any drop in pressure.
2. Gas Distribution Systems utilizing Copper Viega Pro-*Press* fittings with SC Feature Contour Design shall be initially tested at a minimum of ½ psig but not more than 50 psig. Joints shall be visually examined for leaks.
3. Leaks, if any, shall be located, repaired, and retested in accordance with the test method specified for the system in which the leaks are located.

B. Prior to testing a system, the Contractor shall provide the proper Building Official and the Owner's Representative with not less than 72 hours notice of the proposed test. The Contractor shall

obtain approval of the test results. Where written approval is required, the Contractor shall obtain such written approval, and submit a copy of the approval.

C. Work requiring testing shall not be covered, or otherwise concealed, until testing is completed, and approval is granted.

D. Work, or portions of work, that are altered in any way after testing and approval shall be retested, witnessed, and approval obtained.

E. Duration of tests, unless specified otherwise, shall be the time required to examine each joint in the system being tested.

F. During tests, isolate system components that have test pressures less than pressures specified for system tests.

G. Use clean soapy water applied to exterior of joints to locate leaks in systems using compressed air, dry carbon dioxide, or nitrogen, under positive pressure as a test medium.

END OF SECTION

SECTION 22 30 00
PLUMBING SPECIALTIES

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. Extent of plumbing specialties work required by this section is indicated on drawings and schedules, and by requirements of this section.

1. Floor drains, cleanouts, water hammer arresters, hose bibbs, wall hydrants, trap primers, backflow preventers, thermostatic mixing valve.
2. Products to comply with ANSI/ASSE 1011, ANSI/ASSE 1012, ANSI A112.21.1, ANSI A112.21.2 and ANSI A112.26.1.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

A. General: Provide factory-fabricated fixtures of type, style and material indicated.

1. Acceptable Manufacturers - Cleanouts:
   a. J. R. Smith
   b. Josam
   c. Zurn
   d. Sioux Chief
      (1) Floor Cleanout/Interior Finished Floor Areas (CO): ANSI A112.21.1; Painted cast-iron two-piece body with round adjustable secured nickel bronze top with depressed cover to accept floor finish and closure plug.
          J. R. Smith #4020
          Josam #56010
          Zurn #ZN-1400-NH
          Sioux Chief #834
      (2) Wall Cleanout (CO): Bronze threaded plug with stainless steel cover and screw.
          J. R. Smith #4472
          Josam #58540 w/58600
          Zurn #Z-1468
          Sioux Chief #870
      (3) Grade Cleanout/Exterior Paved Areas (CO): Painted cast iron body with round adjustable scoriated cast iron top and non-tilt tractor cover.
          J. R. Smith #4240
          Josam #56050
          Zurn #Z-1400
          Sioux Chief #852
      (4) Grade Cleanout/Exterior Unpaved Areas (CO): Painted cast iron body with round adjustable scoriated cast iron top and non-skid cover. Install flush in concrete pad for protection.
          J. R. Smith #4231
          Josam #56060-Y
          Zurn #Z-1400-NL
          Sioux Chief #852

2. Acceptable Manufacturers - Water Hammer Arresters:
   a. J. R. Smith Series 5000
   b. Josam Series 75000
   c. Zurn "Shoktrol”
   d. Sioux Chief Series 650
      (1) Water Hammer Arrester (WHA): ANSI A112.26.1; sized in accordance with PDI WH-201, pre-charged suitable for operation in temperature range - 100 to 300 degrees F and maximum 250 psig working pressure, stainless steel construction.
3. Acceptable Manufacturers - Wall Hydrant:
   a. J. R. Smith #5509QT-SAP
   b. Josam #71010
   c. Zurn #Z-1320
      (1) Wall Hydrant/Building Exterior (HB-1): ANSI/ASSE 1011; vandal-proof cast bronze, mild-climate recessed wall hydrant with satin face, self-opening locking cover removable key, 3/4-inch HPT outlet, integral vacuum breaker; recessed stainless steel box.
4. Acceptable Manufacturers - Hose Bibb:
   a. J. R. Smith #5609QT-SAP
   b. Josam #71070
   c. Zurn #Z-1310
      (1) Hose Bibb/Building Interior (HB-2): ANSI/ASSE 1011; cast bronze hose bibb with replaceable hexagonal disc, 3/4-inch HPT outlet, vacuum breaker.
5. Acceptable Manufacturers - Trap Primer:
   a. Precision Plumbing Products Model Prime-Rite with distribution unit.
   b. J. R. Smith Series 2699
   c. Josam #88250
   d. Zurn #Z-1022
   e. Sioux Chief Series 695
      (1) Trap Primer: Automatic 1/2-inch trap primer systems for all interior floor drains.

PART 3 - EXECUTION

3.1 PREPARATION

A. Coordinate cutting and forming of roof and floor construction to receive drains to required invert elevations.

3.2 INSTALLATION

A. Extend cleanouts to finished floor or wall. Lubricate threaded cleanout plugs with mixture of graphite and linseed oil. Ensure clearance at cleanout for rodding of drainage system.

B. Install water hammer arresters on each non-group fixture or at the end of supply lines of group of fixtures to prevent water hammer.

C. Provide shutoff valves to isolate each cold and hot water branch line.

D. Install backflow preventer no higher than 5 feet maximum above finished floor.

END OF SECTION

SECTION 23 05 00
GENERAL PROVISIONS

PART 1: GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.2 SCOPE

A. The Work shall include the furnishings of systems, equipment and materials specified in this Division and as called for on Mechanical Drawings, to include supervision, operation, methods and labor for the fabrication, installation, start-up, and tests for the complete mechanical installation.

B. Drawings for the Work are diagrammatic, intended to convey the scope of the Work and to indicate the general arrangement and locations of the Work. Because of the scale of the Drawings, certain basic items such as pipe fittings, access panels, hangers, supports, and sleeves may not be shown. This Section shall be responsible for selecting the equipment to fit the space provided. The location and sizes for pipe fittings, sleeves, inserts, and other basic items required by code and other sections shall be coordinated with other trades and specification sections and included for the proper installation of the Work.

C. Equipment Specification may not deal individually with minute items required such as components, parts, controls, and devices which may be required to produce the equipment performance specified or as required to meet the equipment warranties. Where such items are required, they shall be included by the supplier of the equipment, whether or not specifically called for in the Contract Documents.

D. Where the words "provide", "furnish", "include" or "install" are used in the Specification or on the Drawings, it shall mean to furnish, install and test complete and ready for operation, the items mentioned. If an item is either called for in the Specification or called for on the Drawings, it shall be considered sufficient for including same in the Work.

E. Where noted on the Drawings or where called for in other Sections of the Specification, the Contractor for this Division shall install equipment furnished by Others and shall make required service connections. Contractor shall verify with the supplier of the equipment the requirements for the installation.

F. Coordinate with all trades in submittal of shop drawings. Shop drawings shall be prepared at scale of the larger of 1/4" 1'-0" or that used in the documents, clearly indicating all applicable components. Space conditions shall be detailed to the satisfaction of all concerned trades, subject to review and final acceptance by the Architect. In the event that Contractor installs his work before coordinating with other trades or so as to cause any interference with work of other trades, the necessary changes shall be made in the work to correct the condition, at no additional cost to the Owner. Coordinate drawing requirements with Division One specifications for coordinated shop drawing submittals. Where shop drawings include items of equipment, the equipment submittals shall be included with the shop drawings. Do not submit equipment and shop drawings as separate submittals.

G. Should conflicts occur between the mechanical and plumbing drawing and Division 23 of the specifications, the more stringent requirement as determined in the sole opinion of the Engineer, shall take precedent. Where items are shown or specified on either the drawing or in the specifications, they shall be deemed as specified by both and included as part of the contract. Should conflicts occur between Division 23 and other specification divisions, the more stringent requirement as determined in the sole opinion of the Architect shall prevail.

H. Coordinate location of all Division 23 work with Division 26. Do not run piping, ductwork, and similar Division 23 work in NEC dedicated service areas for electrical equipment, including above panel boards, starters, communication panels, control panels, telephone backboards, data panels and similar electrical elements. Coordinate with submission of shop drawings and refer questionable locations to architect/engineer for resolution prior to installation and correct non-conforming installed work at no additional cost to the owner.

1.3 CODES AND STANDARDS

A. All work shall be performed in compliance with all applicable Laws, Codes and Regulations of the Governmental Bodies having jurisdiction over the site.

B. Work not regulated by Governmental Bodies shall be performed in accordance with current and/or adopted issues of the following Codes and Standards.

1. Codes
   a. Florida Building Code, 7th Edition (2020)
   b. Florida Building Code Mechanical, 7th Edition (2020)
   c. Florida Building Code Plumbing, 7th Edition (2020)
   d. NFPA-13 (2010), Standard for the Installation of Sprinkler Systems
   e. NFPA-90A (2012), Standard for the Installation of Air Conditioning and Ventilating Systems
   f. NFPA-90B (2012), Standard for the Installation of Warm Air Heating and Air Conditioning Systems
   g. NFPA-101 (2012), Life Safety Code
   h. ASHRAE Standard 90.1 - 2016
   i. ASHRAE Standard 62-2016
   j. ASHRAE Standard 15 - 2019
   k. Occupational Safety Act of 1970, as amended (OSHA)
   l. Palm Beach County Ordinances and Code Amendments
   m. Other codes as individually referred to in other sections
2. Standards
   a. Air Moving and Conditioning Association - AMCA
   b. American National Standards Institute - ANSI
   c. American Society of Mechanical Engineers - ASME
   d. American Society for Testing and Materials - ASTM
   e. American Water Works Association - AWWA
   f. Factory Mutual - FM
   g. Manufacturers Standardization Society of the Valve and Fittings Industry - MSS
   h. National Electrical Manufacturers Association - NEMA
   i. National Fire Protection Association, National Electrical - NEC
   j. National Fire Protection Association - NFPA
   k. Sheet Metal and Air Conditioning Contractors National Association - SMACNA
   l. Underwriters' Laboratories – UL

m. LEED for New Construction
n. Other Standards as individually referred to in other Sections of the Specification.

C. Where Code requirements vary from specified requirements alert Engineer prior to proceeding with the work. Where Code requirements exceed or are more strict than specified requirements, the Code requirements shall be included in the Contractor's bid and be incorporated into the work.

D. Where later editions of the above referenced Codes have been adopted, they shall take precedence.

1.4 FEES, PERMITS AND INSPECTIONS

A. Coordinate and provide such inspections as are required by the Authorities with jurisdiction over the site. Obtain all necessary permits and pay all fees associated with the work to be performed.

B. Attend and provide necessary subcontractors and manufacturers representatives participating in system demonstration. Provide access to the work for necessary inspections.

1.5 ACTIVE SERVICES

A. Existing active services: water, gas, sewer, electric, fire protection, etc., when encountered, shall be protected against damage. Do not prevent or disturb operation of active services which are to remain. If active services are encountered which require relocation, make request to Owner for determination of procedures and for approval of outages. Where existing services are to be abandoned, they shall be terminated in conformance with requirements of the Utility or Municipality having jurisdiction.

B. Any active service requiring an outage shall only be as approved by the Owner in writing. Such outages shall be scheduled with the Owner and shall be scheduled to occur during periods which will result in the least disruption to the Owner's operation.

C. Where an outage could result in disruption of a critical system or service, provide temporary systems or services as needed, such that there is no outage and service remain uninterrupted.

1.6 SITE INSPECTION

A. Contractor shall inspect and carefully examine the plans and the site to familiarize himself with conditions which will affect his work. He shall verify points of connection with utilities, routing of outside piping to include required clearances from any structures, trees or other obstacles. He shall verify available space in the existing structure and accessibility required for the installation of work under this contract and alert the Architect/Engineer to conditions which may be detrimental or will prevent proper execution of the work.

B. The submission of a bid will be construed that such an inspection has been performed and extra payment will not be allowed for changes in the Work required resulting from observable existing conditions.

1.7 OPENINGS, CUTTING AND PATCHING

A. Coordinate the placing of openings in the structure as required for the installation of the Mechanical Work.

B. When additional patching is required due to failure to inspect work, then provide the patching required to properly close the openings, to include patch painting.

C. When cutting and patching of the structure is made necessary due to failure to install piping, ducts, sleeves, or equipment on schedule, or due to failure to furnish, on schedule, the information required for the leaving of openings, then provide the cutting and patching as required.

D. Provide cutting and patching and patch painting in the existing structure, as required for the installation of work, and furnish lintels and supports as required for openings. Cutting of structural support members will not be permitted without prior approval of the Architect. Extent of cutting shall be minimized, use core drills, power saws or other machines which will provide neat, minimum openings. Patching shall match adjacent materials and surfaces and shall be performed by craftsmen skilled in the respective craft required.

1.8 WIRING FOR MECHANICAL SUPPORT

A. Division 26 shall provide power services for motors and equipment furnished under this division, to include safety disconnect switches and final connections. The entire fire alarm system including interlock wiring required for air handling unit shutdown shall be provided under Division 26. The Division 23 Contractor is responsible for locating and physical mounting of duct mounted smoke detectors.

B. Division 23 shall provide internal wiring, alarm wiring, control wiring or interlock wiring (except the fire alarm system) for equipment furnished, to include temperature control wiring.

C. Division 26 shall furnish motor starters for motors furnished by this Contractor, except where other Sections call for starters to be furnished by this Contractor, or where starters or drives are provided integral to the equipment.

D. Coordinate with Division 26 all motors and other mechanical equipment which require electrical services. Confirm the exact locations for rough-ins, electrical loads, voltage, size and electrical characteristics for all services required, with the Division 16 contractor, prior to submission of shop drawings and equipment cut sheets. Identify any conflicts and bring them to the Architects/Engineers' attention prior to ordering equipment.

E. Where motors or equipment furnished require large services or services or of different electrical characteristics than those called for on the Drawings, and/or equipment submittals that were not coordinated between the trades, this contractor shall provide material as required to suit the substitute equipment, at no additional cost to the Owner.

1.9 PROTECTION

A. Special care shall be taken for the protection of equipment furnished. Equipment and material shall be completely protected from weather elements, painting, plaster, etc.,

until the project is completed. Damage from rust, paint, scratches, etc., shall be repaired as required to restore equipment to its original condition.

B. Where the installation or connection of equipment requires work in areas previously finished by other Contractors, the area shall be protected and not marred, soiled, or otherwise damaged during the course of such work. Contractor shall arrange with other Contractors for repairing and refinishing of such areas which may be damaged.

C. During construction, the open ends of piping, equipment and ductwork shall be protected from construction dust and debris utilizing caps, plastic sheeting, or other approved means. Equipment and materials shall remain in original shipping containers and be kept above grade/slab, until installed.

D. Building HVAC systems shall not be operated for any purpose during dust generating construction activities. Where conditioning of spaces is necessary during construction, provide temporary HVAC systems to maintain space conditions.

1.10 SUBMITTALS

A. Method or procedure for submitting shop drawings and submittal data shall be in compliance with the General Conditions, and Division 1 requirements.

B. Submittal data for mechanical equipment shall consist of shop drawings and/or catalog cuts showing technical data necessary to evaluate the material or equipment, to include dimensions, wiring diagrams, performance curves, ratings, control sequence and other descriptive data necessary to describe fully the item proposed and its operating characteristics.

C. Submittal data shall be clearly marked to indicate the actual item being submitted including accessories, and items not applicable to the submittal shall be crossed or marked out. Where materials or features deviate from the specified requirements, the deviation shall be clearly identified and noted in writing on the submittal cover sheet.

D. Where manufacturer's standard catalog cut sheets do not provide sufficient detail to indicate full compliance with the project specifications, provide supporting data as required. Where generic unmarked submittals are provided, they will be returned un-reviewed for correction and resubmittal by the Contractor.

E. Submittals shall clearly indicate the specification section and paragraph that applies to the item being submitted.

F. Submittals shall include, but not be limited to:

1. Valves
2. Pipe/duct insulation
3. Plumbing fixtures and equipment
4. Vibration isolation
5. Terminal boxes
6. Grilles, diffusers, intakes and louvers
7. Filters
8. Controls
9. Ductwork shop drawings, including coordination layout drawing and materials
10. Condensing units
11. Pipe materials and accessories
12. Volume dampers
13. Supports

14. Other items specifically called for in subsequent specification sections.

F. Basis of Design

1. Certain manufacturer's products have been designated on the drawings as the basis of design. Other manufacturer's names have been listed as firms producing products that are generally comparable with those used as the basis of design.
2. It shall be the exclusive responsibility of the Contractor to ascertain that equipment submitted and used in the work, satisfies all of the specified requirements, including equipment used as the basis of design.
3. Listing of a product as the basis of design does not imply that the manufacturer's standard product meets the specified requirements. Custom, non-standard modifications in materials of construction, fabrication and components shall be provided, where required to comply with the Contract Documents.

1.11 FINISHING

A. General

1. Prior to acceptance of the installation and final payment of the Contract, the Contractor shall perform the work outlined herein.

B. Cleaning

1. At the conclusion of the construction, the site and structure shall be cleaned thoroughly of all debris and unused materials remaining from the mechanical construction. All tunnels and closed off spaces shall be cleaned of all packing boxes, wood frame members and other waste materials used in the mechanical construction.
2. The entire system of piping and equipment shall be cleaned both externally and internally. The Contractor shall open all dirt pockets and strainers, completely blowing down as required and clean strainer screens of all accumulated debris.
3. All tanks, fixtures and pumps shall be drained and proven free of sludge and accumulated matter.
4. All temporary labels, stickers, etc., shall be removed from all fixtures and equipment. (Do not remove permanent name plates, equipment model numbers, ratings, etc.).
5. Heating and air conditioning, plumbing and fire protection equipment, tanks, pumps, traps, etc., shall be thoroughly cleaned and new filters or filter media installed.
6. Perform cleaning required by General Conditions, and Division 1 as applicable to this Division of the work.

C. Project Recording Documents

1. Prepare and submit project record documents, in accordance with Division 1 requirements.

D. Operation and Service Manuals

1. The Contractor shall provide the Owner with a minimum of five (5) copies of a hardbound operating manual for all equipment furnished and installed under his work.

2. The manual shall include a manufacturer's maintenance and operating instructions and parts list and serial numbers for all operating equipment.
3. All controls and safety devices shall be clearly and permanently embossed or printed plates as to purposed and as to operation. Plates shall be laminated plastic black background with white letters, attached to the equipment or device with screws, rivets or non-soluble cement (glue).
4. Upon completion of the work, the Contractor shall put the system into service. The Contractor shall be entirely responsible for the equipment during all testing operations.
5. The contractor shall assist the Test and Balance firm in operation of equipment and providing access (in the form of ladders and scaffolding where required) to devices which require measurement and/or adjustment. The Contractor shall aid in the identification and location of dampers and equipment located above ceilings. The Contractor shall correct all field conditions found to be unsatisfactory by the Test and Balance firm to include but not by way of limitation, reconfiguration of ductwork and fittings, addition/removal of volume dampers, providing duct access doors to evaluate installed conditions, replacement of belts and pulleys and similar tasks as may be necessary but not otherwise required under specific specification sections or other portions of by the contract documents.

1.12 TEST AND DEMONSTRATIONS

A. Systems shall be tested and placed in proper working order prior to demonstrating systems to Owner.

B. Prior to acceptance of the mechanical installation, demonstrate to the Owner or his designated representatives all essential features and functions of all systems installed, and instruct the Owner in the proper operation and maintenance of such systems. The Contractor shall allow for one (1) working day to perform the demonstrations.

C. Provide necessary trained personnel to perform the demonstrations and instructions. Provide manufacturer's representatives for systems as required to assist with the demonstrations.

D. Dates and times for performing the demonstrations shall be coordinated with the Architect/Owner.

E. System demonstrations shall be in accordance with operating and maintenance data.

F. Upon completion of demonstrations, provide a certificate testifying that demonstrations have been completed. Certificate shall list each system demonstrated, dates demonstrations were performed, names of parties in attendance, and shall bear signatures of Contractor and Owner.

1.13 PAINTING AND IDENTIFICATION

A. Provide painting as scheduled below:

1. Touch-up paint where damaged on equipment furnished with factory applied finished, to match original finish.

B. Identification of mechanical systems shall be as specified in Section 23 05 53, “Identification”.

1.14 CONCRETE WORK

A. Provide concrete bases and housekeeping pads for mechanical equipment unless indicated otherwise. Concrete work shall be as specified in Division 3. Vibration pads and equipment base shall be provided under this Division.

B. Provide equipment anchor bolts and coordinate their proper installation and accurate location.

1.15 ACCESS PANELS

A. Provide access panels where shown, and where required but not shown on the drawings for installation by the drywall Contractor. Access panels shall be as specified in Division 8. All access panel locations shall be approved by the Architect. If not otherwise specified, provide minimum 16-gauge steel panels, continuous concealed hinge, screwdriver operated catch, with prime finish coat, equal to ELMDOR. Doors shall be fire rated where installed in listed fire rated construction assemblies. Panels for “wet” locations such as showers shall be constructed of stainless steel.

1.16 SLEEVES

A. Sleeves passing through non-load bearing or non-fire rated walls and partitions shall be galvanized sheet steel with lock seam joints of minimum gauges as follows: for pipes 2½" size and smaller - 24 gauge; 3" to 6" - 22 gauge; over 6" - 20 gauge.

B. Sleeves passing through load bearing walls, concrete beams, foundations, footings and waterproof floors shall be Schedule 40 galvanized steel pipe or cast-iron pipe.

C. Sleeve for fire-rated walls shall comply with the manufacturer’s UL listed installation requirements. Where the UL installation requirements allow for sleeve materials which meet the requirements specified in the proceeding paragraphs, sleeves as specified above shall be used.

D. Sleeves for insulated piping shall be of sufficient internal diameter to take pipe and insulation and to allow for free movement of pipe. Waterproof sleeves shall be of sufficient internal diameter to take pipe and waterproofing material. Sleeves passing through underground walls and floors shall be of the modular type, with interlocking mechanical rubber links shaped to fill the annular area between the pipe and wall sleeve, equal and similar to link-seal.

E. In finished areas where pipes are exposed, sleeves shall be terminated flush with wall, partitions, and ceilings, and shall extend 1/2" above finished floors. Extend sleeves 1" above finished floors in areas likely to entrap water.

F. Sleeves passing through membrane waterproofing or lead safing shall be flashed by Division 7 as required.

G. Piping and sleeves passing through floors, roof, smoke walls, fire walls, and other partitions, shall be provided with a UL rated firestop assembly. Penetrations of smoke walls shall be fully caulked airtight using an approved sealant.

H. Ducts shall be provided with 26-gauge sheet metal sleeves where non-rated block or concrete walls are penetrated. The sleeve shall be sized to be between 1 to 2 inches larger than the duct plus insulation (if any) all around and the space between the sleeve and the duct filled with non-combustible insulation (mineral wool or fiberglass).

The wall shall be neatly finished to the sleeve with 1 inch by 1 inch by 24 gauge angle attached to the sleeve all around on both sides of the wall.

1.17 ESCUTCHEONS

A. Provide chrome-plated non-ferrous, corrosion resistant escutcheons at each sleeve opening into finished spaces. Escutcheons shall fit around insulation or around pipe when not insulated; outside diameter shall cover sleeve. Where sleeve extends above finished floor, escutcheon shall be high cap type and shall clear sleeve extension. Secure escutcheons or plates to sleeve but not to insulation with set screws or other approved devices.

1.18 PROTECTION OF ELECTRICAL EQUIPMENT

A. Ductwork and piping shall not be installed directly above electrical equipment or with NEC required clearance areas. When piping is required to be installed in electrical rooms, a drain pan shall be provided to protect the electrical equipment.

1.19 WARRANTY CALLS

A. During the one-year period, all responses to warranty calls made by the contractor shall be documented by leaving a copy of the mechanics service ticket with the Owner's representative, prior to leaving the site upon completion of his work.

B. Unless otherwise noted in individual sections, a 1 year warranty shall be provided.

C. Submit warranty information under provisions of Division 1. Provide information to include terms and conditions, beginning date, duration, name, address, telephone number and procedure for obtaining warranty service.

1.20 INSULATION PROTECTION

A. Where exposed insulated piping extends to floor, provide sheet metal guard around insulation, up to 12 inches above finished floor.

1.21 PROJECT RECORD DOCUMENTS

A. Requirements and methods of preparing and procedure for submitting project records shall be in accordance with Division One.

1.22 OPERATION AND MAINTENANCE MANUALS

A. Requirements and methods of preparing and procedures for submitting Operating and Maintenance Manuals shall be in accordance with Division 1.

B. Include description of function, operating characteristics, performance curves, engineering data and tests, model, and serial numbers of all equipment.

C. Maintenance information including procedures for routine preventative maintenance, troubleshooting, disassembly, repair, reassembly, aligning and adjusting instructions. Also include lubrication charts and schedules.

D. Standard manufacturer's data shall be clearly marked to identify model number and features of equipment actually furnished.

E. All mechanical equipment data shall be provided in a loose-leaf, 3 hole punched binder(s), which includes at a minimum, an identifying cover and spline, section dividers and table of contents. Where required, provide multiple binders such that the thickness of any one binder does not exceed two (2) inches.

F. At the beginning of each section, provide a summary of the manufacturers recommended preventative maintenance requirements, and the frequency that they are to be performed (monthly, quarterly, yearly, etc.).

1.23 ANCHORING OF EQUIPMENT

A. All equipment that is not mounted on wheels and is capable of being moved shall be secured to the floor with anchor bolts. A minimum of two bolts are required per each piece of equipment and bolts shall be of sufficient size to prevent equipment of overturning.

B. All exterior equipment shall be **DESIGNED, MANUFACTURED, AND INSTALLED** to withstand the applied wind force. The applicable wind force shall be as determined in accordance with the Florida Building Code, Chapter 16. A “specialty engineer” licensed to practice in Florida shall determine the applicable wind force and certify the proposed equipment construction and mounting meets the applied wind force with suitable documentation provided to the permitting authorities. Mounting details shown on the drawings are generic in nature, intended only to convey the general concept for bidding purposes only. Where the manufacturer has acceptable certifying information, the Engineer need only confirm the actual wind force is within the manufacturer’s certified range, and the manufacturer’s installation anchoring requirements shall be strictly followed.

1.24 OWNER FURNISHED EQUIPMENT

A. The Contractor shall coordinate with rough-in dimensions, services required (gas, water, exhaust), maintenance access areas and the exact location of Owner furnished equipment.

1.25 PREVENTION OF CORROSION

A. The Contractor shall use materials of construction that will aid in the prevention of corrosion.

B. Dissimilar metals shall be separated by dielectric fittings and/or materials.

C. Copper pipe shall be isolated from concrete.

D. Exterior supports and fasteners shall be constructed of galvanized or stainless steel.

END OF SECTION

SECTION 23 0 529
HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

B. Refer to Section 23 05 00, “General Provisions”, paragraph entitled, “Anchoring of Equipment” for additional requirements.

1.2 SCOPE

A. Provide materials, equipment, labor, and supervision necessary to install pipe hangers and supports.

B. Pipe support systems shall secure pipes in place, prevent pipe vibration, provide vertical adjustment for maintaining required grades, provide for expansion and contraction.

C. Where supports are attached to concrete or other structural members, care shall be taken to prevent damage or weakening of the structural members.

D. Where concrete inserts are to be used, it shall be this Contractor's responsibility to accurately locate and attach inserts to concrete forms.

E. Equipment supports shall secure equipment in-place, prevent transmission of vibration to the structure, provide for expansion and contraction, and permit for servicing and maintenance of equipment without obstructing access doors or removable covers.

F. Pipe hangers, supports, and attachments shall have sufficient strength to withstand all anticipated static and dynamic loading conditions associated with the intended use. Manufacturer’s maximum recommended load ratings shall not be exceeded. Where hanging system uses multiple components, load rating for the assembly shall be based upon the weakest component.

1.3 SUBMITTALS

A. Provide manufacturers catalog data for pipe supports, upper attachments, and threaded rod indicating materials of construction and dimensional data.

B. Submit details for connection of upper attachment to structure.

1.4 CODES AND STANDARDS

A. Hanger spacing, and support rod size shall comply with the minimum requirements of the Florida Building Code - Mechanical.

B. Comply with ASME B31.1, MSS Standard Practice SP-58/SP-69.

PART 2 - PRODUCTS

2.1 HANGERS AND SUPPORTS

A. Hangers and support devices shall be Michigan, Anvil, Fee & Mason, B-Line or Elcen. Figure numbers based on Anvil.

B. All exterior hangers, supports, and accessories shall be stainless steel. Interior hangers and supports shall be cadmium plated in conformance with ASTM B-766.

C. Materials in direct contact with the piping shall be compatible with the piping and not promote galvanic action.

2.2 SLEEVES

A. Refer to Section 23 05 00 - “General Provisions”.

2.3 HARDWARE

A. Hardware and fasteners shall be of the same material as the product supported and of a grade suitable for the application, as defined by the manufacturer's installation guidelines.

2.4 MISCELLANEOUS ITEMS

A. Hanger rod shall be one-piece circular cross section and shall be used to connect building structural attachments to pipe support devices. Provide turnbuckles, swing eyes, and clevises as required to accommodate thermal expansion/contraction, pipe accessibility and adjustment for load and pitch.

B. Provide supplementary steel as required between existing structural members where necessary for support. Steel shall be provided with a protective organic zinc coating to protect against rust.

C. Support elements, except for supplementary steel, shall be catalogued, load rated, commercially manufactured products.

PART 3 - EXECUTION

3.1 INSTALLATION - HORIZONTAL PIPE SUPPORTS

A. Hanger rods for steel and wrought iron pipe shall be installed in accordance with the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1¼"	3/8”	8'-0"
1½" and 2"	3/8”	10'-0"
2½" and 3"	½”	10'-0"
4" and 6"	5/8”	12'-0"
8” thru 12”	7/8”	12’-0”

B. Hanger rods for copper and brass pipe and tube shall be installed in accordance with the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
Up to 1/4"	3/8”	6'-0"
1 ½" thru 2"	3/8”	10'-0"
2½"	½"	10'-0"
3" thru 6”	½"	10'-0"
8” thru 12”	7/8”	10’-0”

C. Hanger rods for PVC and CPVC pipe shall be installed in accordance with the following schedule:

Pipe Size	Rod Diameter	Maximum Spacing
1" and smaller	3/8"	3
1-1/4" thru 2"	3/8"	4
2-1/2" thru 6"	½"	4
8" thru 12"	7/8"	4

D. Support horizontal cast iron soil pipe at 5'-0" on center with one hanger for each pipe length. Locate hangers close to hubs. Where 10-foot lengths of pipe are used spacing may be increased to 10'-0" on center.

E. In addition to the above specified spacings, install additional hangers within 12 inches or change in pipe direction (elbows, tees) and at concentrated loads, large valves, strainers, etc.

F. Where more than one pipe is to be run parallel together, they may be supported on trapeze type hangers. Trapeze bar angles and hanger rods shall be of sufficient size with required spacing to support the particular group of pipes.

G. For suspending hanger rods from brackets attached to walls, use welded steel brackets. Fig. 194 for loads up to 750 lbs.; Fig. 195 for loads up to 1500 lbs.; Fig. 199 for loads up to 3000 lbs.

H. Where pipes are to be racked along walls, use "Unistrut" pipe racks.

I. Plastic coated hangers shall be provided where hangers are in direct contact with copper piping. On insulated copper piping, plastic coated hangers may be omitted, provided hanger is isolated from copper pipe.

3.2 VERTICAL PIPE SUPPORTS

A. For steel piping vertical support, spacing shall not exceed 15 feet.

B. For copper and brass tube and pipe vertical support, spacing shall not exceed 10 feet.

C. For cast iron pipe vertical support, spacing shall not exceed 15 feet.

D. For PVC and CPVC vertical support, spacing shall not exceed 10 feet, with mid-story guides provided for piping 2 inches and smaller.

3.3 PIPE SUPPORTS

A. For uninsulated horizontal steel and wrought iron pipe, use malleable iron split pipe ring with turn buckle adjuster, Fig. 108 and 114 combined for pipes up to 8" with loading not exceeding 860 pounds; carbon steel double bolt pipe clamp, Fig. 295 with weldless eye nut, Fig. 290 for pipes over 8".

B. For horizontal copper pipe and tube through 2-inches in size, use copper-plated malleable iron split pipe ring with turn buckle adjuster, Fig. CT-138R and 114 combined. For larger copper pipe use Figure 260 with isolating insulation between hanger and pipe.

C. For horizontal cast iron soil pipe, use clevis hanger, Fig. 590.

D. For vertical, steel, wrought iron and cast-iron pipe, use extension steel riser pipe clamps, Fig. 261, installed below a coupling or welded lugs. Figure 103 offset pipe clamp may be used where riser guiding, or intermediate support is required by Code.

E. For vertical copper pipe and tube through 4 inches in size, use copper-plated extension pipe clamp, Fig. CT-121. For larger piping, use Figure 261 with isolating insulation between pipe and hanger.

F. Exterior or floor supported piping on slabs shall be supported using restrained pipe stanchion saddle Figure 265 for 4-inch piping and above, or 191 for sizes less than 4" diameter.

G. Multiple or Trapeze Hangers: Steel channels with welded spacers and hanger rods Figure 46; cast iron roll and stand for hot pipe sizes 6" and over Figure 175.

H. Wall Support for Pipe Sizes to 3" cast malleable iron hook Figure 126.

I. Wall Support for Pipe Sizes 4" and Over: Welded steel bracket and wrought steel clamp as specified under paragraph 3.1-F; adjustable steel yoke and cast-iron roll for hot pipe sizes 6" and over, or clevis hanger.

J. For insulated piping where vapor barrier is to be maintained, use adjustable clevis hanger Figure 260 with Figure 167 pipe shield, except that minimum gauge not less than 14 through 3 inches in size, 12 through 12 inches in size and 1/8 inch thick through 26 inches in size. Shields shall be a minimum of 12 inches long.

K. Shield for Vertical Copper Pipe Risers: Sheet lead.

L. All ferrous pipe supports shall be cleaned and painted with one coat of rust inhibiting paint.

M. Vertical runs of insulated copper (domestic or refrigerant) use 1-5/8" uni-struct metal channel with "cush-a-clamp" assembly and 20 gauge, 6-inch long galvanized shield between clamp and insulation.

3.4 INTERMEDIATE ATTACHMENTS

A. Hanger rods: use galvanized, or plated steel single or double end threaded, Figs. 140 or 253. Continuous threaded rod, Fig. 146 shall be used wherever possible.

B. Chain wire or perforated strap hangers will not be permitted. One pipe shall not be suspended from another pipe. No piping shall be supported from the roof deck.

3.5 STRUCTURAL ATTACHMENTS

A. For attaching steel or carbon-plated hanger rods to reinforced concrete, use galvanized malleable iron concrete inserts, Fig. 282, 281 or 285 as appropriate.

B. For attaching steel hanger rods to structural steel beams, use malleable iron C-clamps, Fig. 87 with retaining clip for loads up to 500 lbs.; Figs. 133, 134, 228 center load clamps for loads larger than 500 lbs. In lieu of the above welded beam attachments Figures 54, 55, and 66 are acceptable for catalogued load ratings. At joists, Figure 60 steel washer plates are acceptable between joist angles installed at panel points.

C. Vertical expansion shields or toggles shall not be used for suspending hanger rods, except with permission in cases where inserts have been omitted or cannot be used. Where expansion shields or toggles are used, loading shall not exceed 25 percent of the manufacturers catalogued ultimate load capacity and a load test shall be performed on not less than four anchors. Where loads exceed those which can be attained using a single hanger, use Figure 47, 49, or 52 concrete plates.

3.6 PIPE COVERING PROTECTION

A. Hangers and supports for insulated piping shall not injure or pierce insulation. Provide insulation protection shields, Fig. 167 in conjunction with hanger or roll device, for cold piping. Shields shall be galvanized steel, minimum 12 gauge and 12 inches long through 12-inch pipe size. Hot piping with compressible insulation shall be provided with Figure 160 protection saddle.

3.7 SLEEVES

A. Position sleeves prior to placement of concrete, provide reinforcement at sleeves.

B. Caulk between pipe and sleeve. At fire rated partitions, walls and floors, install a UL listed pipe penetration assembly and install in accordance with the manufacturers requirements, to provide an UL listed, fire rated assembly with a rating which equals or exceeds that of the item penetrated.

C. At smoke tight walls and partitions, fully caulk around pipe/duct and sleeve and sleeve and wall to maintain smoke integrity.

3.8 EQUIPMENT

A. Support suspended equipment as generally specified above for piping.

B. Support shall be in accordance with the equipment manufacturer’s recommendations, except as otherwise detailed on the drawings.

C. For rotating equipment, provide vibration isolation as specified in Section 23 05 48.

D. Install supports to provide full access to equipment for maintenance and servicing.

E. Roof mounted equipment not otherwise provided or specified with roof curb supports shall be provided with pre-manufactured roof supports specifically designed for the support of mechanical equipment and have a notice of product acceptance. Supports shall be constructed of aluminum or stainless steel, incorporate an integral screw type height adjustment device, integral deck flange, flashing and related appurtenances required to provide a wind load rated, watertight installation, as manufactured by Thaler

Metal Industries, Type MERS-900A (metal deck), or Type MERS-920A (concrete deck). Supports shall be anchored to the building structure, and equipment anchored to supports to withstand the imposed wind loading. Bottom of mechanical equipment shall not be less than 18-inches above the roof surface, or greater where required to comply with code minimums.

F. All equipment installed outdoors shall be designed, constructed, and installed to meet the applied wind force, refer to Section 23 05 00.

3.9 LOADING

A. Confirm load imposed upon the building structure with the project structural engineer, or for pre-manufactured buildings, the building manufacturer.

3.10 SWAY BRACING

A. For all pipe sizes 4 inches and larger that change in direction more than 45 degrees, provide rigid support sway bracing.

END OF SECTION

SECTION 23 05 48
VIBRATION ISOLATION

PART 1: GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.2 SCOPE

A. Provide vibration isolation support for all rotating and reciprocating mechanical equipment, piping and ductwork as required to prevent transmission of vibration to building structure. Expected noise levels in various parts of the building shall generally conform to noise criteria recommendations set forth in 2011 ASHRAE Applications Handbook, Chapter 48, Table 1. Contractor shall be responsible for selecting and installing vibration isolators as specified or indicated or otherwise required to prevent transmission of vibration which would cause noise levels in excess of expected noise levels. Provide concrete bases as required for equipment.

1.3 QUALITY ASSURANCE

A. All vibration isolation devices, including auxiliary steel bases and placing forms with steel reinforcing, designed, and furnished by single manufacturer, or supplier, who will be responsible for adequate coordination of all phases of work. Deflections as scheduled in 2011 ASHRAE Applications, Chapter 48, Table 47. Concrete material shall be as specified in Division 3.

B. Air handling units with factory installed spring isolators are specified.

C. Vibrator isolation manufacturer is responsible for providing such supervision as may be necessary to assure correct installation and adjustment of isolators. Upon completion of installation and after system is put into operation, manufacturers shall make final inspection and submit his report to Architects in writing certifying correctness of installation and compliance with approved submittal data.

D. Mason Industries used as basis of design. Provide products by Mason, Amber Booth, Vibration Eliminator Co. or Vibration Mountings and Controls.

1.4 SUBMITTALS

A. Submittal data to show type, size dimensions, rated capacity, rated deflection, compressed spring height, solid spring height, identity color coding and labeling details, and location diagrams for each color coding and labeling details, and location diagrams for each isolator proposed and any other information as required for Architects to check isolator selections for compliance with Specifications. All steel bases and concrete inertia bases completely detailed. Submittal data to include clearly outlined procedures for installing and adjusting isolators.

B. Coordinate submittals to indicate loading at each isolation point for actual equipment being furnished.

PART 2: PRODUCTS

2.1 EQUIPMENT

A. Unless otherwise noted, all mechanical equipment shall be mounted on vibration isolators to prevent transmission of vibration and mechanically transmitted sound to building structure. Vibration isolators shall be selected in accordance with weight distribution so as to produce reasonable uniform deflection. Deflections as required to meet criteria established under paragraph 1.2, or as specified.

B. All isolators exposed to outdoor weather with galvanized finish of all ferrous parts and bolts and nuts cadmium-plated, or electro zinc plated.

C. Vibration Isolation Mountings

1. Double Deflection Neoprene Mountings (Mason Specification A)
   a. Double deflection neoprene mountings maximum static deflection 0.35", friction pads both top and bottom. Bolt holes are provided for areas where bolting is required.
   b. Pads shall be a minimum 3/4” thickness neoprene, Mason “super waffle” type.

PART 3: EXECUTION

3.1 INSTALLATION

A. Installation and adjustment in accordance with manufacturer’s instructions.

B. Vibration isolators shall provide required deflection under imposed loads and shall produce uniform loading and deflection even when equipment weight is not evenly distributed. Leveling bolts shall not be used as jacking devices.

C. Vibration isolation types and deflections as specified, indicated, or scheduled.

D. Contractor and vibration isolation manufacturer or his regularly designed and factory authorized representative shall perform following tasks in addition to supply and installation of isolation equipment:

1. Obtain from Architect approved manufacturer's name, model number and other necessary identifying data for each item of mechanical equipment to be resiliently mounted. Coordinate resilient mounting systems with exact equipment furnished in regard to physical size, isolator locations, weight, rotating speed, etc. Direct contact and cooperation between vibration isolation device fabricator and equipment manufacturer required.
2. Provide on-the-job supervision as required during installation of resiliently mounted equipment and piping to assure that vibration isolators are installed in strict accordance with normally accepted practices for critical environments.
3. Replace at no extra cost to Owner, isolators which do not produce required deflection, are improperly loaded above or below their correct operating height, or which do not produce required isolation.
4. Cooperation with other Contractors engaged in project so that installation of vibration isolation devices will proceed in manner that is in best interests of Owner.

5. Notify Architect of project conditions which affect vibration isolation system installation or performance, and which are found to be different from conditions indicated or specified. Should vibration isolation system installation proceed without such notification, remedial work required to achieve proper isolator performance shall be accomplished by Contractor at no additional cost to Owner.
6. Be alert for possible "short-circuiting" of vibration isolation systems by piping supports, electrical connections, temperature control connections, drain lines, building construction, etc., and notify involved contractor as to these problems or potential problems. Where such situations cannot be easily resolved, notify Architect so that preventive or remedial action can take place on timely basis. Remedial measures required shall be undertaken by Contractor responsible at no additional cost to Owner.

3.2 APPLICATION

A. Internally isolated air handling units and condensing units shall be isolated using Type "A" neoprene pads.

END OF SECTION

SECTION 23 05 53
IDENTIFICATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.2 SCOPE

A. Provide equipment, materials, tools, labor, and supervision necessary to label and identify piping systems equipment, valves, and duct systems as specified herein.

B. Provide for painting of piping systems within mechanical rooms, boiler rooms, fan rooms and chiller (utility) plants.

1.3 QUALIFICATION

A. Piping identification materials by Allen Systems, Brady, Seton, or Industrial Safety Supply Company.

1.4 SUBMITTALS

A. Submit manufacturer's catalog cuts including installation instruction showing complete descriptive data. Clearly mark items to be furnished.

B. Submit list of wording, symbols, letter size, and color coding for mechanical identification of piping, equipment, and duct systems.

C. Submit valve chart and schedule, including valve tag number, service, location, normal position, valve type, manufacturer's name, and model number.

PART 2 - PRODUCTS

2.1 MATERIALS

A. All piping shall be identified with snap-on type identification markers.

B. For insulated piping systems provide snap-on type identification markers.

C. For pipes under 1/2" O.D. (too small for color bands and legends), provide stamped metal tags at locations of pipe markers, attached to pipe with 16-gauge copper or stainless-steel wire.

D. For large diameter piping 12-inches and above (too large for snap-on labels), use strap around markers, secured to pipe with nylon ties.

E. For buried piping, use metallic backed 6 inch wide by 4 mil thick tape above pipe.

F. For piping, use weather-resistant, non-vinyl chloride markers constructed of polyester materials, pressure sensitive or pre-coiled type equal to SEATON “Ultra-Mark”.

2.2 LABEL AND COLOR

A. Labeling and color-coding shall be in accordance with "Scheme for the Identification of Piping Systems" (ANSI A13.1-1975), Compressed Gas Association (CGA) Pamphlet C-9-1988 (R1993), and as specified herein.

B. Each marker must show (1) approved color-coded back- ground, (2) proper color of legend in relation to background color, (3) approved legend letter size, (4) approved marker length, (5) directional flow arrow, and (6) fluid being conveyed.

C. Provide legend indicating color and service in the operating and maintenance manuals.

2.3 LOCATION OF PIPE MARKERS

A. Locations for pipe markers in equipment rooms, tunnels and shafts shall be as follows:

1. Adjacent to each valve and fitting (except on plumbing fixtures and equipment).
2. At each branch and riser take-off.
3. At each pipe passage through wall, floor, and ceiling connection.
4. At each pipe passage to underground.
5. On all horizontal pipes run-marked every 25 feet.

B. Locations for pipe markers above ceilings in finished areas.

1. Adjacent to each valve.
2. On all horizontal pipes run-marked every 20 feet, and at least once in each separate space through which the piping passes.

2.4 VALVES

A. Identify each valve with an engraved brass metal tag. Tags to be affixed to valves using either an “S” hook or jack chain.

B. Provide schedule listing valve numbers and their location. Schedule shall be provided in the operating and maintenance manuals, with a framed copy located in the main mechanical equipment room. Valve chart shall list the tag number, service (chilled water, domestic water, hot water, etc.), location (room number), normal state (open/closed), type of valve (gate, ball, etc.), manufacturer and model number.

C. All main and branch line valves are to be tagged in accordance with the following numerical schedule, except where an existing scheme is already in place, it shall be followed:

1. Cold Water 1000 - 1999
2. Hot Water 2000 - 2899

2.5 EQUIPMENT

A. Identify air handling units with 3-layer black-white-black phenolic tags, minimum size of 6 inches in length by 4 inches tall, with 3-inch-tall letters engraved not less than 1/8-inch thickness, for fan coil units size shall be 4 x 2 with ½-inch tall letters.

B. Identify condensing units as described above for air handling units.

C. Identify terminal boxes using minimum 3-inch tall, stenciled lettering, day glow color at bottom of terminal box, color to match duct system color.

D. Identify fans with minimum 3-inch-tall letters indicating fan mark as shown on the plans, exhaust or supply and area(s) served.

PART 3 - EXECUTION

3.1 PREPARATION

A. De-grease and clean surfaces to receive adhesive for identification materials.

B. Prepare surfaces in accordance with Division 9 for stencil painting.

3.2 INSTALLATION

A. Plastic Nameplates: Install with corrosive-resistant mechanical fasteners.

B. Metal Tags: Install with corrosive-resistant brass bead or jack chain.

C. Stencil Painting: Apply paint in general accordance with Division 9.

D. Plastic Pipe Markers: Install in accordance with manufacturer's instructions.

E. Underground Plastic Pipe Markers: Install 6 to 8 inches below finished grade, directly above buried pipe.

F. Equipment: Identify air handling units, chillers, packaged HVAC units, and related equipment with plastic nameplates.

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

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

I. Piping: Identify piping, concealed or exposed, with plastic pipe markers. Tags may be used on small diameter piping. Identify service, flow direction and pressure. Install in clear view and align with axis of piping.

3.3 VALVE CHART AND SCHEDULE

A. Provide valve chart and schedule in aluminum frame with clear plastic shield. Install at location in each equipment room as directed. Schedule shall include the following information: tag number, system, normal position, location (floor/room), make and model.

3.4 CONCEALED LOCATIONS

A. At valve locations above accessible type suspended ceilings, provide an adhesive green color square on the closest ceiling grid beneath the valve.

B. At terminal box locations above accessible type suspended ceilings, provide an adhesive orange color 1” x 1” square on the closest ceiling grid beneath the terminal box.

C. At fire and smoke damper access door locations above accessible type suspended ceilings, provide an adhesive red color 1” x 1” square into the closest ceiling grid beneath the damper access door.

END OF SECTION

SECTION 23 05 93
TESTING, ADJUSTING AND BALANCING (TAB) OF HEATING, VENTILATING & AIR CONDITIONING (HVAC) SYSTEMS

PART 1 - GENERAL

1.1 SCOPE OF SERVICES:

A. The TAB Consultant shall be a firm certified by either the Associated Air Balance Council (AABC) or the National Environmental Balancing Bureau (NEBB).

B. The TAB Consultant shall provide all technically qualified personnel, equipment, instrumentation, and materials on a continuous basis in order to complete TAB services in a timely manner.

C. The scope of services shall include, but not be limited to, the following:

1. Review Project Documents to ascertain that the HVAC systems are designed in such a manner that TAB may be accomplished.
2. Perform TAB of the HVAC systems in accordance with industry standards and submit certified TAB Report.
3. Provide a Certificate of Conformance or similar guarantee attesting to the performance of the services provided.
4. Calibration measurements for all thermostats and humidity sensors, maintenance of temperature setpoints and confirmation of control interlocks.

1.2 REFERENCES

A. Associated Air Balance Council (AABC) - National Standard for Field Measurement and Instrumentation, Total System Balance, latest edition.

B. National Environmental Balancing Bureau (NEBB) - Procedural Standard for Testing, Balancing, and Adjusting of Environmental Systems, latest edition.

C. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc., (ASHRAE) - HVAC Systems and Applications Handbook, Testing, Adjusting and Balancing, latest edition.

D. Sheet Metal and Air Conditioning Contractors National Association (SMACNA) - HVAC Systems Testing, Adjusting and Balancing, latest edition.

1.3 SUBMITTALS

A. Submit Pre-TAB inspection reports.

B. Submit certified TAB report for all HVAC systems.

C. Submit certificate of conformance attesting to full completion of the TAB work in accordance with the standards and requirements of the certifying agency (AABC or NEEB).

1.4 INSTRUMENTATION

A. All instrumentation shall be provided by the TAB firm.

B. Instrumentation used shall be calibrated by a certified firm at a frequency not less than the prescribed by the certifying agency, but in no case more than annually.

1.5 DOCUMENTS

A. The Contractor shall furnish the TAB firm with a complete set of construction documents and HVAC system shop drawings.

1.6 ACCEPTABLE FIRMS

A. Dade Test and Balance Corporation

B. Total Dynamic Balance

C. Owner/Engineer approved firm.

PART 2 - PRODUCTS

NOT USED

PART 3 - TAB WORK

3.1 Coordinate TAB work schedule through the Contractor, with the HVAC work being performed under Division 23.

3.2 Provide personnel on a continuous basis in order to complete the TAB work in a timely manner. The TAB work shall be completed before Owner occupancy. After Owner occupancy, access to occupied areas may be restricted and work schedules shall be modified accordingly. Work after normal business hours shall be coordinated with the Owner's project manager.

3.3 Inform the Contractor on a regular basis of work progress, work schedules and potential problem areas which may delay the timely completion of TAB work.

3.4 Permanently mark the final position of dampers and valves.

PART 4 - TAB REPORT

4.1 Publish a final report, certified by the Test and Balance firm as being an accurate representation of the data gathered, with a certificate of conformance after successful completion and acceptance of the project.

PART 5 - TAB REPORT REQUIREMENTS

5.1 Provide reports in hard cover, letter size, 3-ring binders with identification on front and binder. Include set of reduced HVAC floor plans with air outlets and equipment identified to correspond with Test Reports. Include fan curves with operating conditions marked.

5.2 Air Handler Units (AHU)

A. General

1. Air handler unit CFM may be determined either by totaling individual CFMs from the supply air grilles or by supply air duct traverse. However, if design CFM (within -5%) cannot be achieved, air handler unit CFM shall be verified by supply air duct traverse; return air duct traverse is NOT acceptable. When a duct traverse is utilized, provide a Duct Traverse Report in the TAB report and note traverse locations on the reduced set of HVAC floor plans.

2. Adjust fan RPM until either design CFM (-10%/+10%) is obtained or motor is at rated HP. Do NOT use motor service factor.
3. If design CFM (-10%/+10%) can not be obtained, provide specific recommendations in order to obtain design CFM.
4. Provide the measured static pressure data at the following locations:
   a. Filter inlet pressure
   b. Filter delta pressure
   c. Coil delta pressure
   d. Fan suction pressure
   e. Fan discharge pressure. Compare measured value with value obtained from fan performance curve based on CFM and RPM.
5. Provide Air Handler Unit Test Report. Include motor full load amps (FLA), operating amps and brake horsepower (BHP) on test report.
6. Provide Coil Test Report. The following data shall be provided:
   a. Outdoor air DB/WB.
   b. Return air DB/WB.
   c. Coil entering air DB/WB.
   d. Coil leaving air DB/WB.
7. Provide Air Outlet Test Report. Note any outlet not within +/-10% of design CFM and any outlet with an objectionable noise level in test report.
8. Provide heat coil test report for heating coils, including airflow, and temperature differentials.

B. Provide test reports and data in the following order:

1. Air Handler Unit Test Report
2. Coil Test Report
3. Air Outlet Test Report
4. Duct Traverse Reports

5.3 Fans

A. Provide test reports in the following order:

1. Fan Test Report
2. Air Outlet Test Report: Provide for fans with multiple air outlets. Note any outlet with an objectionable noise level.

5.4 Filters

A. Record area, flow, velocity, and pressure drop. Note visual condition of filters and inspect for air bypass.

5.5 Report Forms

A. Submit test reports on standard AABC, NEBB or SMACNA forms. Forms shall be expanded to include all data listed, as well as any required data not listed. Each test report shall bear the name of the person who recorded the data, the date when the data was recorded, and the seal of the supervisor. Test reports shall be computer generated.

B. Title Page

1. Date
2. Project's name and address
3. Architect's name and address
4. Mechanical Engineer's name and address

5. General Contractor's name and address
6. Mechanical Contractor's name and address
7. TAB Consultant's name, address, and phone number

C. Certification Page

1. Project's name and address
2. Certification statement
3. TAB Consultant's name
4. TAB supervisor's name
5. Certification number
6. Date
7. Seal and signature of TAB supervisor

D. Instrument Calibration Report

1. Instrument
2. Manufacturer
3. Model number
4. Serial number
5. Range
6. Calibration date

E. Air Handler Unit (Packaged and Central Station) Test Report

1. Air Handler Unit Data
   a. Mark
   b. Manufacturer
   c. Model number
   d. Serial number
   e. Wheel type: forward curve (FC), airfoil (AF), backward incline (BI)
   f. Wheel diameter (IN)
   g. Fan arrangement: Draw thru (DT), blow thru (BT)
   h. Fan discharge: Upblast front (UBF), upblast rear (UBR), top horizontal (TH), bottom horizontal (BH)
   i. Fan sheave diameter and bore, IN
   j. Number of fan belts, manufacturer, and size
   k. Number of filters, type and size
   l. Note any abnormal vibration.
2. Motor Data
   a. Manufacturer
   b. Frame size
   c. Nameplate HP, volts, amps, phase, RPM and service factor
   d. Motor sheave diameter and bore, IN
   e. Motor sheave to fan sheave centerline distance, IN
   f. Starter size and overload element capacity, amps
3. Performance Data (Design and Actual)
   a. Supply air CFM
   b. Return air CFM
   c. Outside air CFM
   d. Fan RPM
   e. Motor volts T1-T2, T2-T3, T3-T1
   f. Motor FLA T1, T1, T3
   g. Motor no load amps T1, T2, T3 (belt drives only) (Actual)
   h. Motor brake horsepower
   i. Fan total static pressure, IN WC

j. Fan suction static pressure, IN WC (Actual)
k. Fan discharge static pressure, IN WC (Actual).
l. Filter static pressure loss, IN WC
m. Cooling coil static pressure loss, IN WC
n. Heating coil static pressure loss, IN WC
o. AHU casing static pressure loss, IN WC
p. External static pressure loss, IN WC
q. Inlet guide vane position (Actual)

4. Temperature Control System Data (Electric, Electronic or Pneumatic) (Actual)

F. Coil Test Report (AHU's and Reheat Coils)

1. Coil Data
   a. Mark
   b. Manufacturer
   c. Serial number
   d. Number of rows and fins per foot
   e. Coil CFM
   f. Face area, SF
   g. Face velocity, FPM
2. Air-side Performance Data (Design and Actual)
   a. Outside air CFM
   b. Outside air DB and WB temperatures, □F
   c. Return air CFM
   d. Return air DB and WB temperatures, □F
   e. Coil CFM
   f. Coil entering air DB and WB temperatures, □F
   g. Coil leaving air DB and WB temperatures, □F
   h. Calculate coil capacity, BTUH (BTUH=4.5*CFM*DH)

G. Fan (Ventilation, Return, Exhaust, Relief) Test Report

1. Fan Data
   a. Mark
   b. Location
   c. Manufacturer
   d. Model number
   e. Serial number
   f. Type: Cabinet, inline, roof mounted, wall mounted
   g. Wheel type: forward curve (FC), airfoil (AF), backward incline (BI)
   h. Wheel diameter, IN
   i. Sheave diameter and bore, IN
   j. Number of belts, manufacturer, and size
   k. Note any abnormal vibration.
2. Motor Data
   a. Manufacturer
   b. Frame size
   c. Nameplate HP, volts, amps, phase, RPM, and service factor
   d. Sheave diameter and bore, IN
   e. Motor sheave to fan sheave center line distance, IN
   f. Starter size and overload element capacity, amps.
3. Performance Data (Design and Actual)
   a. CFM
   b. Fan RPM
   c. Fan suction static pressure, IN WC (Actual)
   d. Fan discharge static pressure, IN WC (Actual)

e. Fan total static pressure, IN WC
f. Motor volts T1-T2, T2-T3, T3-T1
g. Motor FLA T1, T2, T3
h. Motor no load amps T1, T2, T3 (belt drives only) (Actual).

H. Air Outlet Test Report

1. Outlet Data
   a. Mark
   b. Manufacturer
   c. Type: Ceiling diffuser (CD), sidewall grille (SG), exhaust grille (EG), return grille (RG), transfer grille (TG), etc.
   d. Size, IN
2. Performance Data
   a. Design CFM
   b. Actual CFM
   c. Note all outlets that are not balanced within +/-10% of design. (Actual CFM-design CFM) x 100/design CFM)
   d. Note all outlets with an objectionable noise level.

I. Duct Traverse Test Report

1. Duct Data
   a. System/Branch
   b. Size, IN
   c. Area, SF
   d. Design airflow, CFM
   e. Design velocity, FPM
2. Traverse Data
   a. Duct static pressure, IN WC
   b. Air temperature, □F
   c. Traverse position, IN
   d. Traverse velocity pressure, IN WC
   e. Traverse velocity, FPM
   f. Average duct velocity, FPM
   g. Measured airflow, CFM.

J. Acoustical Data

1. In space perceived or identified as “noisy”, provide noise level measurements by Octave Bands and plot NC levels.

END OF SECTION

SECTION 23 07 13
DUCT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.2 SCOPE

A. Provide materials, labor, and supervision necessary to cover ducts.

B. Insulation shall include insulating materials, jackets, adhesives, mastic coatings and materials required to install the work.

C. The term ductwork refers to duct, fittings, dampers, flexible connections, air devices and similar ductwork system appurtenances.

1.3 STANDARDS AND CODES

A. Covering materials shall have maximum UL Flame Spread Index of 25, and maximum Smoke Developed Index of 50, and shall meet all requirements of NFPA-90A.

B. Insulation valves shall be the greater of that required by Chapter 13 of the Florida Building Code “Energy Efficiency “, or as specified herein.

1.4 QUALIFICATIONS

A. Duct covering/lining materials shall be by Certainteed/Saint Gabain, Owens-Corning Fiberglas, KNAUF, or Mansville.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Type 'A' Duct Covering; flexible mineral fiber blanket, ASTM C553, Type 1 with Foil Scrim Kraft vapor barrier facing, minimum ¾ pound (0.75) per cubic foot density, K factor of 0.24 per inch at 75 degrees F.

B. Type 'C' duct covering: Rigid insulation board, ASTM C612, with foil skrim kraft jacket 3 pound per cubic foot density, K factor of 0.24 per inch at 75-degrees F.

2.2 COVERING SCHEDULE

A. Ducts shall be covered as scheduled herein:

1. Outdoor air intake to AHU and exhaust ducts; uninsulated.
2. Supply air ducts; covered with Type 'A' duct covering, 2" thick in concealed locations above ceilings. For exposed locations such as in equipment rooms Type 'C' duct covering shall be used except at flexible connections and round and oval ducts, use Type 'A'.
3. Return air ducts shall be covered with 2” thick Type 'C' duct covering in equipment rooms and Type 'A' in concealed locations above ceilings.

PART 3 - EXECUTION

3.1 DUCT COVERING APPLICATION

A. Covering shall be cut slightly longer than perimeter of duct to insure full thickness at corners. Insulation shall be applied smoothly with edges tightly butted and shall be adhered to duct with fire resistant adhesive. Adhesive shall be applied for 100 percent coverage of the ductwork and so that insulation conforms to duct surfaces uniformly and firmly. With insulation in place, thickness shall not be reduced by more than ½ inch, and no condensation shall appear on any surface.

B. In addition to the adhesive, the insulation shall be additionally secured to the bottom of ducts 18" or wider by means of welded or impaled pins and speed clips located 12" on centers. The protruding ends of the pins shall be cut off flush after the speed clips have been applied. The vapor-barrier facing shall be thoroughly sealed with a vapor-barrier mastic and tape where the pins have pierced through.

C. Joints, seams, cuts or tears shall be sealed with a foil faced tape, approved by the insulation manufacturer. Tape shall be covered with a leno weave cloth embedded in mastic.

D. Insulation shall be continuous through walls and floors except at fire dampers and combination fire/smoke dampers. Vapor seal all hanger penetrations.

E. Vapor barrier shall be continuous and maintained for the insulation system. Duct insulation terminating at insulted or non-insulated sheet metal equipment surfaces, supports, damper fittings, and similar penetration and construction points shall be sealed with vapor barrier coating. Where total length of penetration exceeds 12 inches, provide two layers of glass cloth tape set in mastic with sheet metal trimming.

F. Insulate back panel of all lay-in type supply air devices.

G. If condensation occurs on ducts at any time from system activation through the warranty period, the insulation shall be reworked to prevent the condensation at no additional cost to the Owner.

END OF SECTION

SECTION 23 07 16
PIPE AND EQUIPMENT INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.2 SCOPE

A. Provide materials, equipment, labor and supervision necessary to install insulation to hot and cold surfaces of piping, tanks, fittings and other surfaces.

B. Insulation shall include insulating materials, jackets, adhesive, mastic coatings, tie wire and other materials as required to complete the insulating work.

C. The term piping refers to pipe, fittings, valves, controls, and related system appurtenances.

D. Attachments to piping surfaces shall be insulated the same as piping.

E. All cold surfaces subject to condensation shall be insulated.

F. All hot surfaces, which could result in injury, shall be insulated.

1.3 CODES AND STANDARDS

A. Insulating materials, jackets, mastics, etc., shall meet flame spread, fuel contribution and smoke developed ratings in accordance with NFPA-90A. Flame spread rating of not more than 25, smoke developed rating of not more than 50.

B. Insulation valves shall be greater of that required by Chapter 13 of the Florida Building Code “Energy Efficiency”, or as specified herein.

1.4 QUALIFICATION

A. Insulating materials by Armacell, Rubatex, Owens Corning, Certainteed, Knauf, Manville and Pittsburg Corning.

B. Mastics and adhesives as recommended by insulation manufacturer.

1.5 SUBMITTALS

A. Submit manufacturer's catalog cuts showing complete descriptive data and installation instructions.

B. Include a summary sheet indicating in tabular format the product, jacketing, mastic adhesive and thickness for each service and location.

PART 2 - PRODUCTS

2.1 PIPE INSULATION - TYPE "A"

A. Pipe Covering: Preformed sectional heavy density fiber-glass insulation and factory applied vapor barrier, all service jacket with pressure sensitivity self-sealing longitudinal laps and butt strips. Suitable for operating temperatures from -20-degrees F to +850-degrees F. Water vapor permeance of .02 perms. Equivalent to Owens Corning 25 ASJ/SSL.

B. Fittings: Fitting coverings for all ells, tees, valves, flanges and other fittings shall be of same thickness as adjacent pipe covering. Jacketing at fittings shall be Zeston 25/50 pre-molded one-piece PVC insulated fitting covers. Installation and vapor barriers shall be in accordance with manufacturer's recommendations.

2.2 PIPE INSULATION - TYPE "S"

A. Flexible closed-cell elastomeric, "K" valve of 0.27 at 75 F equal to Armaflex Type "AP". Install using Armstrong 520 adhesive with 100 percent coverage of all seams and ends. Finish with two coats of a polyvinylchloride ultra-violet resistant finish where exposed to view inside the building or exposed to the weather approved by the manufacturer which will not crack when compressed, custom color blended where installed indoors to match the color of the surrounding surfaces.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use only experienced applicators regularly engaged in the trade. Rough work will be rejected. Application details shall be in accord with the insulating materials suppliers' recommendations except where a higher standard is specified.

B. Inspect piping and equipment before applying insulation to insure the installing Contractor has completed leak tests and surfaces are clean, dry and ready for application of insulation.

C. Covering for "cold" pipes shall pass unbroken through hanger clevises, sleeves, etc. All details of covering for cold surfaces shall be such that continuous covering with unbroken vapor barrier is provided. The same covering and hanging detail shall be used for pipes connecting to vibrating equipment or carrying pulsating pressures to avoid metal to metal contact between pipes and hangers.

D. Insulation at pumps, strainers and other access points shall be fabricated in such a manner that it can be readily removed without damage to the insulation. Removable insulation shall have a vapor proof cover fabricated so as to allow it to be resealed to the equipment vapor barrier.

E. Insulation at hot strainers, unions and flow measurement devices requiring access may be omitted provided the adjoining insulation is tapered to the pipe using a diatomaceous silica or mineral fiber insulating cement conforming to ASTM C195.

3.2 INSULATION SCHEDULE

SERVICE

A. Domestic Cold Water (Equipment rooms and spaces outside building thermal envelope). Type A, all pipe sizes 1" thick.

B. Domestic Hot Water, Re-circulating Lines, and Reheat. Type A, all pipe sizes 1" thick through 2 inch in pipe size, 1.5” thick for piping greater than 2 inches.

C. Horizontal Portions of Downspout Lines and roof drains. Type A, 1" thick all pipe sizes.

D. Condensate Drain Lines. Type S, ½" thick all sizes, with polyvinylchloride finish for piping exposed to the weather.

E. Refrigerant suction piping: Type S, 3/4” thick with polyvinylchloride finish for piping located outdoors.

F. In addition to the above, insulate all fittings, piping supports and equipment cold surfaces subject to condensation with materials and jacketing used for the piping to which it attaches.

3.3 GUARDS

A. Where exposed insulated piping extends to floor, provide sheet metal guard around insulation to extend up from floor 24". Guard to be galvanized sheet steel not less than 26 gauge.

3.4 CONDENSATION

A. Should condensation occur on any cold surface (including but not limited to piping, equipment, supports, framework), at any time from system activation through the warranty period, the insulation shall be reworked to prevent the condensation at no additional cost to the Owner.

END OF SECTION

SECTION 23 08 00
COMMISSIONING OF HVAC

PART 1 – GENERAL

1.1 SCOPE OF WORK

A. Independent commissioning of heating, ventilation, and air conditioning in accord with project documents and include:

1. Evaluate proposed HVAC, Electrical and Plumbing systems design, and control system documents.
2. Review and document HVAC and Electrical and Plumbing control interface systems interface.
3. Coordinate start-up of HVAC and Electrical and Plumbing systems.
4. Coordinate and review operation, training procedures, demonstration and instructions for HVAC equipment use by Owner.
5. Review, evaluate, and document HVAC equipment operation and performance.

B. Work with TAB contractor for testing, adjusting, and balancing to ensure HVAC system performance is maximized for operational efficiency.

C. Coordinate HVAC Commissioning scheduling and activities with GC/CM.

D. Commissioned Systems Include:

1. HVAC components and equipment.
2. HVAC interaction of cooling, heating, and comfort delivery systems.
3. Building Automation System (BAS): control hardware and software, sequences of operation, and integration of factory controls with BAS.
4. Lighting Control System with interface with daylighting.
5. Plumbing: Domestic hot water systems.

1.2 REFERENCES

A. American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE):

1. ASHRAE Guideline 0-2019The Commissioning Process.
2. ASHRAE Guideline 1.1-2007 HVAC/R Technical Requirements for the Commissioning Process.
3. ASHRAE Guideline 1.4-2019 Preparing Systems Manuals for Facilities.

1.3 DEFINITIONS

A. Definition of terms used are as follows:

1. Acceptance Phase: Phase of construction after initial start-up and check-out when functional performance testing, operational training, and operating and maintenance documentation development and review occurs.
2. Basis of Design: Documentation of primary thought processes and assumptions for design decisions made to meet Owner's Project Requirements as reflected in construction documents (drawings and specifications). Basis of design describes intent of project, systems, components, conditions, and methods chosen to meet Owner's Project Requirements. Design professionals (Architect and Engineer) are responsible for interpretation of the basis of design.

3. Commissioning Provider: Independent entity, not otherwise associated with design team or Contractor/CM, who directs and coordinates day-to-day commissioning activities. Commissioning Provider does not have construction oversight or design role.
4. Commissioning Plan: Overall plan providing structure, schedule, and coordination planning for commissioning process.
5. Commissioning Team: Group responsible for accomplishing commissioning process.
6. Data Logging: Monitoring flows, currents, status, and pressures of equipment using stand-alone recording equipment, separate from control system. Additional monitoring may be provided through capabilities of control system.
7. Deferred Functional Performance Tests: Functional tests performed after date of substantial completion due to partial occupancy, equipment and seasonal testing requirements, design or other site conditions precluding testing of system or piece of equipment during normal commissioning sequence.
8. Owner's Project Requirements: Documents prepared by Owner providing explanation of concepts, criteria, and work scope critical to Owner's expectations.
9. Factory Testing: Testing of equipment at factory (or on-site) by factory personnel in Owner's representative and commissioning agent's presence.
10. Functional Performance Tests: Tests of dynamic function and operation of equipment and systems using manual (direct observation) or monitoring methods. Functional testing is dynamic testing of systems (rather than just components) under full operation. Systems are tested under various modes, such as during low cooling or heating loads, high loads, component failures, unoccupied modes, varying outside air temperatures, fire alarm modes, and power failure. Systems are run through control system's sequences of operation and components are verified to respond properly. Commissioning Provider develops Functional Performance Test procedures in sequential written form, coordinates, oversees and documents actual testing performed by GC/CM. Functional Performance Tests are performed after Test and Balance, pre-functional checklists and start-up is complete.
11. Indirect Indicators: Indicators of response or condition, such as reading from control system screen reporting damper to be 100% closed.
12. Manual Tests: Using hand-held instruments, immediate control system read-outs or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make observations.
13. Monitoring: Recording of parameters (flow, current, status, or pressure) of equipment operation using data loggers or trending capabilities of control systems.
14. Over-written Value: Writing over sensor value in control system to determine response of system (e.g., changing outside air temperature value from 50ºF to 75ºF to verify economizer operation). See "Simulated Signal.
15. Owner-contracted Tests: Tests paid by Owner outside GC/CM's contract and for which Commissioning Provider does not oversee. Tests shall not be repeated during functional testing if properly documented.
16. Phased Commissioning: Commissioning completed in phases (by floors, for example) due to size of structure or other scheduling issues, to minimize total construction time.
17. Pre-functional Checklists: Lists of items to inspect and elementary component tests to conduct to verify proper installation of equipment, provided by GC/CM to Commissioning Authority who shall review and approve scope of tests. Pre-functional checklists are primarily static inspections and procedures to prepare equipment or system for initial operation (e.g., belt tension, oil levels, labels affixed, gauges in place, sensors calibrated). Some pre-functional checklist items may entail simple testing of function of components, piece of equipment or systems. Pre-functional refers to testing to be accomplished prior to formal functional testing of installed equipment. Pre-functional checklists augment and may be combined with manufacturer's start-up checklist. GC/CM shall execute checklists.
18. Sampling: Functional Performance Testing of fraction of total number of identical or near identical pieces of equipment. Sampling population is at discretion of commissioning firm

and is subject to modification based upon sampling results (i.e., will be expanded if initial results warrant).

19. Simulated Condition: Condition created for purpose of testing response of system (e.g., blowing hair dryer on space sensor to determine response of variable volume terminal unit).
20. Simulated Signal: Disconnecting sensor and using signal generator to send amperage, resistance or pressure to transducer and control system to simulate sensor value.
21. Start-up: Initial starting or activating of dynamic equipment, including executing pre-functional checklists.
22. Test, Adjust, and Balance: Process of measuring actual flows of air and hydronic systems, adjusting flows to required values, and documenting results.
23. Trending: Monitoring of equipment performance over time, using data logging equipment or building control system.

1.4 QUALITY ASSURANCE

A. Supervision, coordination, and documentation of commissioning process shall be responsibility of Commissioning Provider.

B. Commissioning Provider shall become familiar with Owner's Project Requirements, Basis of Design documentation, project documents, and shall assume responsibility for overall system commissioning effort.

1.5 COORDINATION

A. Commissioning Provider will be hired by Owner. Commissioning Provider shall direct and coordinate activities of commissioning team.

B. Commissioning team shall consist of Commissioning Provider, Owner, GC/CM, and associated subcontractors.

C. Scheduling: Commissioning Provider shall schedule commissioning activities of and shall coordinate schedule with GC/CM. Commissioning Provider shall generally provide not less than two (2) weeks' notice to GC/CM of commissioning activities, except where retesting is required, or commissioning activities have been delayed by no fault of commissioning firm.

1.6 COMMISSIONING PROCESS

A. Commissioning Provider shall develop and coordinate execution of commissioning plan; observe and document installation, check-out, start-up, and equipment and system testing to establish that equipment and systems are functioning in accord with project requirements, and to assist in developing correct and complete documentation of construction effort.

B. Commissioning Provider shall not be responsible for design concept, design criteria, compliance with codes, design, construction scheduling, cost estimating, construction management, or construction supervision.

C. Commissioning Provider may assist design team with problem-solving, or GC/CM with correction of non-conformance items or deficiencies.

D. Commissioning Provider is not responsible for providing tools required to start, check-out and perform functional tests of equipment and systems, except for specified testing with supplemental portable data-loggers, which shall be supplied and installed by Commissioning Provider.

E. Work Required during Construction Phase:

1. Ensure compliance with construction documents, and achieve following objectives:
2. Develop commissioning plan and distribute to GC/CM, Owner and Engineer.
3. Coordinate commissioning activities during construction with GC/CM and ensure that commissioning activities are included in master project schedule.
4. Develop specific Functional Performance Test procedures and forms to document proper operation of equipment and system.
5. Submit proposed functional tests to Engineer for review and general conformance to requirements of contract documents and provide copy of proposed functional performance test procedures to GC/CM who shall review proposed tests for feasibility, safety, equipment, and warranty protection.
6. Required performance testing includes control system trending, stand-alone data logger monitoring, or manual logging of system operation to demonstrate proper operation. Functional Performance Test forms shall include following information:
   a. Date.
   b. Project name.
   c. System and equipment or component name(s).
   d. Equipment location and identification number.
   e. Test identification number, and reference to pre-function checklist and start-up documentation identification numbers for each piece of equipment.
   f. Participating parties.
   g. Reference to specification describing specific sequence of operations or parameters being tested or verified.
   h. Formulae used in calculations.
   i. Required pre-test field measurements.
   j. Instructions for setting up test.
   k. Special cautions or alarm limits.
   l. Specific step-by-step procedures to execute test, in clear, sequential, and repeatable format.
   m. Acceptance criteria of proper performance with provisions for clearly indicating whether or not proper performance of each part of test was achieved.
   n. Section for comments.
   o. Signature and date block for Commissioning Provider and participating parties.

F. Acceptance Phase: demonstrate that performance of equipment and systems installed during construction phase meets requirements of construction documents. Notify Owner and Engineer of deficiencies in results or procedures. Commissioning activity shall achieve following objectives:

1. Coordinate, witness, and approve functional tests of equipment and systems performed by GC/CM. Review functional test reports and analyze trend logs, data logger reports, and other monitoring data to evaluate equipment and system performance.
2. Document performance of functional testing and provide comparison to required performance, as defined by project documents.
3. Coordinate retesting as necessary until satisfactory performance is demonstrated.
4. Maintain master deficiency and resolution log, separate testing record log, and provide written progress reports and test results with recommended corrective actions for observed deficiencies.
5. Compile and submit commissioning report to Owner and Engineer documenting results of the Start-Up, Pre-Functional Performance Testing, and Functional Performance Testing.

PART 2 – PRODUCTS

Not Used.

PART 3 – EXECUTION

3.1 REPORTING

A. Provide final commissioning report to Owner with following reports:

1. Copies of Functional Performance Test reports.

3.2 SYSTEMS TO BE COMMISSIONED

A. As defined by the 2020 Florida Building Code – Energy Conservation

1. HVAC Rooftop packaged air conditioning unit.
2. Electrical lighting control.
3. Plumbing service water heating.

3.3 FUNCTIONAL PERFORMANCE TESTING

A. Functional Performance Testing of equipment or systems shall be conducted only after pre-functional testing and start-up has been satisfactorily completed. Schedule functional tests with GC/CM. Direct, witness, and document Functional Performance Testing of equipment and systems to be commissioned. GC/CM shall be responsible for execution of Functional Performance Tests.

B. Functional Performance Testing shall demonstrate that each item of equipment and each system is operating according to requirements of construction documents as defined by A/E. Each item of equipment and system undergoing Functional Performance Testing shall be operated through all modes of operation where there is required system response. Verify each action required in sequences of operation has been accomplished according to requirements, or A/E shall revise sequences as deemed appropriate.

C. Functional Performance Testing shall proceed from components to subsystems to systems. When proper performance of interacting, individual systems has been achieved, interface or coordinated responses between systems shall be tested.

D. Proper and accurate operation of control system shall be proven by functional testing and approved by Commissioning Provider before it may be used for testing, adjusting and balancing activities or to verify performance of other components or systems. If authorized by Commissioning Provider, portions of control system may be tested and approved before functional testing of the entire system is completed.

E. Air and water balancing shall be completed and corrected as necessary before Functional Performance Testing of air-related or water-related equipment or systems.

F. Test Methods:

1. Functional Performance Testing and verification shall be achieved by manual testing (direct manipulation of equipment and observation of its response and performance) or by monitoring performance using control system's trend log capabilities.

2. Functional Performance Test procedures shall specify which methods shall be used for each test. Determine which method is most appropriate for tests that do not have method specified.
3. Commissioning Provider may substitute specified methods or require additional method to be executed, other than that specified, if required to demonstrate proper operation of equipment or system being tested.
4. Develop Functional Performance Testing plans that define allowable sampling procedures and that specify procedures to be followed in case of observed discrepancies or failures in sample chosen for functional testing.
5. Sampling: multiple identical pieces of non-life-safety or otherwise non-critical equipment may be functionally tested using sampling strategy, as defined in functional test procedures.
   a. Significant application differences and significant sequence of operation differences in otherwise identical equipment invalidates their common identity.
   b. Small size or capacity difference, alone, does not constitute difference.
   c. The following equipment may be sample tested: reheat coils, terminal boxes, occupancy sensors, and lighting controls.
6. If 10% or 3 or more identical pieces of equipment (size alone does not constitute a difference) fail to perform to requirements of project documents (mechanically or substantively) due to manufacturing defects or application error not allowing it to meet performance specifications, identical units may be considered unacceptable by Commissioning Provider. In such case, GC/CM shall provide Commissioning Provider with the following:
   a. Within 1 week of notification from Commissioning Provider, GC/CM or manufacturer's representative shall examine other identical units making record of findings. Findings shall be provided to Commissioning Provider within 2 weeks of original notice.
   b. Within 2 weeks of original notification, GC/CM shall provide signed and dated, written explanation of problem, cause of failures, and proposed solution, including full equipment submittals for corrective or replacement equipment, if appropriate. Proposed solutions shall meet requirements of original installation.
   c. Commissioning Provider shall evaluate proposed solution and submit recommendation of approval or disapproval to Owner and Engineer.
   d. When approved, 2 examples of proposed solution shall be installed by GC/CM and Commissioning Provider shall schedule and conduct functional testing of proposed solution. Upon completion of functional testing of proposed solution, Commissioning Provider shall recommend acceptance or disapproval of proposed solution to Owner.
   e. Upon acceptance of proposed solution by Owner, GC/CM shall replace or repair identical items and extend warranty accordingly, if original equipment warranty had begun. Replacement/repair work shall proceed with reasonable speed beginning within 2 weeks of approval of proposed solution.
7. Ensure that each Functional Performance Test is performed under conditions that simulate actual operating conditions as closely as is practically possible.
8. Simulation of operating conditions (not by overwritten value) may be allowed, at Commissioning Provider's discretion. Simulation of conditions shall be accomplished by subjecting the equipment to actual operating conditions by artificial means whenever possible.
9. Where actually achieving simulated operating condition is impractical, as determined by Commissioning Provider or as identified in Functional Performance Test procedure, use of signal generators to create simulated signal may be used to test and calibrate transducers and DDC constants instead of using sensor to act as signal generator via simulated conditions or overwritten values. Signal generators or simulators shall be provided by GC/CM.
10. Overwriting sensor values to simulate conditions, such as overwriting outside air temperature reading in control system to be different than it really is, may be allowed if approved by Commissioning Provider. Simulation of operating conditions is preferable.

11. Altering setpoints: rather than overwriting sensor values, and when simulating conditions is difficult, altering setpoints shall be used to test sequences.
12. Indirect indicators: relying on indirect indicators for responses or performance may be allowed only after the Commissioning Provider has visually and directly verified that indirect readings represent actual conditions and responses over range of test parameters.

3.4 RETESTING OF EQUIPMENT AND/OR SYSTEMS

A. Prior to retesting of functional performance tests found to be deficient, submit data indicating that deficient items have been completed and corrected to Commissioning Provider.

B. After review of submitted data, if corrective measures are acceptable, Commissioning Provider shall schedule, and conduct recheck.

C. If during retesting it becomes apparent that deficient items have not been completed and corrected as indicated in data provided by GC/CM, retesting shall be stopped. Costs for commissioning team to further supervise retesting of Functional Performance Test shall be the responsibility of GC/CM.

3.5 DOCUMENTATION, NONCONFORMANCE, AND APPROVAL OF TESTS

A. Documentation: Witness and document results of functional tests using specific procedural forms developed for that purpose. Deficiencies or nonconformance issues shall be noted and reported with test results. Include completed test forms in final commissioning report.

B. As Functional Performance Testing progresses and deficiencies are identified, discuss issues, and attempt to resolve discrepancies with GC/CM.

C. Approval: Note each satisfactorily demonstrated function on functional test form. Formal approval of functional tests shall be made after review of test reports by Commissioning Provider and Owner. Recommend acceptance of each test to the Owner using standard form. Owner shall give final approval on each test using same form, providing signed copy to Commissioning Provider and GC/CM.

3.6 DEFERRED TESTING

A. Deferred testing: if required pre-functional or functional test cannot be completed as scheduled, execution of checklists and functional testing may be delayed upon approval of Commissioning Provider and Owner. Deferred tests shall be conducted in same manner as seasonal tests as soon as possible.

B. Schedule and coordinate any required seasonal testing, tests delayed until weather or other conditions are suitable for demonstration of equipment or system's performance. Seasonal testing shall be executed, documented, and deficiencies corrected as specified herein for functional testing. Adjustments or corrections to operations and maintenance manuals and record documents due to test results of shall be made before seasonal testing process is considered complete. Schedule deferred testing with GC/CM and Owner.

3.7 OPERATION AND MAINTENANCE MANUALS

A. Prior to beginning specified training programs, review draft operations and maintenance manuals, equipment documentation, and as-installed drawings for systems that were commissioned and verify compliance with documents. Communicate deficiencies in

documents to Owner and Contractor. When identified deficiencies have been corrected, recommend approval and acceptance of operations and maintenance manuals to Owner. Review equipment warranties and verify that requirements needed to keep warranty valid are clearly identified.

B. Ensure that Owner's Project Requirements, basis of design, are included in the first section of operations and maintenance manuals. Narrative sections shall be updated by responsible parties to record status.

END OF SECTION

SECTION 23 09 00
CONTROLS AND INSTRUMENTATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Head End Operators Workstation (OWS) Computer and Accessories

B. Microprocessor Based Building Controller

C. Microprocessor Based Controllers

D. Software, Programming, Graphics for new and existing OWS

E. Control Equipment, network devices, power, signal, and communication wiring systems

F. Sequence of operation.

1.2 PRODUCTS FURNISHED BUT NOT INSTALLED UNDER THIS SECTION

A. Hydronic Piping:

1. Control valves, water flow switches, temperature sensor wells, gauge taps, flow meters and isolation valves.
2. Installation performed under other Division 23 sections.

B. Ductwork Accessories:

1. Automatic dampers and Outside Air Flow Stations: To include assembly of multiple section dampers with required interconnecting linkages, shafts and brackets and extend the required number of shafts through the ducts for externally mounted damper motors. Jack shafts will be assembled with sealed roller or ball bearings of stainless-steel construction.
2. Installation performed under other Division 23 sections.

1.3 PRODUCTS FURNISHED UNDER OTHER DIVISIONS

A. Equipment Wiring Systems:

1. Installation and connection of power wiring shall be performed under Division 26. Power wiring shall be defined as follows:
   a. Wiring of power feeds through all disconnect starters to electric motors.
   b. 120 VAC Power feeds to all BAS building and CAC control panels.
   c. Wiring of any remote start/stop switches and manual or automatic motor speed control devices not furnished by the BMS/BAS/ATC Contractor.

1.4 AGENCY LISTINGS

A. UL 916 PAZX Energy Management Systems

B. FCC-Part 15 Subparagraph J. Class A, Emissions requirements.

1.5 GENERAL PROVISIONS

A. The General Provisions of the Contract, including the General Conditions and supplementary General Conditions, apply to the work specified in this Section.

1.6 RELATED SECTIONS

A. Section 23 05 00 - General Provisions

B. Section 23 08 00 – Commissioning ofHVAC

C. Section 23 33 00 – Ductwork Accessories

D. Section 26 00 01 – Basic Electrical Requirements

E. Section 26 05 00 – Electrical Materials and Methods.

1.7 GENERAL INSTRUCTIONS

A. The BMS/BAS/ATC systems as specified herein shall be provided in their entirety by the BMS/BAS/ATC Contractor. The BMS/BAS/ATC Contractor shall base his Bid on the system as specified, general control notes, the sequence of operations and the points list.

B. In general, the proposal shall be based on a completely electronic/DDC system including valve and damper actuators.

C. The documents (specifications and drawings) set forth the basic requirements to be met to provide a completely functional system fully integrated with the equipment and systems furnished under this contract. This specification limits the acceptable manufacturers to those entities which have detailed knowledge of the existing systems and the requirements of integration. The documents do not identify all possible elements, products or work elements which may be required to provide a complete system but shall be included in the contractor's base bid and provided at no additional cost to the Owner.

1.8 SCOPE

A. The BMS/BAS/ATC systems shall be supplied and installed completely under the BMS/BAS/ATC Contract. Control components shall be mounted and wired by the BMS/BAS/ATC Contractor except as noted in 1.3. A 120- or 277-volt power source (1 box) will be provided in each equipment room or floor under Division 26. Extension of power to control panels, actuators and similar devices requiring same shall be performed under this section of the specifications. Control transformers shall be provided under this section of the specifications. Certain items of mechanical equipment are designated to be connected to emergency power systems; the controls for this equipment shall also be connected to emergency power circuits.

B. The engineering, installation, calibration, software programming and checkout necessary for complete and fully operational BMS/BAS/ATC systems, as specified hereafter, shall be provided by the BMS/BAS/ATC Contractor. The contractor shall provide full user training and demonstration of the system in all modes of operation.

C. The BMS/BAS/ATC systems shall be designed, installed, commissioned, and serviced by manufacturer employed, factory trained personnel. Manufacturer shall have an in-place support facility within 50 miles of the site with technical staff, spare parts inventory and necessary test and diagnostic equipment.

D. The system shall provide remote monitoring of the local operator's workstation (OWS). All necessary software and integration shall be provided.

1.9 QUALIFICATIONS

A. Control components and services shall be provided by one of the following:

1. Siemens Building Technologies Building Automation Division.
2. Automated Logic – Wisch and Jackson.
3. Johnson Controls.

1.10 SUBMITTALS

A. The following data/information shall be submitted for approval.

1. Complete sequences of operation.
2. Control system CAD generated drawings including number and color-coded wiring diagrams and all pertinent data to provide a functional operating system.
3. Valve and damper schedules showing size, configuration, capacity, and location of all equipment.
4. Data sheets for all hardware and software control components.
5. Thermostat/sensor locations.
6. Building Management System panel locations.
7. Graphical Screens
8. Proposed Alarms, Trend-Logs and Reports
9. Mounting locations for immersion temperature sensors, pressure sensors and flow meters on Contractor's piping shop drawings.

B. The following shall be submitted prior to Substantial Completion:

1. Training Manuals.
2. Sensor Calibration Reports.
3. As-Built documents.
4. Operation and Maintenance manuals.

PART 2 - PRODUCTS AND SYSTEMS

2.1 MANUFACTURERS

A. Approved Systems

1. Siemens Building Technologies – APOGEE
2. Automated Logic
3. Engineer pre-approved equal.

B. Approved Installing Contractors

1. Siemens
2. Wisch & Jackson
3. Engineer pre-approved equal.

2.2 GENERAL

A. The Building Automation System shall include but not be limited to the following components.

1. The Operator Interface shall consist of software and hardware that allows full user monitoring and adjustment of system parameters via simple to use, English language menus, with graphical representation of equipment, valves and dampers and room temperatures. The system shall share information with other workstations over Ethernet TCP/IP. Communication protocol between the local workstations and the building level/floor level networks shall be BACNET based.
2. Modular Building Controllers shall manage the Energy and Building Management capabilities of the automation system, provide distributed custom programming capability for AHU control, as well as facilitate remote communications and central monitoring.
3. Custom Application Controllers shall provide distributed, custom-engineered control in accordance with the sequences of operation.
4. Terminal Equipment Controllers shall provide distributed, pre-engineered control, specific to the mechanical equipment specified.
5. The Data Communications capability shall allow data to be shared between the various controllers in the architecture.
6. The system software shall include system software for global application functions, application software for distributed controllers, graphics, and operator interface software.
7. End devices such as sensors, actuators, dampers, valves, and relays.
8. Electrical components, wiring and conduit.
9. Network interface to other equipment including chillers, variable frequency drives, ductless DX variable refrigerant flow systems and other items as indicated.

B. The failure of any single component shall not interrupt the control strategies of other operational devices. System expansion shall be through the addition of end devices, controllers, and other devices described in this specification.

2.3 OPERATOR INTERFACE

A. A new personal computer interface shall be provided for the new local OWS that will allow the building operator to view and acknowledge all alarms, access/edit all system and controller database information, view all system displays and reports, and customize all systems as described in this specification. The communications from the local OWS system shall be protocol level using an Ethernet TCP/IP communications medium. All necessary components required for the seamless connection to the remote OWS shall be provided.

B. Compatibility to the systems shall be defined as a single Operator Interface that allows real-time monitoring of all system points, alarming of all system points and equipment, graphical representations of all system points and equipment, and the ability to make complete adjustments to the systems and controller databases including the following: controller programming modifications, controller point database addition/deletions/modifications, controller level time of day equipment scheduling additions/deletions/modifications, controller point alarming criteria additions/deletions/modifications, automatic controller database backups, and automation controller database downloads on memory failures.

C. All of the above functions shall be performed from a single software program consisting of simple-to-use, mouse-driven menus, with the provision of graphical representations of all new and existing mechanical equipment. Windowing between two or more software programs is not acceptable. The BMS/BAS/ATC contractor must fully demonstrate 100% compatibility with the systems to the Owner’s and Engineer’s satisfaction prior to shop drawing submittal.

D. Nomenclature used in naming convention shall be consistent with that already in use at the facility.

E. The new personal computer head-end shall have the following minimum features:

1. 2.6 gigahertz 64-bit dual core or greater Intel processor, 8MB cache.
2. 24-inch flat screen LCD color monitor.
3. 750 Gigabyte hard drive.
4. Graphics card; N Vidia GEForce GTS 240.
5. Sound card and stereo speakers.
6. 10/100 MHz Ethernet Network card.
7. Dual drives 16x DVD-ROM + 16x DVD ± RW.
8. Norton or McAfee security software – 24 months.
9. Enhanced wireless keyboard.
10. Wireless Laser Mouse.
11. USB and parallel ports.
12. Windows 7 Professional operating system as compatible with the BAS operating system requirements.
13. MS Office 2013 Suite software.
14. HP Color Laser printer minimum.
15. 500 VA UPS power supply.
16. 16 GB RAM.
17. 2-year service plan.

F. Where higher performance components/software is required, it shall be provided at no additional cost.

2.4 MODULAR BUILDING CONTROLLERS

A. Where required for the system architecture, stand-alone, microprocessor based Modular Building Controllers shall be utilized to manage the global strategies described in Application software section.

B. The operating system of the Modular Building Controller shall manage the input and output communications signals to allow distributed terminal equipment controllers to share real and virtual point information and allow central monitoring and alarms.

C. Data shall automatically be shared between Modular Building Controllers when they are networked together.

D. The database and custom programming routines of remote Modular Building Controllers shall be editable from a single operator station.

E. The controller shall continually check the status of all processor and memory circuits. If a failure is detected, the controller shall:

1. Assume a predetermined failure mode.
2. Emit an alarm.
3. Display card failure identification.

2.5 CUSTOM APPLICATION EQUIPMENT CONTROLLER

A. Custom application equipment controllers shall be stand-alone, microprocessor based, fully programmable, fully configurable controllers, providing custom programming capability and provide control for non-standard sequences.

B. Controllers shall have sufficient memory to support its operating system, database, and programming requirements. Programming shall be memory resident and either retained in permanent memory or be provided with not less than 72 hours of battery backup.

C. Devices shall incorporate a port for connection of a portable operator interface to allow for programming, editing, and similar functions.

D. Controllers for AHU's shall be wall mounted not unit mounted.

E. Controllers shall incorporate a local keypad and LCD display for display, interrogating and editing of data. Not less than three (3) levels of system security shall be provided to prevent unauthorized use of the keypad. Display of data shall be available without the use of a password.

F. Each AHU shall have a dedicated CAC. The chilled water system shall have two (2) CAC's with the points split across two (2) controllers (i.e.: one (1) secondary pump, chiller on one (1) panel) to increase reliability.

G. Outputs shall have an on-board hand-off-auto switch.

2.6 APPLICATION SPECIFIC TERMINAL EQUIPMENT CONTROLLERS

A. Terminal Equipment Controllers shall be stand-alone, microprocessor based Direct Digital Controllers with sufficient memory to handle its operating system, database, and programming requirements.

B. The Terminal Equipment Controller shall be clearly labeled as to controller type, where it is to be installed, and software address (if applicable). The controller shall be fully tested upon installation to ensure that it is properly matched to the equipment it is controlling.

C. The controller shall communicate with other devices on the communication network and be fully integrated with the other system components.

D. Power for terminal box and fan coil unit ASC shall be obtained by the use of a 24-volt control transformer on the duct heater.

E. Combination controllers/actuators may be used.

2.7 CONTROLLER GENERAL REQUIREMENTS

A. The hardware shall be suitable for the anticipated ambient conditions.

1. Controllers used outdoors and/or in wet ambient shall be mounted within waterproof enclosures, and shall be rated for operation at -40 deg. F to 155 deg. F.
2. Controllers used in conditioned ambience shall be mounted in dust-proof enclosures and shall be rated for operation at 32F to 120F.
3. Controllers used outdoors and control wiring (sensor, power, and communication) between outdoor and indoor devices shall be provided with lightning surge protection.

B. Input/output points shall be as indicated on the drawings and as required to satisfy the sequence of operation.

C. Where custom application and/or application specific controller are to be factory installed on equipment, comply with the following:

1. Confirm equipment mounting location to provide required access.
2. Where devices are mounted on equipment provided by a third party, provide detailed wiring and tubing connection diagrams and requirements to the third-party manufacturer.
3. Identify all control components for each terminal box.
4. Assist in troubleshooting, performance testing and checkout requirements.

2.8 INPUT/OUTPUT INTERFACE

A. Hardwired inputs and outputs may tie into the system through Modular Building, Custom Application or Terminal Equipment Controllers. Any critical points requiring immediate reaction shall be tied directly into the controller hosting the control software algorithm for the critical function.

B. Binary inputs shall allow the monitoring of on/off signals from remote devices. The binary inputs shall provide a wetting current of 12mA at 12VDC to be compatible with commonly available control devices. All status points shown on the point list shall be contact closure, end switch, positive proof differential pressure or current sensing binary switches.

C. Analog inputs shall allow the monitoring of low voltage, current, or resistance signals and shall have a minimum resolution of 0.1% of the sensing range. Analog inputs shall be compatible with, and field configurable to commonly available sensing devices, 4-20mA.

D. Binary outputs shall provide a continuous low voltage signal for on/off control of remote devices. Where specified in the sequence of operations or indicated on the points list, binary outputs shall have 3-position (on/off/auto) override switches, status lights, and shall be selectable for either normally open or normally closed position.

E. Analog outputs shall provide a modulating signal for the control of end devices. Outputs shall provide either a 0 to 10 VDC or a 4 to 20 milliampere signal as required to provide proper control of the output device.

1. Each Analog control point shall utilize a separate output. Sequencing of several actuators (i.e., heating and cooling, or economizer and cooling) from one analog output shall not be acceptable.
2. Tri-State output is not acceptable.

2.9 AUXILIARY CONTROL DEVICES

A. DAMPERS

1. The Building Automation System supplier shall provide all automatic control dampers not specified to be supplied integral to the HVAC equipment.
2. Dampers shall be low leakage or high velocity low leakage type. All proportional dampers shall be opposed blade type. Two position dampers shall be parallel blade type.
3. Damper frames and blades shall be aluminum construction. Blade width shall not exceed 8 inches. Dampers and seals shall be suitable for temperature ranges of -50 to 250 degrees F. Blades shall be of the airfoil type. Duct mounted dampers shall be of the T-flanged frame type with exposed linkage.

4. Standard Low Leakage Dampers shall be provided to conserve energy. Dampers shall be equipped with neoprene edge seals and compressible metal jamb seals. Leakage shall not exceed 6 CFM/Sq. Ft. at 4" W.G. differential, 3 CFM/sq. ft. at 1" W.G., AMCA Class 1A.
5. Dampers shall be Ruskin, Model CD50 or equal.
6. Where called for on the drawings, blades shall be of the double wall thermally insulated type Ruskin Model CDTI50.

B. DAMPER OPERATORS

1. Damper operators shall be electronic, spring return, low voltage (24VAC) and shall be properly sized so as to stroke the damper smoothly and efficiently throughout its range. Actuator response shall be linear in response to a sensed load. Dampers shall fail to the full cooling position.
2. Smoke damper actuators shall be of the electric type and furnished as a UL listed component of the damper. Smoke dampers shall fail to the closed position.

C. CONTROL VALVES

1. Valve bodies shall be 2 or 3-way, modulating or two-position as scheduled. Valves shall be pressure independent, adjustable characterized type bronze body, screwed ends and have stainless steel ball and stem equal to Belimo B2/3 Series, rated at 250 psig.

D. VALVE ACTUATORS

1. Valve actuators shall be electronic, spring return, low voltage (24VAC), and properly selected for the valve body and service.
2. Actuators shall be fully proportioning, or two-position as called for and be spring return for normally open or normally closed operation as called out in the sequence of operations.
3. Actuators shall be selected to allow for close off against the secondary pump head pressure.

E. TEMPERATURE SENSORS

1. Temperature sensors shall be Resistance Temperature Detector (RTD) or Thermistor type. RTD transmitters shall be compatible with the sensor furnished.
2. Leaving coil sensors shall be continuous resistance RTD type or thermistor averaging type. Averaging sensors have at least nine (9) thermistors along its length. Leaving coil sensors shall be at least 20-feet in length, but of sufficient size to cover the coil face area. Sensors shall be mounted using properly sized and spaced capillary mounting clips (M648). Accuracy shall be +/- 0.36 degrees F or better.
3. Immersion sensors shall be thermistor or RTD type and provided with a separable stainless steel or brass well. Compatible transmitters shall be provided for RTD sensors. Wells shall be filled with a thermal conducting paste and installed so as not to obstruct flow; provide oversized fittings where required. Where not otherwise noted, accuracy shall be +/- 0.36 degrees F or better. Where indicated, provide matched sensor pairs with an accuracy of +/- 0.10 degrees F, NIST certified at two (2) points. Basis of design is Kele Model ST-W.
4. Space sensors shall be thermistor type. Terminal box sensors shall have a LCD temperature display with occupied/unoccupied override pushbutton, user adjustable set point, range of adjustment as defined in software. Common area temperature sensors shall not have a display, override pushbutton or

temperature adjustment mechanism. Under the alternate bid to provide DDC controls for apartments, temperature sensors shall be of the same as those for terminal boxes except no override pushbutton shall be included. All space sensors shall include a local communications jack.

5. Except as otherwise specified, accuracies shall be +/- 0.36-degree F for thermistor applications. Where RTD type is shown or specified, accuracies shall be +/- .2 degrees F.

F. HUMIDITY SENSORS

1. Humidity sensors shall be capacitance or bulk polymer resistance type.
2. Room sensors shall have a sensing range of 0 to 90% with accuracy of +/- 2% R.H.
3. Sensors shall include a calibration port, for in-place calibration.

G. DIFFERENTIAL PRESSURE SWITCHES

1. Differential Pressure Switches shall be furnished as indicated for status purposes in air and water applications. Provide single pole double throw switch with fully adjustable differential pressure settings.

H. CURRENT SWITCH

1. Solid-state UL listed current switch with self induced power, 600-volt isolation rating, split core type.
2. Adjustable trip setpoint from 1 to 135 amps plus or minus 1 percent.
3. Suitable for use between 0-95 percent relative humidity, 5 to 185 degrees F.
4. LED power and trip status indication and integral mounting bracket.

I. STATIC PRESSURE SENSORS

1. Differential pressure capacitance principal type, range as required to suit system static pressure.
2. Accuracy of plus or minus 1 percent of the sensing range.
3. 0 – 10 VDC, 4-20 mA output.
4. Basis of design: Setra 265.
5. At filter bank, provide Setra Model 267 with LCD display.

J. STATIC PRESSURE SWITCHES

1. Differential pressure switch of the diaphragm type with field adjustable setpoint from 0.07 to 12 inches W.C.
2. UL listed SPDT contacts 300 VA pilot duty.

K. FLOW METERS

1. Electro-magnetic pick-up retractable insertion type, suitable for use with chilled and hot water systems, wetted parts 316 stainless steel, hot tap insertion tool.
2. Performance +/- 1.0 percent of full scale 80 to 1 turndown ratio.
3. 4-20mA, 0-10 VDC or pulse output as compatible with the control system.
4. Integral LCD display of flow rate.
5. Provide Onicon Model F-3500 with D-1200 display.

L. LIGHTNING ARRESTORS

1. Gas tube type designed to protect against high voltage transients. Device shall have an impulse breakdown of 300-750 volts, insulation resistance greater than 100 M Ohms, and heavy-duty impulse life of 80 percent survival to 400 surges of 500 amps.

M. PILOT LIGHTS

1. UL listed NEMA Type 4 or 13 small pilot light, full voltage type with red lens and push to test circuitry.

N. SELECTOR SWTICHES

1. UL listed two or three-position as appropriate for the intended use, with on-off or hand-off auto legend plate, maintained position type with quick connect terminals.

O. RELAYS

1. UL listed mount type, single or double pole contacts and coil voltage as required by circuitry, continuous duty rating, contact amperage rating to suit application with 10 amp minimum. Provide with encapsulating polycarbonate dust cover, and cover plug in terminations with matching socket.

P. TERMINAL BLOCKS

1. Terminal blocks shall be UL listed and shall be of the direct-mount multiple type, with fully encased polyamide construction that prohibits contact with the conductor. Conductors shall insert from the side and be held in-place by a screw accessible from the front but recessed into the block. Barrier type strips are not acceptable. Mounting shall be either direct or rail type.

Q. CARBON DIOXIDE (CO_2) SENSORS

1. Space carbon dioxide sensors shall use non-dispersive infrared technology and provide a linear 0-10 VDC or 2-10 mA output from 2000 to 0 parts per million. Accuracy shall be the larger of $\pm$ 3% of reading, sensor shall include automatic calibration firmware to compensate for sensor drift, the annual drift shall not exceed $\pm$ 10 ppm. Wall mounted sensors shall be provided in a tamper resistant plastic enclosure and include a built-in LCD display. Duct mounted units shall be of the pitot tube style, suitable for measurement down to 400 FPM. Unit shall be of the self-calibrating type and include a lifetime calibration guarantee. Provide one (1) licensed copy of the user interface program for use on an Owner provided PC. Basis of design is AIRTEST.

R. DIFFERENTIAL PRESSURE SENSORS

1. Industrial quality capacitance-based sensor with wetted parts constructed of Type 316 stainless steel with aluminum housing. Unit shall include optional 3 valve carbon steel isolation manifold. Accuracy shall not be less than +/- 0.25 percent of calibrated span. Range shall be as required for the application. Provide Setra Model 230.

S. AIR FLOW MEASUREMENT STATIONS

1. Thermal dispersion type using multiple instrument grade self-heated thermistor type sensors and microprocessor based solid-state electronics.
2. Flow measurement drifts shall not exceed ± 0.2% of scale for the life of the equipment, auto zeroing sensors are not acceptable.
3. The sensor array and mounting location shall be as selected designed by the manufacturer to provide the specified performance. A factory trained authorized representative shall oversee and approve device placement, model selection and start-up.
4. Characteristics:
   a. Velocity Range: 0-5,000 feet per minute
   b. Humidity Range: 0-99% non-condensing
   c. Output: 4-20mA
   d. Velocity Accuracy: ± 2% reading
   e. Repeatability: ± .02% scale
5. Device shall be manufactured by Ebtron “Gold Series”.

T. ENCLOSURES

1. Enclosures shall be UL listed, NEMA 1 cabinet, fabricated or not less than 16-gauge steel with 16-gauge perforated sub-panels for component mounting, and have removable hinged doors. Enclosures shall be sized to house the controllers, power supplies, transformers, relays, wire duct, din rails, and miscellaneous equipment required to support the application. Enclosure power supply shall provide at least one (1) 40 VA and one (1) 100 VA transformer with individual on/off switches and circuit breakers, and two (2) 120 VAC outlets. Enclosures and power supplies shall be UL listed, Class II. Provide one (1) enclosure per AHU CAC, and at other locations as required. Door shall include a keyed locking mechanism and be furnished with not less than two (2) keys per panel, and all panels shall be keyed alike. Enclosures shall include suitable knockouts for conduit penetration and have an enamel finish.

U. BTU METER

1. Integral flow and differential temperature sensing devices, NIST calibrated BTU meter.
2. Flow accuracy of +/- 0.5 percent of the calibrated flow rate; +/- 2-percent over the flow range of the device.
3. Matched temperature pairs accurate to +/- 0.15 degrees F.
4. Serial connection using Siemens PI or Johnson Controls N2 protocol, or equal.
5. Basis of design Onicon System – 30.

V. UNINTERRUPTIBLE POWER SUPPLY

1. Regulated battery backup power supply with surge protection, UL listed with integral data line surge protection.
2. Unit shall be sized to provide not less than 30 minutes of backup run time.
3. Provide wall mounting brackets for use at building panels and CAC’s.

W. FAN THERMOSTAT

1. Line voltage single stage SPDT temperature control, -20 – 100-degree range and 1 – 30-degree adjustable differential with solid-state sensor.

X. POWER MONITOR

1. Solid-state UL listed three-phase power monitor 9wye or delta, 120-600V input voltage 60 Hz, internally fused.
2. Pulse output for KWH, four (4) selectable KWH/pulse rates.
3. Two (2) 4-20mA signals for total KW, peak KW, peak window KW.
4. Accuracy of 0.75% full scale; operating temp 32 – 122 degrees F, 5 – 95% RH.
5. With LCD display and separate communications module for Lonworks, Modbus or Metasys to coordinate with system interface; include all necessary software and set-up tools.
6. Basis of design is Kele PowerTrak Model PT-9000 with PT-NT communication module.

2.10 ENERGY MANAGEMENT SOFTWARE

A. Furnish the following applications software for building and energy management. All software applications shall reside and run in the system controllers. Editing of applications shall occur at the operator workstation.

1. SCHEDULING
   a. The scheduling program shall have a minimum of 32 named master schedules. Each master schedule shall have a minimum of eight-day schedules (seven plus holiday).
   b. To these master schedules, a minimum of 24 system loads (HVAC equipment etc.) or groups of loads can be assigned.
   c. The master schedule shall be individually editable for each day of the week and holiday.
   d. On any day, a minimum of six time of day events may be edited including:
      1) equipment start/stop
      2) occupied/unoccupied.

2.11 BUILDING MANAGEMENT SOFTWARE

A. The following Building Management capabilities shall be furnished as part of the Building Automation System:

1. DIRECT DIGITAL CONTROL
   a. The Direct Digital Control program shall allow modulating control of remote devices based on sensed data.
   b. Standard control strategies shall include proportional, proportional plus integral, and proportional plus integral plus derivative control.
   c. Control routines shall be flexible enough to allow operator to set parameters and make adjustments.
   d. Direct Digital Control loop setup and modification shall be done through pre-formatted edit screens, with parameters listed in English language.
   e. Program shall include a dynamic graphic display printout routine to indicate the status and real-time performance of the control loop. As an alternative, auto tuning loops or another method of testing and proving control loop response may be provided.
2. CUSTOM PROGRAMMING LANGUAGE
   a. A custom control language capability shall be provided to allow the operator to create real time, equation based, custom control routines.
   b. All binary and analog points in the Building Automation System shall be available as inputs to the custom routines.
   c. Equation operations shall include math functions such as addition,

subtraction, multiplication, division, square root, minimum, maximum, and average. Logical functions such as greater than, less than, equal to, not equal to, less than or equal to, greater than or equal to, variable timing and delays shall also be allowed.

3. TOTALIZING
   a. A totalizing program shall be provided to enable the building operator to monitor and totalize any user-defined flow such as water flow, electricity, natural gas, steam, and air.
4. RUN TIME MAINTENANCE
   a. The system shall monitor equipment status and generate maintenance messages based upon user designated run time, starts and/or calendar date limits.
   b. A minimum of 32 separate devices shall be monitored under this function.
5. REPORTS AND LOGS
   a. The system shall include the capability to store, review and print reports and logs.
   b. Trend Logs - A custom report generator allowing the user to trend and store at least 24 sample points based on a user-defined schedule.
   c. Event Logs - The system shall track system events including alarms, logons, and diagnostics.
   d. Input/Output Status Reports - This reporting tool shall allow the operator to review the status of all system points.
   e. HVAC Equipment Reports - Reports shall be provided which indicate the HVAC equipment status as well as the status of all input/output points connected with HVAC equipment.
   f. Custom Report Capability - The building operator shall be provided with a simple method of creating custom reports.
   g. Paging – The system shall pass alarms and/or equipment status as selected at the OWS via alphanumeric beeper type paging systems.
   h. E-Mail – The system shall pass alarms and/or equipment status as selected at the OWS via internet e-mail to web enabled devices with addresses as specified at the OWS.
   i. Web Enabled – The system shall allow access to the graphics and OWS functions via remote web enabled access according to established security levels as set in the OWS. Where licensed software is required, provide not less than two (2) copies in addition to remote access provided for the OWS.
6. ANTI-RECYCLE TIMER PROTECTION
   a. A software program shall be provided to allow each individual piece of HVAC equipment to be individually programmable with "minimum on", and "minimum off" timers to protect HVAC equipment from rapid cycling due to system or operator errors.
   b. Minimum on/off timer program shall have priority over all application software functions except fire shutdown and smoke evacuation modes.
   c. For system startup purposes, timers shall be set at 15 minutes or at an acceptable time as documented by the HVAC equipment supplier.
   d. Timers shall be individually programmable from 0 to 120 minutes.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. All electrical work performed in the installation of the BMS/BAS/ATC system as described in this specification shall be per the National Electrical Code (NEC), applicable state and local codes and meet Division 26 requirements, except that minimum 1/2” conduit is

acceptable. All wiring shall be installed in conduit run parallel to building lines properly supported and sized at a maximum of 40% fill. Except that communications cabling, where concealed above ceilings may be run without conduit if plenum rated wiring is used and it is supported in cable tray or bridal rings. In no case shall field installed conduit smaller than 1/2" trade size be allowed. Miscellaneous electrical devices, relays, contactors, transformers, switches, fuses, wiring and similar electrical items shall be provided and meet Division 26 requirements.

B. Devices installed outdoors shall be in NEMA 4 weatherproof enclosures. Provide filtered forced ventilation fans where heat build-up is of concern.

C. Provide lightning protection arrestors for all wiring of sensors and/or controllers located outdoors.

D. Provide application specific controllers to the equipment manufacturer for factory mounting complete with wiring diagrams, defined access areas, special handling/storage procedures, mounting requirements and similar items necessary for proper installation, operation, and maintenance of the controller. Coordination of these requirements with the equipment supplier is the exclusive responsibility of this section of the specifications. Any field modification of the controllers necessary to integrate them with the control system, provide for proper operation, provide access, and to comply with requirements of local authorities having jurisdiction shall be provided under this section of the specifications at no additional cost to the Owner. Include all necessary software and hardware for factory check-out and commissioning prior to shipment to the jobsite.

E. The Contractor shall provide all necessary labor to operate the control system for terminal box operation during the Test and Balance phase of the project or provide to the Test and Balance firm at no cost, all necessary hardware and software required to operate such systems.

F. Confirm mounting location of all temperature, pressure, relative humidity and carbon dioxide sensors with the Owners Test and Balance and Commissioning firms. Where measurements, testing or operation indicate the selected location is inappropriate or does not provide an accurate representation of the actual conditions due to stratification, eddy flows and similar phenomenon, relocate sensors and associated wells, hardware, and mountings at no additional cost to the Owner.

G. Coordinate acquisition and display/presentation of equipment connected to the EMS through multiplexed interfaces.

H. Where equipment is indicated to be connected to emergency sources of power, controllers and actuators shall also derive their power from emergency powered sources, coordinate with Division 26.

3.2 OWNER TRAINING

A. The BMS/BAS/ATC contractor shall provide 3 copies of an operator's manual describing all operating and routine maintenance service procedures to be used with the temperature control and Building Automation System supplied. This contractor shall instruct the owner's designated representatives in these procedures during the startup and test period. The duration of the instruction period shall be no less than 24 hours, during normal working hours. Refer to Section 23 05 00, “General Provisions”, paragraph entitled, “Training” for additional requirements.

3.3 CALIBRATION AND ADJUSTMENTS

A. After completion of the installation, perform final calibrations and adjustments of the equipment provided under this contract and supply services incidental to the proper performance of the ATC and BAS system under warranty below.

B. Provide input and assist in start-up of variable speed drives controlled by the BMS/BAS/ATC system.

C. Provide real-time calibration of all flow and temperature sensors, measurements will be made by the Test and Balance firm and furnished to this contractor for calibration.

D. Provide real-time testing/verification for all control sequences, alarms, and modes of failure.

E. Provide input and assistance in operational troubleshooting to include but not limited to trendlogging revisions to setpoints, deadbands, time intervals and sequences.

3.4 ACCEPTANCE PROCEDURE

A. Upon completion of the calibration, contractor shall startup the system and perform all necessary testing and run diagnostic tests to ensure proper operation. Contractor shall be responsible for generating all software and entering all database (including occupancy schedules) necessary to perform the sequence of control and specified software routines. An acceptance test in the presence of the Test and Balance contractor shall be performed.

B. All sequences shall be demonstrated and confirmed in the presence of the Test and Balance firm.

C. Participate in commissioning and certify that all control equipment meets pre-functional tests. After pre-functional tests are accepted, participate in commissioning functional testing.

3.5 WARRANTY

A. All BMS/BAS/ATC devices and installation shall be warranted to be free from defects in workmanship and material for a period of one year from the date of job acceptance by the owner. Any equipment, software, or labor found to be defective during this period shall be repaired or replaced without expense to the owner. Factory authorized warranty service shall be available within 50 miles of job site.

3.6 GRAPHICS

A. Provide graphical screens for each air handling unit, chiller system and exhaust fans with active display of monitored conditions, control output values and setpoints.

B. Provide a graphical floor plan showing each zone temperature setpoint and measured value and provide color coding to indicate whether the area is within or out of setpoint limits. Provide graphics of each individual terminal box, or item of equipment controlling the zone temperature.

C. Provide a graphical display of direct expansion package air conditioning units.

D. Provide a graphical display of the chilled and thermal storage systems, including full system graphics.

PART 4 - SEQUENCE OF OPERATIONS

4.1 GENERAL

A. Control sequences shall be provided for each item of equipment connected to the automation system.

B. Sequences do not refer to specific deadbands, delays and ranges required for stable operation, but shall be provided and be fully user adjustable at the operator workstation.

C. Where proposed sequences could defeat the equipment manufacturers recommended safety or be injurious to the equipment controlled, alert engineer of conflict prior to proceeding with the work.

D. Provide modification of sequences, setpoints, deadbands, delays and ranges based upon actual performance of controlled equipment, in base contract price at no additional cost to the Owner.

E. Demonstrate sequence of operation in the presence of the Owner for all controlled equipment, to include generation of alarms and simulation of equipment failures.

F. In addition to specific equipment alarms noted in the sequence, provide standard alarms for items such as sensor failure, out of range and similar items.

G. Coordinate sequences and data acquisition for trend logging, report generation, run hours and preventive maintenance functions.

END OF SECTION

SECTION 23 23 00
REFRIGERATION PIPING

PART 1: GENERAL

1.1 SECTION INCLUDES

A. Piping.

B. Refrigerant.

C. Moisture and liquid indicators.

D. Valves.

E. Filter-driers.

F. Brazing Materials.

1.2 REFERENCES

A. ANSI/ARI 710 - Liquid Line Dryers.

B. ANSI/ASHRAE 15 - Safety Code for Mechanical Refrigeration.

C. ANSI/ASHRAE 34 - Number Designation of Refrigerants.

D. ANSI/ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.

E. ANSI/ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.

F. ANSI/ASME B31.5 - Refrigeration Piping.

G. ANSI/ASME B31.9 - Building Services Piping.

H. ANSI/ASTM B32 - Solder Metal.

I. ANSI/AWS A5.8 - Brazing Filler Metal.

J. ANSI/AWS D1.1 - Structural Welding Code, Steel.

K. ASTM B280 - Seamless Copper Tube for Air Conditioning and Refrigeration Field Service.

1.3 SUBMITTALS

A. Submit shop drawings under provisions of Division 1.

B. Submit shop drawings indicating layout of piping system, including accessories equipment, traps, critical dimensions, and sizes down to a scale of 1/4 inch equals 1 foot.

C. Provide certification by the equipment manufacturer that piping is properly sized and arranged for oil return and system operation.

D. Submit product data under provisions of Division 1.

E. Submit product data indicating general assembly of specialties, including manufacturer's catalogue information.

F. Submit manufacturer's installation instructions under provisions of Division 1.

G. Submit design data as a submittal under provisions of Division 1.

H. Submit manufacturer's data indicating pipe sizing.

I. Submit test reports under provisions of Division 1.

J. Submit Test reports indicating results of leak test, acid test.

1.4 PROJECT RECORD DOCUMENTS

A. Submit documents under provisions of Division 1.

B. Accurately record exact locations of equipment and refrigeration accessories on record drawings.

1.5 REGULATORY REQUIREMENTS

A. Conform to ANSI/ASME B31.9.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site under provisions of Division 1.

B. Deliver and store piping and specialties in shipping containers with labeling in place.

C. Store and protect products under provisions of Division 1.

D. Protect piping and specialties from entry of contaminating material by leaving end caps and plugs in place until installation.

PART 2: PRODUCTS

2.1 PIPING

A. Copper Tubing: ASTM B280, Type 'L' ACR hard drawn copper for exposed/accessible lines. Type ACR soft drawn (annealed) for piping below slabs, and grade installed without joints.

1. Fittings: ANSI/ASME B16.22 wrought copper.
2. Joints: ANSI/AWS A5.8 BCup silver braze.

B. Brazing Compound: Minimum of 15% silver with melting point greater than 1000 degrees.

2.2 REFRIGERANT

A. Coordinate with equipment furnished under other sections.

2.3 MOISTURE AND LIQUID INDICATORS

A. Indicators: Single port type, UL listed, with copper or brass body, flared or solder ends, sight glass, color coded paper moisture indicator and plastic cap; for maximum working pressure of 500 psi and maximum temperature of 200 degrees F.

2.4 VALVES

A. Packed Angle Valves: Forged brass or nickel-plated forged steel, forged brass seal caps with copper gasket, rising stem and seat with backseating, molded stem packing, solder, or flared ends; for maximum working pressure of 500 psi and maximum temperature of 275 degrees F.

B. Packed Ball Valves: Two piece forged brass Body with Teflon ball seals and copper tube extensions, brass bonnet and seal cap, chrome plated ball, stem with neoprene ring stem seals; for maximum working pressure of 500 psi and maximum temperature of 300 degrees F.

2.5 FILTER-DRIERS

A. Replaceable Cartridge Angle Type: ANSI/ARI 710, UL listed, brass shell and bronze cap, perforated brass shell and molded desiccant filter core; for maximum working pressure of 350 psi.

PART 3: EXECUTION

3.1 PREPARATION

A. Ream pipe and tube ends. Remove burrs.

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

3.2 INSTALLATION

A. Install refrigeration specialties in accordance with manufacturer's instructions.

B. Route piping in orderly manner, parallel to building structure, and maintain gradient.

C. Install piping to conserve building space and not interfere with use of space.

D. Group piping whenever practical at common elevations and locations. Slope piping one percent in direction of oil return. Provide traps, double risers and similar piping configurations as required to ensure proper oil return.

E. Provide non-conducting dielectric connections when joining dissimilar metals.

F. Install piping to allow for expansion and contraction without stressing pipe, joints, or connected equipment. Nitrogen purge lines during brazing.

G. Provide clearance for installation of insulation and access to valves and fittings.

H. Provide access to concealed valves and fittings.

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

J. Prepare pipe, fittings, supports, and accessories not pre-finished, ready for finished painting.

K. Insulate piping.

L. Locate expansion valve sensing bulb immediately downstream of evaporator on suction line.

M. Provide external equalizer piping on expansion valves with refrigerant distributor connected to evaporator.

N. Fully charge completed system with refrigerant after evacuation and testing. Take precautions so as not to discharge refrigerant into atmosphere.

3.3 APPLICATION

A. Provide line size liquid indicators in main liquid line leaving condenser. Install moisture indicator so it can be viewed from service area.

B. Provide replaceable cartridge filter-driers, with three-valve bypass assembly. Provide filter-driers for each refrigeration circuit.

C. Provide refrigerant charging valve connections in liquid line between receiver shut-off valve and expansion valve.

3.4 FIELD QUALITY CONTROL

A. Field testing will be performed under provisions of Division 1.

B. Test refrigeration system in accordance with ANSI/ASME B31.5.

C. Pressure test system with small amount of refrigerant and dry nitrogen 200 psi. Using halide torch or electronic leak detector check for leaks. Perform final test at 30 inches vacuum for a 24-hour period with no deviation. Provide notification a minimum of 48 hours prior to test and submit written report to Architect verifying test results.

D. Start-up of system shall be done in the presence of the equipment manufacturer. A field start-up report shall be submitted to the Architect/Engineer indicating the amount of refrigerant and oil added to the system, operating pressures and temperatures, control and operational checkout and similar features of the installation.

END OF SECTION

SECTION 23 31 00
DUCTWORK

PART 1: GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.2 SCOPE

A. Provide material, devices, labor, and supervision necessary to fabricate and erect ductwork.

B. Store ductwork not less than 6 inches above grade, protected from the elements with plastic sheeting. Protect ductwork from debris generated during construction. Comply with specified SMACNA cleanliness level.

C. Clean duct systems after installation.

D. Prepare coordination drawings for HVAC ductwork.

E. Prepare duct surfaces for painting where run exposed in occupied spaces.

F. Perform ductwork leakage testing.

G. Correct deficiencies identified by the Commissioning Agent.

1.3 STANDARDS

A. Ducts, plenums, metal gauges, reinforcing, methods of supporting and hanging, and other sheet metal work as called for shall be in accordance with the following standards:

1. SMACNA "HVAC Duct Construction Standards Metal and Flexible", 2nd Edition, 1995.
2. UL Fire Resistance Directory, latest edition.
3. ASHRAE Fundamentals - 1997, Chapter 32.
4. SMACNA “Duct Cleanliness for New Construction Guidelines” 2000.
5. Florida Building Code Mechanical – Chapter 6.
6. Florida Building Code Chapter 13 – Energy Efficiency.

B. Air conditioning, heating and ventilating system ductwork construction and installation shall conform to requirements of NFPA Bulletin No. 90-A, "Air Conditioning and Ventilating Systems".

C. Where requirements contained in these specifications or the drawings are more strict, they shall take precedence over the above referenced Standards.

1.4 QUALIFICATIONS

A. Shop fabricated sheet metal work shall be constructed of prime quality re-squared tight coat G-90 galvanized steel, except where other type material is specified herein. Manufacturer's name and U.S. gauge number shall appear on each sheet.

B. Round ductwork shall be factory manufactured spiral seam or ribbed type, produced by one of the following firms:

1. United McGill
2. Semco
3. Metal-Mart
4. Monroe.

C. Round flexible duct shall meet the strict acoustical criteria specified herein, produced by one of the following:

1. Flexmaster (Type 6M)
2. Thermaflex (Type M-KE).

1.5 PRESSURE CLASSIFICATION

A. General

1. Ductwork shall be designed in accordance with requirements for the specified SMACNA duct pressure classification. Duct pressure classification shall be as required for the static no-flow pressure available from fan, as otherwise specified herein or a minimum of 2 inches water gauge whichever is larger. Ductwork shall be sealed to SMACNA Class "A" requirements including transverse joints, fitting connections, spin collars, and seams, for all duct systems including supply, return, outside and exhaust air systems.

B. System Pressure Definitions

1. All supply air ductwork: Fabricate for 2 inches positive water gauge.
2. All return and exhaust ductwork: Fabricate for 2 inches negative water gauge.
3. Dryer vents fabricate to ½ inch positive water gauge.
4. Flexible air duct shall be manufactured for not less than 6-inch positive (through 16-inch in diameter) and 1-inch negative (through 12-inch in diameter).

C. Closure Requirements

1. Pressures less than 1 inch water gauge:
   a. Continuous welds.
   b. Snaplock seams.
   c. Pittsburg lock seams.
   d. Mastic, mastic-plus-embedded fabric, or mastic ribbons.
   e. Gaskets.
   f. Pressure sensitive tape.
   g. Aerosol sealant.
2. Pressure 1 inch water gauge and greater:
   a. Continuous welds.
   b. Mastic, mastic-plus-embedded fabric, or mastic ribbons.
   c. Gaskets.

D. Testing Requirements

1. Formal leakage testing for ducts is not required, provided the following criteria is met:
   a. There are no visible mechanical defects.
   b. All duct seams, joints, and penetrations are sealed.

c. There is no audible leakage.
d. There is no noticeable air movement when a hand is placed within 3 inches of any duct surface.

1.6 SUBMITTALS

A. Submit ductwork shop drawings for all duct systems for the entire facility. The construction documents shall not be reproduced as the basis of the ductwork shop drawings. Where required by Division 1, in addition to ductwork drawings, provide full coordination drawings.

B. Shop drawings shall show the duct routing, actual duct dimensions, elevations of ducts above finished floor line, dimensions from fixed elements such as columns, walls, beams, and slabs, and shall include the location and size of balancing dampers, control dampers, fire dampers, access panels, registers, and diffusers.

C. Shop drawings shall include plan view and elevation view for air handling units, exhaust fans, filters, apparatus, and apparatus casings. Plans shall reflect actual equipment being furnished.

D. Shop drawings shall include Contractor's standard duct and sheet metal fabrication details. SMACNA figures may be submitted to satisfy this requirement but shall be clearly marked to illustrate what is actually being proposed on this project.

E. Contractor shall review the Drawings for the work of other trades and shall coordinate the ductwork drawings with the work for other trades. Layout of the drawings is schematic in nature and does not indicate every bend, offset or fitting which may be required, or necessary to coordinate with existing conditions or other trades, and such work shall be provided at no additional cost to the Owner.

F. The Contractor shall maintain two sets of record drawings - one in the field, one at their office, which accurately reflect changes to the work and as-installed conditions.

G. Provide plan work drawing at a scale of at least that used for the Contractor Drawings, but in no case, not less than 1/4-inch equals 1 foot. Provide large scale blow-ups of congested areas, mechanical equipment rooms and building chases drawn to a scale of not less than 3/8-inch equals 1 foot.

H. Submit data for flexible ductwork to include certified acoustical data, spin collars and nylon straps.

I. Submit data for medium pressure duct and fittings to include materials of construction, dimensional data, construction characteristics and gauges.

J. Submit data for upper attachments to structure and lower attachments to ductwork.

K. Submit data indicating the type of transverse and longitudinal joints to be used on shop fabricated ductwork.

PART 2: PRODUCTS

2.1 LOW PRESSURE DUCTS

A. Rectangular Duct:

1. Exhaust, supply, return and outside air ductwork shall be G-90 galvanized steel except where flexible duct runouts to supply and return air devices are specifically indicated.
2. Elbows shall be constructed with a centerline radius of not less than 1.5 times the duct width; where space conditions will not permit this radius or where indicated, square elbows with single thickness air turns shall be used.
3. Slopes for transitions or other changes in dimension shall be a minimum of 1 to 3.
4. Longitudinal seams for ducts with either dimension exceeding 11 inches shall be of the Pittsburgh Lock Type.
5. Minimum duct gauge shall be 24.

B. Round Ducts (Low Pressure)

1. Where round rigid ductwork is indicated for use in supply, return, or exhaust systems (non-dwelling units) fabricated for 2" water gauge or less, it may be of the spiral seam type or of the light gauge (26 minimum) ribbed spiral lock seam type.
2. Round snaplock duct shall not be used. Adjustable type elbows shall not be used.

2.2 DUCT ACCESSORIES

A. See Section 23 33 00 of these specifications.

2.3 FLEXIBLE DUCT

A. Flexible duct shall be factory pre-insulated, acoustical type, consisting of galvanized steel spring steel wire helix bonded to a “spunbond” nylon fabric, having one (1) inch nominal fiberglass insulation and vinyl impregnated closely woven vapor barrier. Duct shall be rated for 6 inches water gauge positive, 1-inch water gauge negative.

B. Composite assembly shall meet requirements of NFPA-90A and UL 181 and shall be UL listed for flame spread rating of not more than 25 and smoke developed rating of not more than 50.

C. Flexible duct shall be connected to ductwork and devices using Nylon straps 0.34-inch width, 175 lb. tensile strength, and sealed with mastic.

D. Length of flexible duct connections shall be not less than 72", or more than 120", and be one-piece without splices.

E. Acoustical performance for sound attenuation shall be tested in accordance with Air Diffusion Council Test Code FD 72-R1, by an independent certified laboratory, and meet or exceed the following sound attenuation values at the frequencies indicated:

DIAMETER	LENGTH	63	125	250	500	1000	2000	4000
6	6’	7	19	20	22	22	25	25
8	6’	7	19	19	20	21	24	24
12	6’	7	19	16	17	19	23	17

F. Insulation thickness shall provide an R-value not less than 6 at 75 degrees mean temperature.

G. Spin collars shall incorporate a beaded end and include a continuous axle locking type butterfly manual damper with 2" tall standoff lever handle and as constructed of galvanized steel equal to Crown Products 3000 DS Series, rated for zero leakage at 2 inches water gauge. Use conical or 45 degree style where duct dimensions permit. Where air flow of device served is 75 CFM or less, use 45-degree take-off for square and rectangular ducts, or a conical tap for round duct with a separate takeoff mounted manual damper utilizing blade and jamb seals meeting the requirements specified in section 23 33 00, “Ductwork Accessories”.

2.4 MISCELLANEOUS MATERIALS

A. Mill-rolled structural steel shall conform to ASTM A36 and be galvanized with materials conforming to ASTM A123.

B. Equivalent strength, proprietary design, rolled steel structural support systems may be submitted for approval, in lieu of mill-rolled structural steel.

2.5 SLEEVED RATED WALL OPENINGS

A. Where ducts do not exceed 100 square inches and meet all of the requirements of the Florida Building Code Mechanical, Section 607.5.3, fire dampers may be omitted.

B. Minimum duct thickness shall be 0.0127 inches.

C. A minimum 0.060 inch thick, 12-inch-long sleeve shall be provided with 1.5 x 1.5 inch retaining angles on both sides and the annular space sealed with rock wool.

PART 3: EXECUTION

3.1 INSTALLATION

A. No ductwork shall be delivered to the jobsite or installed until ductwork submittals including layout drawings have been approved and the facility is in a substantially watertight condition, acceptable to the Architect/Engineer. Comply with SMACNA “Duct Cleanliness for New Construction Guidelines”, duct cleanliness level “Advanced”.

B. Ducts shall be installed following essentially lines indicated; install offsets, angles, transitions as may be required to avoid interferences with other work, install streamlined easements around obstructions where necessary to pass obstructions through ducts. Maintain full capacity of ducts at offsets, angles, transitions and easements, except where drawings indicated use of reducing or increasing transitions. Layout shown on the drawings is schematic in nature and does not indicate every bend or offset necessary to coordinate with the building structure and other trades, which shall be identified in the Contractors shop drawing submittal and provided at no additional cost to the Owner.

C. Install dampers in all duct systems as required for controlling air volumes to trunk ducts, branch ducts, outlets and inlets. Install splitter type dampers in duct wyes and at streamlined branch takeoffs. Where branch ducts tap off of trunk ducts, install opposed blade volume dampers. Contractor shall install a complete system of dampers as required for balancing air systems.

D. Install access panels for inspection and servicing of duct-mounted equipment; heating coils, control dampers, smoke and fire dampers, and similar locations as required and/or deemed necessary by the Engineer.

E. Install flexible connections in ducts at connections to air handling units, exhaust fans and other equipment which could transmit vibrations to the duct systems.

F. Each duct section shall be rigidly supported from structure. Attach hangers to structure with expansion anchors, concrete inserts, beam clamps or other approved means. Powder activated studs may be used and selected for a four to one safety factor based upon the manufacturers catalogued strength. For loads that exceed 250 pounds, expansion type drill-in anchors or concrete inserts shall be used. Coordinate all structural attachments to post tension slabs with the post tension cables.

G. Install duct-mounted equipment as specified in other Sections.

H. Duct sizes shown are net inside dimensions and sheet metal size shall be increased to allow for duct linings.

I. Specified duct sealant pumped or painted into joints on all ductwork systems, as required, before assembly and painted over after assembly. Sealant shall be allowed to set 48 hours before any air pressure is put on system. All tie bars, bolts and rivets shall be sealed with the specified sealant. Corners on all take-offs, tap-ins, penetrations, and joints shall be closed type. Low pressure ductwork over 30", shall be cross broken or beaded between joints and reinforcing angles. If beading is used, beads shall be on 12" centers. Pocket lock construction of any kind will not be permitted in any ductwork, plenums, casings, etc., all galvanized mild steel.

J. Upper attachments shall be securely fastened to the building structure using load rated fasteners, methods which rely upon friction shall not be used. Upper attachments shall not rely on fasteners that penetrate or attach to metal roof decks. The Contractor is cautioned that many SMACNA illustrations of proposed upper attachments are not acceptable, and the method to be used by the Contractor shall be clearly defined in the shop drawing submittal.

K. Install kitchen exhaust duct with fully welded joints, ground smooth to prevent collection of grease. Supports for ducts shall not penetrate duct walls. Provide grease-tight access doors at changes of direction and at the base of duct risers.

L. Install access doors in kitchen hood duct at every 12-feet of horizontal run, each change in direction at vertical risers (base, top, and each floor) to provide access for cleaning. Doors shall be installed on the side of the ductwork.

3.2 CLEANING

A. Clean duct system to force out accumulated dust. Clean half of the system at a time by forcing all of the air through half of the system. Protect equipment surfaces which could be damaged by excessive dust.

B. Protect duct systems from entry of dust and debris generated during transportation, storage, installation, and construction by providing plastic sheathing over the ends of ducts. Comply with requirements for “Advanced” duct cleanliness level as defined by SMACNA “Duct Cleanliness for New Construction Guidelines”.

C. In the opinion of the Architect/Engineer, where the Contractor fails to protect the ductwork interior during construction, cleaning by mechanical means shall be performed.

D. Exterior duct surfaces shall be cleaned of dust and debris.

3.3 IDENTIFICATION

A. Identify duct systems per specification Section 23 05 53.

B. In concealed locations above ceilings and in equipment rooms, paint spin-collar damper handles with day-glow paint prior to installation and provide 18-inch length of surveyors' tape to aid in location.

C. Paint interior of duct surfaces that are visible through air devices or louvers flat black. Paint exterior surfaces of exposed to view ductwork as directed by the Architect.

END OF SECTION

SECTION 23 33 00
DUCTWORK ACCESSORIES

PART 1 - GENERAL

1.1 SCOPE

A. The other Contract Documents complement the requirement of this section. The General Requirements apply to the work of this section.

1.2 WORK INCLUDED

A. Volume control dampers.

B. Air turning devices.

C. Flexible duct connections.

D. Duct access doors.

1.3 REFERENCES

A. NFPA 90A - Installation of Air Conditioning and Ventilating Systems.

B. SMACNA - Low Pressure Duct Construction Standards.

1.4 SUBMITTALS

A. Submit shop drawings and product data under provisions of Division One.

B. Provide shop drawings for shop fabricated assemblies indicated, including volume control dampers, duct access doors, flexible duct connectors and duct test holes. Provide product data for hardware used.

C. Submit manufacturer's certified air leakage rates for dampers and access doors.

D. Submit pressure drop, insertion drop, and noise generation levels for silencers.

1.5 MANUFACTURERS

A. Provide Products meeting the specified requirements provided by the following firms:

-Volume Control Dampers:	Ruskin, National Controlled Air, Nailor, Safe-Air
-Flexible Duct Connections:	Duro-Dyne
-Duct Access Doors:	National Controlled Air, United Air, Ruskin, United McGill, Safe-Air
-Spin Collars	Crown Products, Model 624 with damper.

PART 2 - PRODUCTS

2.1 GENERAL

A. Duct accessories shall be coordinated with the characteristics of the system for which they are to be installed.

B. Manufacturers' recommendations as to maximum velocities and operating pressure, and pressure differentials shall be followed.

2.2 VOLUME CONTROL DAMPERS

A. Manual Volume Dampers shall be single blade type for ducts when either dimension is twelve (12) inches or less. Single blade dampers shall be factory fabricated minimum 22-gauge galvanized steel and equal to Ruskin MD25 with damper, blade, frame, bearings, and continuous d" square plated steel control rod (National Controlled Air Model MBD-57, Nailor Model 1820, Safe-Air Model 612).

B. Manual Volume Dampers shall be opposed blade type for ducts where both dimensions exceed twelve (12) inches. Opposed blade dampers shall be factory fabricated and equal to Ruskin MD35 with 16-gauge frame, 16-gauge galvanized steel blades, molded synthetic bearings, 3/8" square control rod, and ½" hex continuous axles (National Controlled Air Model MBD-57, Nailor Model 1820, Safe-Air Model 612).

C. No splitter dampers shall be used.

D. Except in spin collars, provide end bearings. On multiple blade dampers, provide oil-impregnated nylon, molded synthetic or sintered bronze bearings. On single blade dampers nylon end bearings are acceptable.

E. Provide locking, indicating quadrant regulators on single and multi-blade dampers. Where rod lengths exceed 30 inches provide regulator at both ends.

F. On insulated ducts mount quadrant regulators on 2" tall stand-off mounting brackets, bases, or adapters, with rigid insulation under stand-off.

G. Manual dampers for round ducts shall be minimum 20-gauge galvanized frame and blade, 3/8" square control shaft, synthetic molded bearings, Ruskin MDRS25 (National Controlled Air Model MBD-RD-88, Nailor Model 1090-H, Safe-Air Model 610R).

2.3 AIR TURNING DEVICES

A. Multi-blade device with single thickness vanes. Blades aligned in short dimension; steel construction; with fixed blades, mounting straps. Provide in square elbows on supply, return, exhaust, and outside air ducts. Where length of vane exceeds 24 inches double wall type vanes shall be used.

2.4 FLEXIBLE DUCT CONNECTIONS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards, and as indicated.

B. UL listed fire-retardant neoprene coated woven glass fiber fabric to NFPA 90A, minimum density 30 oz per sq yd, approximately 6 inches wide, crimped into 3" wide minimum 24-gauge galvanized metal edging strip on both ends of fabric.

2.5 DUCT ACCESS DOORS

A. Fabricate in accordance with SMACNA Low Pressure Duct Construction Standards and as specified.

B. Review locations prior to fabrication. Size of door shall be maximum size allowable by duct dimensions and building construction to serve the intended purpose. Where required to coordinate with construction features provide multiple doors.

C. Fabricate rigid and close-fitting doors of galvanized steel with sealing gaskets and quick fastening locking devices. For insulated ductwork, provide galvanized dual wall type with minimum one-inch-thick insulation with sheet metal cover. At 4” water gauge leakage shall not exceed 2 CFM per square foot.

D. Access doors smaller than 12 inches square may be secured with sash locks. National Controlled Air ADR/ADH-1.

E. Provide hinge and sash locks for door sizes greater than 12 x 12 inches. National Controlled Air Model ADH-1.

F. Access doors with sheet metal screw fasteners are not acceptable.

G. Kitchen hood access doors shall be UL listed, gasketed with black iron frame, bolted type, stainless steel door equal to Flame Guard, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install accessories in accordance with the manufacturer’s instructions.

B. Provide balancing dampers at all necessary points on low pressure supply, return, and exhaust systems where branches are taken from larger ducts and/or as required for air balancing. Do not use splitter dampers. Also see floor plans, sections, and details for additional damper requirements.

C. Locate outside air dampers to direct air stream into return air to promote mixing.

D. Provide flexible connections immediately adjacent to equipment in ducts associated with exhaust fans.

E. Provide duct access doors for inspection and cleaning before and after filters, coils, fans, automatic dampers, at fire dampers, smoke detectors, and elsewhere as indicated. Access door size shall be at least 3/4 the width of the fire damper or duct it serves. Multiple doors shall be provided on large ducts.

END OF SECTION

SECTION 23 34 00
FANS AND GRAVITY VENTILATORS

PART 1: GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

B. Refer to Section 23 05 00, “General Provisions”, paragraph entitled, “Anchoring of Equipment”.

1.2 SCOPE

A. Provide material, equipment, labor, and supervision as necessary for complete installation of the fans.

1.3 STANDARDS AND CODES

A. All fan performance shall be tested and rated in accordance with AMCA Standard 210, and the Certified Rating Program and sound testing shall be in accordance with AMCA 300 and 301. Fans shall bear the AMCA Certified Rating Seal for sound and air performance.

B. Fans shall be UL listed.

C. Fans located outdoors shall be fabricated and installed to withstand the applied wind force.

1.4 QUALIFICATIONS

A. For general exhaust, provide products manufactured by one of the following firms:

1. Greenheck
2. Cook
3. Acme.

1.5 SUBMITTALS

A. Shop drawings shall include the following information:

1. Fabrication details, material specifications, dimensional data, weight.
2. Factory certified air performance data with operating point plotted.
3. Guaranteed sound power output. Tests of sound power shall be performed in accordance with AMCA 300.
4. Roof curb details.

PART 2: PRODUCTS

2.1 ROOF EXHAUST FAN

A. Fans shall be complete factory assembled units and shall include housing, non-overloading centrifugal fan wheels, adjustable speed V-belt drives, air stream cooled motors, and vibration isolators.

B. Housings shall be of aluminum.

C. Fan wheel shall be of aluminum construction, statically and dynamically balanced, centrifugal backward inclined blades with a spun aluminum inlet cone inlet.

D. Each unit shall be equipped with the following accessories:

1. Expanded aluminum bird screen.
2. Disconnect device.
3. Self-acting backdraft damper.
4. Prefabricated, minimum 18" high, fully welded galvanized construction. Curb shall be provided by the fan manufacturer.
5. Permanently affixed manufacturer's nameplate with model and serial numbers.

E. Motors shall be of the electrical characteristics specified, premium efficiency type.

F. Fans for commercial kitchen hoods shall include the following additional features:

1. Upblast arrangement, discharging a minimum of 40-inches above the roof.
2. Integral grease drain trough with fittings and grease collection cup.
3. UL listed for electrical (UL-705) and grease removal (UL-762).
4. Heat baffle separating the wheel from the motor and drive.
5. Greenheck Model "HCVE" is Basis of Design.

2.2 IN-LINE FANS

A. Fans shall be complete factory assembled units including housing, supports, frame, fan wheel, spring type hanging vibration isolators, motors, and belt drive with adjustable sheaves.

B. Housing shall be heavy gauge galvanized steel or aluminum with integral inlet and discharge collar. Housing shall be internally insulated where noted in schedule. Painted steel housings are not acceptable.

C. Fan wheels shall be backward inclined centrifugal type, aluminum construction, statically and dynamically balanced.

D. Motors shall be permanently lubricated, heavy duty ball or pillow block bearings, and electrical characteristics scheduled. A belt guard motor cover shall be provided for belt driven fans.

E. Drives shall be sized for 150 percent of the driven horsepower, pulleys shall be cast iron, and the motor pulley shall be adjustable.

F. A disconnect switch shall be provided.

G. Greenheck Model "SQ" is Basis of Design.

2.3 CELING MOUNTED EXHAUST FANS

A. Fans shall be of the centrifugal direct-drive type. The housing shall be constructed of galvanized steel with minimum ½-inch thick acoustical lining.

B. Fans shall have an integral discharge outlet with aluminum backdraft damper. Outlet shall be field convertible from horizontal to vertical.

C. Inlet grille shall be constructed of polystyrene or aluminum, color shall be white unless otherwise indicated.

D. Fans shall be resiliently mounted and dynamically balanced. Wheels shall be forward curved type.

E. Wiring shall be external and include a plug type disconnect.

2.4 SIDEWALL PROPELLER EXHAUST FANS

A. Fans shall be complete factory assembled units including drive frame and panel assembly housing, non-overloading motor, v-belt or direct drive as scheduled, propeller type fan, vibration isolators, OSHA fan/belt guards, and accessory items as specified and required for a complete installation.

B. Propellers shall be constructed of cast aluminum blades and hubs, securely attached to fan shaft, statically and dynamically balanced.

C. Motors shall be permanently lubricated, heavy duty, premium efficiency, open drip-proof type, of the electrical characteristics scheduled.

D. Fan shafts shall be ground and polished, mounted in permanently lubricated, sealed ball bearing pillow blocks, selected for a minimum life in excess of 100,000 hours (L10).

E. Drive frame and panel assemblies shall be constructed of galvanized steel with a deep formed venture inlet.

F. Accessories shall include a galvanized steel wall collar and motor side guard constructed of galvanized steel.

2.5 GENERAL

A. For belt-driven fans, a drive change-out (pulleys and belts) shall be included in the base contract.

B. Roof curbs shall be a cataloged product of the fan manufacturer, and shall be fully welded galvanized steel construction, minimum of 18 inches tall (above roof surface). Coordinate curb characteristics (cant, flashing, slope) with the building roofing system. Curb interior shall be provided with not less than 1.5 inch thick fibrous or rigid insulation. Curbs shall incorporate a wooden nailor.

C. Fans shall be UL listed.

D. Direct drive fans shall be provided with a speed controller, except where integral to the motor.

E. Bearings shall have an L-50 life of not less than 200,000 hours.

2.6 GRAVITY VENTILATORS

A. Gravity Ventilators/Intake:

1. Gravity ventilators shall be aluminum construction and designed to withstand the applied wind loads set forth under the provisions of Section 23 05 00. Basis of design is Greenheck Model “SDLE”.

PART 3: EXECUTION

3.1 INSTALLATION

A. Install flexible connectors at duct connections to fans. Flexible connectors shall meet requirements of NFPA 90A.

B. Coordinate with actual fans furnished and ductwork shop drawings.

C. Fasten curbs to building structural steel and provide miscellaneous steel at opening as required, and secure to curb and structure. Provide minimum ¾-inch wide by ¼-inch thick neoprene gasket between roof curb and fan.

D. Install roof mounted fans on curbs fabricated by the fan manufacturer. Anchor fans to curb in accordance with the manufacturer's requirements as necessary to withstand applied wind loading, see Section 23 05 00.

E. For fans and equipment not mounted on roof curbs, provide mechanical equipment support rails as specified in section 23 05 29.

F. Coordinate location of roof mounted gravity ventilators with other trades. Maintain a minimum 10-foot separation between intakes plumbing vents and exhaust fans. Fasten curbs to building structural steel and provide miscellaneous steel framing around openings as required. Provide gasket material, minimum 1/4" thick neoprene, between roof curb and ventilator.

END OF SECTION

SECTION 23 37 13
GRILLES, REGISTERS AND DIFFUSERS

PART 1: GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.2 SCOPE

A. Provide materials, devices, labor, and supervision necessary for the installation of grilles, registers, diffusers, louvers, and discharges.

B. Provide grilles, registers, and diffusers as per schedule.

1.3 QUALIFICATIONS

A. Products by Price, Krueger, or Titus. Design, specification, and schedule based on Titus. See Schedule on drawings.

B. Louvers shall be Ruskin, Cesco, or Airline. Design and specification based upon Ruskin.

C. Gravity ventilators shall be Greenheck, Cook or Penn. Design and specification based upon Greenheck.

D. Air devices shall be tested in accordance with ANSI/ASHRAE Standard 70-1991.

1.4 SUBMITTALS

A. Submit manufacturer's data for air devices and louvers to include materials of construction, dimensional data, performance, and acoustical data.

PART 2: PRODUCTS

2.1 CEILING DIFFUSERS

A. Ceiling diffusers shall be of type and style as scheduled. Volume control dampers shall be provided in branch takeoffs, not in diffusers, except as noted otherwise. Provide with accessories as noted.

B. Other devices shall be of the same salient characteristics as those specified as the basis of design. Refer to the schedule on the drawings.

C. Mounting shall be as indicated in the schedules but shall be fully coordinated with the Architectural Reflected Ceiling Plan. Where lay-in devices are scheduled, the contractor shall verify the grid type prior to submittal/order.

D. The back side of all lay-in devices shall be insulated with flexible duct wrap, minimum 1.5-inch thick, 1.0 pcf density, all seams sealed with foil-faced tape.

2.2 CEILING RETURN REGISTERS

A. Ceiling return registers shall be provided with devices including scheduled opposed blade volume control where noted or required for balancing.

B. Mounting shall be as indicated in the schedules but shall be fully coordinated with the Architectural Reflected Ceiling Plan.

2.3 MATERIAL

A. All devices shall be constructed of aluminum, except where otherwise indicated in the air device schedule, or in fire rated ceilings where steel devices shall be used.

2.4 FINISH

A. Provide baked enamel factory finish as scheduled, color to match ceiling grid.

PART 3: EXECUTION

3.1 INSTALLATION

A. In grid panel type ceilings, acoustical, etc., grilles, registers and diffusers shall be located in the center of the panel.

B. Coordinate location of ceiling diffusers and registers with Architect's reflected ceiling plan. Locate devices in a symmetrical pattern.

C. Paint inside of ductwork visible through grilles, louvers, or diffusers flat black.

D. Confirm mounting of all devices prior to order. Where lay-in mounting is indicated, confirm grid dimensions (i.e., narrow-line grid) prior to order.

E. Field insulate rear panel of all supply air devices.

F. Adjust throw patterns to eliminate drafts.

G. Where devices generate unacceptable noise levels, provide larger devices.

END OF SECTION

SECTION 23 40 00
AIR FILTERS

PART 1: GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.2 SCOPE

A. Provide material, equipment, labor, and supervision as necessary for complete installation of the air filtering systems to include filter units, holding frames.

1.3 STANDARDS AND CODES

A. Filters shall be UL listed as Class I and shall bear UL label and shall meet NFPA-90A Standards.

B. Filter efficiencies shall be in accordance with ASHRAE 52-2004. Minimum efficiencies and maximum clean pressure drops shall be as specified, indicated and/or scheduled on the Drawings.

1.4 QUALIFICATIONS

A. Provide products by one of the following manufacturers:

1. Filters:
   a. Farr
   b. Air Guard
   c. Flanders - Precision Aire
   d. American Air Filter.

1.5 SUBMITTALS

A. Shop drawings shall include fabrication details, material specification, physical dimensions, efficiencies, and pressure drops for filters and housings.

PART 2: PRODUCTS

2.1 FILTER

A. High capacity, pleated panel, electrostatically charged extended surface type, pleated glass, poly cotton blend or synthetic fiber filtering media 2" thick. Media shall be laminated to an expanded metal grid located on the leaving air side and be enclosed within a moisture-resistant carrier board frame.

B. Initial pressure drop at a 500 FPM face velocity shall not exceed 0.25" w.g.

C. Average atmospheric dust efficiency shall be a minimum of MERV 8 based on ASHRAE Test Standard 52.1-92. Performance shall be guaranteed within the tolerances outlined in Section 7.4 of ARI Standard 850.

D. Basis of design is American Air Filter “AM Air 1300”.

PART 3: EXECUTION

3.1 INSTALLATION

A. Install filter equipment in accordance with manufacturer's recommendations, check for filter bypass and correct unsatisfactory conditions.

B. Provide an initial set of filters for operating unit during construction, and change-out filters with new filters prior to start of test and balance. Do not operate air handling units without filters including final filters.

END OF SECTION

SECTION 23 74 16
PACKAGED ROOFTOP AIR CONDITIONING UNITS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.2 SCOPE

A. Provide material, equipment, labor, and supervision necessary to install Packaged Rooftop Air Conditioning Units.

1.3 STANDARDS

A. Comply with applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup.

B. Damper leakage tested in accordance with AMCA 500-D.

C. UL Compliance: Comply with UL 1995.

1.4 SUBMITTALS

A. Submittal data shall consist of drawings showing coil dimensions, construction materials, fan performance curves, coil capacity, horsepower, electrical characteristics, and installation instructions.

B. Manufacturers shall furnish for approval for each unit certified sound power ratings with an octave band analysis and the volume-pressure-horsepower characteristic curves from shutoff to free air delivery.

1.5 PREFORMANCE REQUIREMENTS

A. Delegated Design: Engage a qualified professional engineer to design mounting and restraints for the installation of roof-mounted packaged rooftop air conditioning units, including a comprehensive engineering analysis.

1. Design the packaged rooftop air conditioning unit’s roof curb and necessary tie-down fasteners and supports to comply with the wind performance requirements of the 2020 Florida Building Code. Reference the project’s structural drawings and specifications for ultimate wind speed and building classification category requirements.

1.6 WARRANTIES

A. Provide parts and labor warranty for the entire unit for a period of one year.

B. Provide an extended 2-year unit control board parts only warranty.

C. Provide an extended 4-year compressor parts only warranty

D. Defective parts shall be repaired or replaced during the warranty period at no charge.

E. The warranty period shall commence at unit startup or six months after shipment, whichever occurs first.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Packaged rooftop air conditioning units shall be as manufactured by the following:

1. Trane
2. Lenox.

B. Basis of Design: Trane Precedent and Voyager 2 models.

2.2 GENERAL

A. Unit shall be factory built and assembled with arrangements as indicated.

B. Units shall have capacities, ratings, and performance as scheduled.

2.3 REFERENCES

A. Unit meets Florida Building Code - Energy Conservation minimum efficiency standards.

B. Units shall be rated in accordance with AHRI Standards 210/240 and 340/360.

C. Units shall be UL tested and certified with ANSI Z21.47 Standards.

D. Insulation and adhesive shall meet NFPA-90A requirements for flame and spread.

E. Unit casing shall be capable of withstanding 500-hour salt spray per ASTM B-117.

F. Unit curbs shall be designed to conform to NRCA Standards.

2.4 SUBMITTALS

A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics, and connection requirements.

B. Product Data:

1. Provide literature that indicates dimensions, weights, capacities, ratings, fan performance, electrical characteristics, and connection requirements.
2. Provide computer generated fan curves with specified operating points clearly plotted.
3. Manufacturer’s Installation Instructions.
4. Submit data on electrical requirements and connection points. Include recommended wire and fuse sizes or MCA, sequence of operation, safety and start up instructions.

2.5 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Provide instructions for installation, maintenance, and service.

B. Unit shall be capable of starting and running at 115 degrees F ambient outdoor temperature.

2.6 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience, who issues complete catalog data on total product.

B. Startup must be done by trained personnel experienced with rooftop equipment.

C. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters and remote controls are in place, bearings lubricated, and manufacturers' installation instructions have been followed.

2.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Accept products on site and inspect for damage.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

2.8 GENERAL DESCRIPTION

A. Configuration: Fabricate as detailed on prints and drawings:

1. Outdoor air / return air section
2. Filter section
3. Cooling and hot gas reheat coil section
4. Electric heating section
5. Supply fan section
6. Condensing unit section.

B. Basis of Design: Trane Precedent and Voyager 2 models.

C. Each unit shall be specifically designed for an outdoor rooftop application and include a weatherproof cabinet. Each unit shall be completely factory assembled and shipped in one piece. Packaged units shall be shipped fully charged with refrigerant and oil.

D. The unit shall undergo a complete factory run test prior to shipment. The factory test shall include a refrigeration circuit run test, a unit control system operations checkout, a unit refrigerant leak test and a final unit inspection.

E. All units shall have decals and tags to indicate caution areas and aid unit service. Unit nameplates shall be fixed to the main control panel door. Electrical wiring diagrams shall be attached to the control panels. Installation, operating and maintenance bulletins and start-up forms shall be supplied with each unit.

F. Performance: All scheduled EER, IEER, capacities and face areas are minimum accepted values. All scheduled amps, kW, and HP are maximum accepted values that allow scheduled capacity to be met.

2.9 CABINET, CASING, AND FRAME

A. Single wall panels constructed of G-90 galvanized steel, phosphatized, and coated with a baked enamel finish.

B. Structural members with access doors and removable panels shall be a minimum 22-gauge sheet metal.

C. Cabinet top cover shall be one piece construction or where seams exist, it shall be double-hemmed and gasket-sealed.

D. The base pan shall have no penetration within the perimeter of the curb other than unit electrical service and raised 1-1/8 high downflow supply/return openings to provide added water integrity precaution.

E. Cabinet construction shall allow for all service/maintenance from one side of the unit.

F. Access panels: Water- and air-tight hinged panels with handle shall provide access to filters, heating section, supply air fan section, evaporator coil section, and unit control section.

G. Unit cabinet shall withstand ASTM B117 salt spray test for 672 hours.

H. Cabinets insulation shall be 1/2" thick foil faced insulation. All edges shall be captured or sealed so there is no insulation exposed in the airstream.

I. Drain pan shall be double sloped with 16-gauge stainless steel construction, compliant with ASHRAE 62.1. Pan shall have a minimum depth of 2 inches, base of pan shall be insulated with 1-inch-thick insulation.

2.10 OUTDOOR AIR / RETURN AIR INTAKE SECTION

A. Unit shall be provided with a 0 – 30% or 0 – 100% (as scheduled) outdoor air damper and mixing section with bird screen. All dampers shall be all aluminum construction. The outdoor air hood shall be factory installed and constructed from the same durable paint finish as the main unit. Damper face velocity shall not exceed 2000 fpm. The damper blades shall be gasketed with side seals to provide an air leakage rate of 4 CFM/square foot of damper area at 1” differential pressure, per ASHRAE 90.1 Energy Standard. Control of the dampers shall be by a factory installed direct coupled actuator. Damper actuator shall be of the modulating, spring return type. The unit controller shall be capable of two-position or resetting minimum damper position as required by the sequence of operation.

B. Where scheduled, a barometric relief damper shall be provided to provide a pressure operated damper for the purpose of space pressure equalization. The damper shall be gravity closing to prohibit the entrance of outdoor air during the equipment off cycle.

2.11 FILTER SECTION

A. Unit shall consist of factory installed, low velocity, throwaway 2-inch thick. The manufacturer shall ship the rooftop unit with an initial set of filters. The contractor shall furnish and install, at building occupancy, the final set of filters per the contract documents.

2.12 COOLING COIL

A. The coil section shall be installed in a draw through configuration, upstream of the supply air fan. The coil section shall be complete with a factory piped cooling coil.

B. The direct expansion (DX) cooling coils (evaporator condenser and hot has reheat) shall be fabricated of copper tubes mechanically bonded to aluminum plate fins.

C. The coil shall be leak tested in accordance with ANSI/ASHRAE 15 at a pressure of 500 psig.

D. The refrigerant suction lines shall be fully insulated from the expansion valve to the compressors. Where exposed to the exterior, two coats of white UV inhibitor paint shall be used.

2.13 MODULATING HOT GAS REHEAT (WHERE SCHEDULED)

A. Unit shall be equipped with a fully modulating hot gas reheat coil with hot gas coming from the unit condenser. Hot gas reheat coil must be piped in series to the condenser coil. Parallel piping is not acceptable.

B. Hot gas reheat coil shall be mounted after the supply fan discharge. If the coil is not located after the fan, a minimum of 12” must be maintained between the hot gas reheat coil and the evaporator coil. Hot gas reheat shall be fully modulating through face and bypass air control or hot gas valve control.

C. The modulating hot gas reheat system shall allow for independent control of the cooling coil leaving air temperature and the reheat coil leaving air temperature. The cooling coil and reheat coil leaving air temperature setpoints shall be adjustable through the unit controller. During the dehumidification cycle the unit shall be capable of 100% of the cooling capacity. The hot gas reheat coil shall provide discharge temperature control within +/- 2 degrees F.

D. The coil shall be leak tested in accordance with ANSI/ASHRAE 15 at a pressure of 500 psig.

E. Hot gas reheat coil shall be provided for all refrigerant circuits; coil shall be fully integrated into supply airstream.

2.14 HEATING SECTION (WHERE SCHEDULED)

A. The rooftop unit shall have an integral factory mounted electrical resistance heating coil. Electric heating coil modules shall be factory installed in the heating section of the rooftop unit. Heating element branch circuits shall be individually fused to a maximum of 48 Amps per NEC requirements. The power supply for the electric heater shall be factory wired single point power for the rooftop unit and located in the primary heating position located downstream of the indoor fan assembly.

B. Heater shall be UL or CSA listed and approved.

2.13 SUPPLY FAN

A. Indoor fans shall be high efficiency backward curved impeller for units 12-1/2 tons and smaller and forward curve, double width, double inlet, centrifugal type fans for units 15 tons and larger.

B. The indoor fan motor shall be either an electronic commutated motor with integrated power electronics for variable motor speed or direct drive with a factory installed and wired Variable Frequency Drive for variable motor speed.

C. Outdoor fans shall be direct drive with premium efficiency motors, statically and dynamically balanced, draw through in the vertical discharge position.

D. Provide shafts constructed of solid hot rolled steel, ground and polished, with keyway, and protectively coated with lubricating oil.

E. For units 12.5 tons or over, fans shall be belt driven.

2.16 CONDENSING SECTION

A. Condenser

1. Outdoor Fans: Shall be direct drive vertical discharge design with low-noise corrosion resistant glass reinforced polypropylene props, powder coated wire discharge guards and electro-plated motor mounting brackets.
2. Fans shall be statically and dynamically balanced.
3. All units to be provided with variable speed condenser fans and active head pressure controls.
4. The coil shall be leak tested in accordance with ANSI/ASHRAE 15 at a pressure of 500 psig.
5. Provide corrosion protected condenser coil including an all-aluminum microchannel condenser. Coil protection shall consist of a corrosion resistant coating that shall withstand ASTM B117 Salt spray test for 10000 Hours. This coating shall be added after coil construction covering all tubes, headers and fin edges, therefore providing optimum protection in more corrosive environments.
6. Provide factory installed Provide tool-less factory installed corrosion resistant louvered condenser coil hail/vandalism guards.

B. Compressor Capacity Control

1. Mechanical Control: shall be equipped with Scroll Compressors to modulate compressor capacity during part load dehumidification while providing simultaneous hot gas reheat capacity at all ambient and load conditions. The dehumidification/cooling setpoint shall be maintained at all times, as well as the reheat set point.
2. Scroll compressors shall be provided to maintain hot gas reheat capacity at all load conditions.
3. Provide modulating hot gas bypass for all refrigerant circuits.

2.17 ELECTRICAL

A. Unit wiring shall comply with NEC requirements and with all applicable UL standards. All electrical components shall be UL recognized where applicable. All wiring and electrical components provided with the unit shall be number and color-coded and labeled according to the electrical diagram provided for easy identification. The unit shall be provided with a factory wired weatherproof control panel.

B. Field wiring access to be provided that unit base into isolated enclosure with removeable cover.

C. Wiring internal to the unit shall be colored and numbered for identification, factory wired to field wiring terminal block mounted in isolated enclosure.

D. Unit SCCR rating shall be a minimum of 65 kA.

E. Phase unbalance protection: Factory set at 2%; over/under/brown out. Voltage protection: +/- 10% of name plate voltage.

F. All low voltage field wiring connections shall be made at factory installed low voltage terminal strip.

2.18 CONVENIENCE RECEPTACLE

A. Shall be factory installed and internally mounted with an externally accessible 120V, 15-amp GFI, female receptacle with hinged cover. The outlet shall remain active when the unit's main disconnect switch is in the off position.

2.19 CONTROLS

A. Provide a complete integrated microprocessor-based control system to control all unit functions including temperature control, scheduling, monitoring, unit safety protection, including compressor minimum run and minimum off times, and diagnostics. This system shall consist of all required temperature sensors, pressure sensors, controller, and keypad/display operator interface. All MCBs and sensors shall be factory mounted, wired, and tested.

B. The microprocessor shall maintain existing set points and operate standalone if the unit loses either direct connect or network communications. The microprocessor memory shall be protected from voltage fluctuations as well as any extended power failures. All factory and user set schedules and control points shall be maintained in nonvolatile memory. No settings shall be lost, even during extended power shutdowns.

C. MCB Touch Screen shall include full color display and shall be factory installed in unit control compartment and provide a full list of points included in the MCM. The display shall provide a list and history of all unit alarms.

D. Provide a minimum 7-inch color touchscreen display for remote mounting inside the facility. The human man interface (HMI) LCD shall provide historical alarm messages, real-time sensor measurements, on board system setpoints, and full system occupancy scheduling capabilities.

E. System Sensors shall include factory installed and wired outdoor air temperature, outdoor air humidity and evaporator leaving air temperature and unit discharge air temperature.

F. System controls shall include:

1. Space Control: Manufacturer shall furnish Space Temperature, Space Humidity, and Space Carbon Dioxide (where scheduled) sensors for field installation and connection to the unit.
2. Cooling, heating, and hot gas reheat dehumidification modes
3. Control modulation shall maintain space temperature space humidity, and space carbon dioxide (where scheduled) setpoints.
4. Unit shall be capable of providing design supply air conditions (cooling coil leaving air dry bulb and wet bulb) during part load operation. Part Load Design point shall be demonstrated at engineer's request; At 68F DB / 66F WB ambient conditions, unit shall deliver supply air design conditions (cooling coil leaving air dry bulb and wet bulb) while maintaining 75 F reheat (hot gas reheat coil leaving air dry bulb and wet bulb).
5. Dehumidification mode control shall provide a maximum 52.2F cooling coil leaving air dew point temperature and a maximum 55.2F hot gas reheat coil leaving air dew point temperature.
6. Anti-cycle timing.
7. Minimum compressor run/off-times.

2.20 ROOF CURB

A. A factory prefabricated heavy gauge NOA rated galvanized steel, mounting curb shall be provided for assembly on the roof decking. The roof curb shall be a full perimeter type with

complete perimeter support of the air handling section and condensing section. The curb shall be a minimum of 18" high. Gasket shall be provided for field mounting between the unit base and roof curb.

2.21 SUBMITTALS

A. Shop Drawings: Indicate assembly, unit dimensions, weight loading, required clearances, construction details, field connection details, electrical characteristics, and connection requirements.

B. Product Data:

1. Provide literature that indicates dimensions, weights, capacities, ratings, fan performance, electrical characteristics, and connection requirements.
2. Manufacturer’s Installation Instructions.

2.22 OPERATION AND MAINTENANCE DATA

A. Maintenance Data: Provide instructions for installation, maintenance, and service.

2.23 QUALIFICATIONS

A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum five years documented experience, who issues complete catalog data on total product.

B. Startup must be done by trained personnel experienced with rooftop equipment.

C. Do not operate units for any purpose, temporary or permanent, until ductwork is clean, filters and remote controls are in place, bearings lubricated, and manufacturers’ installation instructions have been followed.

2.24 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Accept products on site and inspect for damage.

C. Store in clean dry place and protect from weather and construction traffic. Handle carefully to avoid damage to components, enclosures, and finish.

2.25 GENERAL DESCRIPTION

A. Furnish as shown on plans, Single-zone Heating and Cooling Unit(s). Unit performance and electrical characteristics shall be per the job schedule.

B. Configuration: Fabricate as detailed on prints and drawings.

C. The complete unit shall be UL listed.

D. Unit shall comply with Florida Building Code – Energy Conservation standards for efficiency and EER.

PART 3 - EXECUTION

3.1 INSTALLATION

A. The Contractor shall layout exact unit location based upon coordinated ductwork shop drawings.

1. Fabricate unit supports as detailed on the drawings.

B. The Contractor shall install units, make piping, and duct connections.

C. Extend condensate drain line from the drain pan, through a trap.

1. The condensate drain shall terminate with a 2-inch air gap above the rim of gutters.
2. The condensate drain shall terminate with a 2-inch air gap above the rim of roof drains.

D. Install fire resistant flexible connectors in ducts at connections to units.

1. Flexible connectors shall be in accordance with NFPA 90A.

E. Maintain access to all unit components that require maintenance.

1. Do not block coil or filter access doors, doors shall open at least 120-degrees.
2. Provide adequate space for coil and filter pull space.

F. Install Division 26 wiring for motors contained inside the packaged rooftop air conditioning units with watertight conduit between motor and unit casing and seal both ends of conduit to prevent moisture intrusion.

1. Motors with multiple wires make the electrical connections with mechanical fasteners (multi-cable connector blocks) that have external insulation.

G. Wire the RTU to immediately shutdown upon activation of the fire alarm system.

3.2 DEMONSTRATION AND TRAINING

A. Training of the Owner's operation and maintenance personnel is required in cooperation with the Owner's Representative:

1. Provide competent, factory authorized personnel for instructing of operation and maintenance personnel concerning the location, operation, and troubleshooting of the installed systems.
2. Schedule the instruction in coordination with the Owner's Representative after submission and approval of formal training plans.

B. Provide demonstration and training for all equipment covered by this section and installed in this project.

END OF SECTION

SECTION 26 00 00
WORK INCLUDED

PART 1 - GENERAL

1.1 DESCRIPTION OF SYSTEMS

A. The work required under this Division shall include all materials, labor and auxiliaries required to install, start up and test a complete and properly operating electrical system. The electrical systems required under this Division consist basically of, but are not limited to, the following:

1. Complete distribution system for power including service entrance, main switchboards and distribution panels, feeders, branch circuits, convenience outlets and connections to motors and other power loads.
   a. The Contractor shall submit at the shop drawing submittal stage, ½- inch scale, dimensioned drawings of actual electrical equipment layouts in all electrical and mechanical rooms, based on the equipment being provided. Any conflicts shall be resolved between the General Contractor and the respective subcontractors to provide for the equipment location and required working clearances.
   b. Conduit routing is not shown on the documents. It shall be the Contractor's responsibility to field route all raceways and coordinate such routing with all disciplines to resolve any conflicts, as necessary to provide the intended connections. It shall be assumed that the design was based on the shortest possible route. Where conduit or duct routing follows other than direct paths, the conductors and raceways shall be adjusted accordingly to account for voltage drop.
   c. The Contractor shall provide a complete Arch Flash, Fault and Coordination study for the entire 600 volt power distribution system. The study shall be based on the actual equipment installed and indicate the required fault duty in RMS symmetrical amps for each Overcurrent protective device. Provide time-current curves for each device, along with settings for all adjustable trip devices. The contractor shall ensure that all adjustable devices are set in accordance with the settings presented in the study. The study shall be signed and sealed by a Florida Licensed Engineer and shall be approved prior to the purchase of any equipment or overcurrent protective devices.
2. Complete distribution system for service, panels, power, & lighting including the necessary equipment, feeders, branch circuits, lighting fixtures, control devices, control wiring and devices.
3. Connecting motors and manual control (unless otherwise specified).
4. Complete system of lightning protection as required by this specification.
5. Complete fire alarm system.
6. Complete power distribution system for HVAC equipment including wiring, conduits, and disconnect switches.
7. Complete system of empty raceways (with pull lines) and terminal cabinets and power requirements for EMCS (Energy Management and Control System), and all communication and technology systems (i.e., telephone, data, public address, CCTV, audio-visual, security, and access control).
8. Furnishing and installing all necessary access panels.
9. Concrete work for equipment pads or encased raceways.
10. Painting (of special equipment).
11. Temporary power.
12. Contractor shall check site and existing conditions thoroughly before bidding. Advise Architect of discrepancies or questions note.

13. Whether indicated on the drawings or not, if a requirement is listed, mentioned, or described in this specification, the cost for its provision and complete installation and connection, shall be included in the Contractor's bid.
14. The Contractor is cautioned to consult drawings of all disciplines to ascertain electrical requirements for systems that may not be on the electrical plans. Specific attention is directed to special systems such as fire alarm, security, EMCS, etc. The Contractor shall include in his bid, the cost for providing and installing all electrical provisions for a complete, operating system.
15. Perform all required commissioning. The contractor shall designate an individual to serve on the commissioning team and shall cooperate as required concerning all commissioning related activities, meetings, documentation, field tests, etc. The contractor shall provide all technically qualified personnel, equipment, instrumentation, and materials on a continuous basis in order to perform their required tasks at the required time period and provide all required or requested assistance by the commissioning provider to complete the commissioning process.
16. The contractor is required per referenced specifications to complete all applicable Pre-Functional Test Report forms on the systems being commissioned. This may include as well; start-up check list forms.

END OF SECTION

SECTION 26 00 01
BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.1 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to Division 26 in addition to Division 1 -General requirements.

1.2 QUALITY ASSURANCE

A. Electrical supervision shall have a current Local County Journeyman Electricians Certificate of Competency, be licensed to do work in the project location, and be present on site while work is being performed.

B. Coordinate with other trades to provide adequate working clearance for equipment.

C. Materials, where applicable, shall bear the label of an approved nationally recognized testing agency, such as:

1. E.T.L. (Electrical Testing Laboratories)
2. U.L. (Underwriters Laboratories, Inc.)
3. F.M. (Factory Mutual).

D. Materials subject to corrosion shall be protected.

1.3 RELATED WORK

A. Continuity of Service:

1. Service or circuits shall not be interrupted or changed without authorization from the Architect and the Owner. Written authorization shall be obtained before work is started.

B. Demolition:

1. Equipment to be removed and turned over to the Owner shall be delivered to the Owner at a place and time mutually agreed upon.
2. Materials to be turned over to the Owner or reused and installed, shall be maintained in the condition equal to that existing before work began. Repair or replace damaged materials or equipment at no additional cost to the Owner.

C. Outdoor equipment to be secured to wall surface shall be mounted on galvanized steel channel or supports.

1.4 TEMPORARY WIRING

A. New Construction: Install according to National Electrical Code.

B. Remodel: Remove temporary wiring upon completion of project. Install according to National Electrical Code.

C. Grounding: Equipment grounding conductors shall be bonded to available electrodes at each building.

1.5 EQUIPMENT

A. Equipment of a similar nature shall be identical and of the same manufacturer.

B. Equipment shall be set level. Where grouped, shall be mounted at the same height, properly aligned, bolted together in sections, and fastened in place. Tighten screws, bolts, nuts, clamps, fittings, or other fastening devices. Install all covers, plates, fittings, and accessories.

PART 2 - EXECUTION

3.1 COMMISSIONING SUPPORT

A. Perform all required commissioning. The contractor shall designate an individual to serve on the commissioning team and shall cooperate as required concerning all commissioning related activities, meetings, documentation, field tests, etc. The contractor shall provide all technically qualified personnel, equipment, instrumentation, and materials on a continuous basis in order to perform their required tasks at the required time period and provide all required or requested assistance by the commissioning provider to complete the commissioning process. The contractor is required per referenced specifications to complete all applicable Pre-Functional Test Report forms on the systems being commissioned. This may include start-up check list forms as well. The Contractor is required, per referenced specifications, to perform all functional performance tests as required by the Commissioning Authority.

END OF SECTION

SECTION 26 01 27
CODES, FEES, AND STANDARDS

PART 1 - GENERAL

1.1 CODES AND STANDARDS

A. Unless specifically noted to the contrary, the Contractor shall furnish all equipment, materials, labor, and install and test in accordance with these specifications.

B. The Contractor shall comply with the latest applicable editions of thefollowing:

1. City of Lake Worth Ord.
2. Florida Fire Prevention Code (2020)
3. NFPA 101 (2018 Edition)
4. 2020 Florida Building Code (Seventh Edition)
5. NFPA-70 - National Electrical Code (2017)
6. NFPA-72 - National Fire Alarm Code (2019)
7. U.L. - Underwriter's Laboratories
8. NEMA - National Electrical Manufacturer's Association
9. ASTM - American Society for Testing and Materials
10. IEEE - Institute of Electrical and Electrical Engineers
11. ANSI - American National Standards Institute
12. ADA - Americans with Disabilities Act.

C. Reference to standards shall mean and intend the latest edition of such standards adopted and published at the date of bidding documents.

D. Materials and installation, as a minimum, shall conform with local and state codes and ordinances.

1.2 FEES, CHARGES, COSTS

A. It is the contractor's responsibility to contact the appropriate Utility Company and/or Building Department to determine if any fees, charges, or costs will be due to them. This fee, charge or cost shall be included in this contractor's bid price.

END OF SECTION

SECTION 26 05 00
ELECTRICAL MATERIALS AND METHODS

PART 1: GENERAL

1.1 WORK INCLUDES

A. Contractor shall provide:

1. Work shown on the drawing and specified herein.

1.2 RELATED WORK

A. Specified Elsewhere

1. Division 1 - Drawings and general provisions of Contract, including, but not limited to, General, Special, and Supplementary Conditions and other Division-1 Specification Sections, apply to the work of this Section.
2. Division 23 - applicable sections.
3. Division 26 - applicable sections.

1.3 QUALITY ASSURANCE

A. All work and materials shall be in accordance with the requirements and codes of the State of Florida, and all other applicable bodies having jurisdiction.

B. If, in the opinion of the Contractor, any part of the specification or plans do not comply with the laws, codes and regulations, that matter shall be referred in writing to the attention of the Engineer for a decision before proceeding with that part of the work. There shall be no changes in the drawings or specifications made without approval of the Engineer. Where a discrepancy exists between the drawings and this specification, the more stringent shall apply.

C. This Contractor shall secure and pay for all permits required by local authorities and shall provide the Owner with satisfactory interim and final inspection certificates.

D. Bidders shall visit the site and familiarize themselves with existing conditions and satisfy themselves as to the nature and scope of the work and the difficulties that attend its execution. The submission of a bid will be construed as evidence that such an examination has been made and that the existing conditions have been allowed for in the bid.

E. Before opening any material or doing any work, examine Architectural, Structural, Electrical, Mechanical, Plumbing, Fire Protection, Civil, Landscape and Equipment drawings, verify all conditions of project. Any differences which occur between drawings or between them and specifications, or between both of these and actual field measurements shall be reported in writing to Consultant and written instructions for changes obtained before proceeding with work.

1.4 SUBMITTALS

A. In accord with Division 1.

1. Product Data
   a. Fire Stopping Material
   b. Conduit seals.

2. Corrections or comments made on the shop drawings during the review do not relieve this Contractor from compliance with requirements of contract documents, plans and specifications. Shop drawings will be checked for general conformance with the design concept of the project and general compliance with information given in the contract documents. Review of the shop drawings shall not relieve the Contractor from responsibility for details and accuracy, confirming and correlating all quantities and dimensions, selecting fabrication processes, for techniques of assembly and construction, coordinating his work with that of all other trades, and performing his work in a safe and satisfactory manner. Review of shop drawings shall not permit any deviation from plans and specifications.
3. Contractor shall submit point to point wiring diagram for all signal and control systems, control panels, terminal cabinets, etc., for complete systems to be provided under this contract. Shop Drawings shall indicate terminal identification, and barrier strip layout.

B. Coordination drawings shall be provided showing routing of ALL trades and systems above ceilings and in chases. Objective of coordination drawings is to identify any conflicts and provide resolution, prior to the start of construction. Division 26 subcontractors shall coordinate with the General Contractor for requirements relating to this submittal. This requirement shall not conflict with requirements for coordination drawings as mandated in any other sections of this specification.

C. In accord with Division One, at the completion of the project, Contractor shall submit operating instructions and maintenance manuals. Submit model numbers, catalog information, technical data sheets, shop drawings, test reports, wiring diagrams, parts lists, and maintenance instructions where applicable for items in each specification section.

D. Throughout the progress of construction, keep a complete and detailed record of all deviations in the electrical installation from that indicated on the Drawings, specifications and/or shop drawings. At the completion of the project and prior to final payment this marked set of drawings shall be submitted to Engineer. As-Builts shall be legible and clearly indicating depths, dimensions of raceways from unknown points. Provide one mylar set of reproducibles to the Owner, certified and signed by the Contractor as to their accuracy.

E. Comply with the following for all work specified in Division 26. As-built information shall be shown to scale, using standard symbols listed in the legend. As a minimum show the following:

1. Location of stub-outs, dimensioned from permanent building lines.
2. All routing of raceways, dimensions from building, depths.
3. Corrected panelboard and equipment schedules.
4. Corrected circuit numbers as they appear on panelboard directories.
5. Number, size, type of insulation and number of wires in each conduit or multi-conductor cable whether in conduit or exposed.
6. Location of junction boxes and splices.
7. Location of access panels.
8. Location of equipment and all associated feeder runs.
9. Conduit runs of 2” conduit or larger and aggregate runs of 6 or moreconduits.
10. Location of all control devices.

1.5 GUARANTEE

A. Guarantee all materials and workmanship for a period of one year in accordance with the General Conditions.

1.6 DELIVERY, STORAGE AND HANDLING

A. Materials shall be suitably packaged by manufacturer to prevent damage during shipment. Damaged materials will not be acceptable for use.

B. Store materials on site in clean, dry storage area; when outside, elevated above grade and enclosed with durable watertight wrapping.

C. Handle all materials carefully to prevent damage. Minor scratches, marks or blemishes to finish shall be repaired by Contractor.

PART 2 - PRODUCTS

2.1 MATERIALS

A. General

1. All equipment and material for permanent installation shall be new unless specifically indicated otherwise. In addition, material shall:
   a. Be without blemish or defect.
   b. Not be used for temporary power or lighting without prior written authorization from the Owner.
   c. Be in accordance with NEMA Standards.
   d. Bear Underwriter's Label where subject to U.L. label service.
   e. U.L. listed for its intended service and application.
2. Equipment and materials of the same type of classification and used for the same purposes shall be products of the same manufacturer.
3. Materials and equipment shall conform in all respects to the requirements set forth in these specifications and the accompanying drawings. However, wherever a product is identified by name, equal products which meet the Consultants written approval may be used (per contract document procedures).
4. Except as otherwise specified, materials and equipment shall be new and bear the approval label of Underwriter's Laboratories, Inc., where applicable. Where equipment and materials are specified or designated on drawings by trade names and catalog numbers, the intent is to establish a standard of quality, appearance, performance, and dimension. Material and equipment of other manufacturers will be considered, provided they are equal in all respects to that specified. However, it will be the Contractor's responsibility to demonstrate equality of substituting with materials or equipment specified by the Consultant. Compensations for "as-built" drawings or contract documents requiring additional engineering services due to Contractor substitutions shall be paid directly by the Contractor to the Consultant. The Consultant shall be compensated by the Contractor for multiple reviews (more than two) of any shop drawing submission.

B. Fire Stopping Material

1. Fire stopping materials shall consist of commercially manufactured products capable of passing ASTM E-814 (UL 1479) Standard Method of Fire Test for Through Penetration Fire Stops.
2. Fire stopping materials shall maintain the F&T ratings of the wall, partition or floor opening that penetration is made.
3. Fire stopping materials shall be U.L. classified.
4. Acceptable Manufactures
   a. 3M
   b. Thomas & Betts
   c. Hilti.

C. Water Seal

1. Seal penetrations of perimeter walls or floors below grade to prevent entry of water. Use materials compatible with wall or floor construction.
2. Seal penetrations of roof, with flashings compatible with roof design.

D. Nameplates

1. General: Furnish and install nameplates wherever indicated as "required" in these specifications. Wording shall be submitted to the Engineer for review prior to purchase of nameplates.
2. Material: Refer to Section 26 05 53 for requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All equipment and materials shall be installed and completed in a first-class workmanlike manner. The right is reserved to direct the removal and replacement of any item, which in the opinion of the Owner's Representative and/or Engineer does not present an orderly and reasonably neat or workmanlike appearance, provided such items can be properly installed in an orderly way by usual methods in suchwork.

B. Electrical drawings are diagrammatic but shall be followed as closely as actual construction of the building and the work of other trades will permit. Do not scale drawings. Consult Architectural drawings and details for exact location of fixtures and equipment and building element dimensions. Because of the small scale of drawings, it is not possible to indicate all of the offsets, fittings and accessories required. This Subcontractor shall investigate the structural and finish conditions affecting his work and shall arrange such work, accordingly, providing fittings, bends, junction boxes, pull boxes, access panels and accessories required to meet such conditions.

C. No deviations for the plans and specifications shall be made without the full knowledge and consent of the Consultant. Should the Contractor find at any time during the progress of the work that, in his judgment, a modification of the requirements of any particular item is needed, he shall report such item promptly to the Consultant for his decision and instruction.

D. Discrepancies in Electrical and Mechanical Drawings - it is recognized that locations of piping, ductwork, etc., shown on Mechanical and Electrical drawings are diagrammatic, except for figured dimensions, and that field conditions may arise that will prevent their being installed as noted on drawings, such as runs of pipe crossovers, risers, panelboards, electric outlets, machinery, etc. within limits established by figures on Architectural Drawing. It is the duty of each and all subcontractors to consult with each other, verifying existing conditions and in each case where there is any questions or doubt as to space conditions or location of outlets, etc., to submit a workable solution to the Consultant for their approval before installing any work which is questionable.

E. The Contractor is specifically directed to the mechanical section of the contract documents for coordination.

F. The Contractor shall refer to the entire set of contract documents for bidding purposes and completeness of proposal. Items not shown on the electrical project documents, but shown on mechanical requiring wiring, components, raceways, etc., must be included in bid proposal to provide a complete working system. Systems and devices shown on one portion of documents shall be included as if they are shown on all portions of the contract documents.

G. The Contractor shall, prior to rough-ins, confirm location of all devices with Owner Representative and Architect. Coordinate with architectural drawings and interior elevations for exact locations, mounting heights and dimensions for installation of all items. Coordinate with wall coverings, furniture, etc.

H. Install all equipment in accord with manufacturer's recommendations.

I. Provide all necessary anchoring devices and supports.

1. Use structural supports suitable for equipment, or as indicated.
2. Check loadings and dimensions of equipment with shop drawings.
3. Do not cut or weld to building structural members.

J. Verify that equipment will fit support layouts indicated.

1. Where substitute equipment is used, revise indicated supports to fit.

K. Arrange for necessary openings to allow for admittance of equipment.

1. Where equipment cannot be installed as structure is being erected, provide, and arrange for building-in of boxes, sleeves, or other devices to allow later installation.

L. Make all penetrations through roofs prior to installation of roofing. For penetrations required after installation of roofing:

1. In built-up roofing (BUR), provide all curbs, cants, and base flashings.
2. In elastic sheet roofing (ESR), arrange and pay for base flashing work by authorized roofer.

M. Install rain hoods and metal counter flashings as indicated and to make all penetrations of electrical work through walls and roof water- and weather-tight.

1. Furnish all clamps, waterproofing material and labor necessary.
2. Where metal flashings are applied over concrete, paint concrete with 1/8 IN of mastic cement first.
3. Set flashing in mastic cement, watertight.

N. Repair and replace roof construction, damaged by this work, in manner which will not nullify roof guarantee.

O. Provide equipment guards at all belts, couplings, moving machinery and equipment provided under this division in accord with OSHA.

1. Use suitable structural frames with 12 ga, 3/4-inch maximum opening galvanized mesh, or expanded metal mesh.
2. Attach to equipment by removable clips and bolts with wing nuts, or other approved connectors.

P. Install equipment to permit easy access for normal maintenance.

1. Maintain easy access to switches, motors, drives, pull boxes, receptacles, etc.
2. Relocate items which interfere with access.

Q. Provide concrete foundations or pads required for electrical equipment, as indicated or as follows:

1. Where drawings do not show special foundations, install 4 IN high concrete pads.
2. Use 3,000 PSI concrete.
3. Reinforce with 6 x 6 x 10 x 10 mesh, with short dowels into floor at 12 IN OC around perimeter.
4. Chamfer top edges 3/4 IN.
5. Rub all faces smoothly with carborundum block.
6. Set anchor bolts for equipment.

R. All connections shall be tightened to the torque values recommended by that device manufacturer's instructions. If these values are not listed, tighten to pound-inch or pound-foot values recommended in UL Standard 486B, a summary of which may be found in Section 110-4 of the National Electric Code Handbook. Record the torques values of all main pieces of equipment and include in the maintenance manuals.

3.2 LOCATION OF EQUIPMENT

A. The approximate location of all equipment and devices is shown on the Drawings. The Owner's Representative and/or Engineer reserves the right to change the location of all equipment or devices 8 feet in any direction at no additional cost provided such changes are requested before final installation.

B. Install all equipment with ample space allowed for removal and repair. Provide ready accessibility to removable parts of equipment and to all wiring without moving equipment which is installed, or which is already in place. Provide access panels for all devices installed above non-accessible ceilings and/or within walls or partitions.

C. In mechanical and electrical equipment spaces, expose ceiling outlets and conduit with due consideration to ventilating ducts and mechanical piping. Where numerous ducts occur, install conduits and outlets after the ventilating ducts. Puncturing of duct work or hanging equipment such as light fixtures, ceiling hangers and conduits from duct work is prohibited unless specifically noted otherwise.

D. Electrical equipment shall be installed to maintain minimum clearances per Article 110 of NEC and ANSI C2 (National Electrical Safety Code and recommendations of manufacturer/vendor).

E. Dimensions indicated on documents are limiting dimensions. Do not provide equipment exceeding dimensions indicated or equipment arrangements that reduce required clearances or exceed specified maximum dimensions.

3.3 COORDINATION

A. Provide day-to-day coordination with the work of other contractors engaged in this project. Execute the work in a manner not to interfere with other contractors.

B. Coordinate with other contractors regarding the location and size of pipes, raceways, ducts, openings, and devices, so that there may be no interferences between installations or in the progress of any contractor.

C. If conflict arises in the installation of work, the following priority schedule shall be followed:

1. Recessed lighting fixtures.
2. Sanitary drainage.

3. Chilled water piping.
4. Low pressure ductwork.
5. Domestic water, storm, and vent lines.
6. Electric conduits.

D. This Contractor shall notify all other contractors of any deviations or special conditions necessary for the installation of his work. Interferences between the work of various contractors shall be resolved prior to installation. Work installed not in compliance with the plans and specifications and without properly checking and coordinating as specified above shall, if necessary, be removed and properly reinstalled by this Contractor without additional cost to the Owner. The Consultant or his representative shall be the mediating authority in all deviation and confliction disputes arising on the project.

E. Insofar as it is possible to determine in advance, this Contractor shall consult with the masonry contractor and others as to leaving the proper chases and openings for his work; and he shall place all of his outlets, anchors, sleeves and supports prior to pouring concrete or masonry work. Should this Contractor neglect doing this, any cutting and/or patching shall be done at this Contractor's expense.

F. Contractor must notify owner prior to excavation and exercise due caution with regard to disturbance of utilities and services.

G. Contractor shall be held responsible for any damage and restoration to utilities and services. Restoration shall be made immediately with methods and materials that are approved for the intended use. Provide written report to the Owner detailing occurrence and corrective action.

H. The locations of existing underground utilities are not shown and have not been independently verified by the Owner or it's representative. The Contractor shall determine the exact location of all existing utilities before commencing work in the vicinity and agree to be fully responsible for any and all damage which might be occasioned by the Contractor's failure to exactly locate and preserve any and all utilities.

3.4 WALL, ROOF AND FLOOR PENETRATIONS AND SLEEVE INSTALLATION

A. Provide sleeves for all electrical raceways, and wiring passing through walls and floors and roof. Sleeves shall be of sufficient length to extend through the wall, roof, and floors. Wall sleeves shall have ends flush with finished thickness of walls and floor sleeves shall extend 1 inch above finish floor. Interior diameter of sleeves shall provide 1/2-inch clearance all around conduit.

B. Below grade wall and roof penetration shall be made watertight. Below grade wall penetration shall be sealed with compression type conduit sealing bushings. Roof penetration shall be sealed and flashed per roof manufacturers published recommendations.

C. Where cutting is required to facilitate construction, this contractor shall patch, and repair cut items to the original state. However, structural work shall not be cut without the written approval of the Engineer or his representative.

D. Holes through concrete and masonry in new and existing structures shall be cut with a diamond core drill or concrete saw. Pneumatic hammer impact, electric hand or manual hammer type drills, shall not be allowed, except where permitted by Engineer as required by limited working space.

E. CUTTING AND PATCHING

1. Any damage caused by cutting or in any other way caused by this Contractor in the performance of his contract shall be repaired or replaced under the separate heading for the type of material required in a manner satisfactory to the Engineer/Owner.
2. Any unnecessary damage caused by this Contractor, due to installation of the electrical work, brought about through carelessness or lack of coordination, shall be corrected under the heading for the type of materials involved, and shall be paid for by this Contractor.

F. ACCESS PANELS

1. The Contractor's attention is called to access panels. It is a requirement of these specifications that all access panels required in architectural finishes or surfaces to provide access to junction boxes, smoke detectors, strip heaters, ballasts or other devices be provided and installed by this Contractor. Advise Consultant of locations and size of all panels.

3.5 FIRESTOPPING

A. Where conduits, wireway, bus ducts and other electrical raceways pass through fire partitions, fire walls or floors, install a firestop that provides an effective barrier against the spread of fire, smoke, and gases. Fire-stop material shall be packed tight, and completely fill clearances between raceways and openings. Fire-stop material shall conform to the following:

1. Fire-stopping material shall maintain its dimension and integrity while preventing the passage of flame, smoke, and gases under conditions of installation and use when exposed to the ASTM #119 time-temperature curve for a time period equivalent to the rating of the assembly penetrated. Cotton waste shall not ignite when placed in contact with the non-fire side during the test. Fire-stopping material shall be non-combustible as defined by ASTM E136, and, in addition, for insulation materials, melt point shall be a minimum of 1700° F for 2-hour protection.
2. Unused, spare sleeves in electrical closets shall be sealed with threaded steel caps on each end.

B. Fire-stopping materials shall be installed in accordance with the manufacturer’s written instructions.

3.6 PROTECTION OF WORK

A. Protect work from injury by keeping all conduit and boxes capped and plugged or otherwise protected. This includes damage by water and/or stoppage from building materials, sand, dirt, or concrete.

B. Protect all equipment and fixtures from damage during the project, provide all tarpaulins, drop cloths, barricades, or auxiliary equipment.

C. All materials or equipment damaged during construction shall be repaired or replaced with new items to the satisfaction of the Engineer.

3.7 IDENTIFICATION

A. Electrical Identification shall be in accordance with Section 26 05 53.

3.8 PAINTING

A. Finish painting shall be as specified in Division 9.

B. Provide touch-up painting of all electrical equipment marred in any way during shipment or installation.

3.9 CONNECTIONS TO EQUIPMENT

A. Equipment: The Contractor shall make final electrical connections to all items of equipment. All power wiring from power source through starters, disconnects and control panels to equipment shall be provided.

3.10 SAMPLES

A. Physical samples of material and equipment proposed for installation in this project shall be submitted to the Consultant upon request.

B. Samples shall be submitted through the General Contractor with all shipping and handling charges prepaid. Any expense incurred in securing, delivery and return of samples, is the responsibility of Contractor. Samples shall be delivered to location designated by Consultant.

C. Samples shall remain the possession of the Contractor except as follows:

1. Approved samples, without physical damage, may be installed on theproject.
2. Samples not called for within 14 days after notification will be disposed of by the Consultant.

3.11 SPARE PARTS AND TOOLS

A. Furnish to Owner and obtain receipt for same, the following:

1. One spare set of fuses for each size and type installed on project including overload relays for magnetic starters.
2. One set of special tools required for equipment furnished, spare keys, etc.
3. See other sections for spare parts relative to specific systems.

3.12 FINAL INSPECTION AND TESTS

A. As precedent to final inspection and acceptance, the Contractor shall have all previously listed defects corrected, complete all work, test all systems, and submit results of such tests to the Engineer, install all directories, and labels and post all instructions and comply with applicable paragraphs of this section. Refer to Section 26 05 70 for additional information.

3.13 PERFORMANCE

A. The Contractor shall employ a competent foreman on the job throughout the entire period of construction to see that his work will not conflict with other trades and that it is properly performed.

B. The foreman shall have a thorough knowledge of the work to be installed under this contract, be a skilled mechanic who has had a minimum of four (4) years previous successful experience on projects of comparable sizes and complexity. Foreman shall be present at all times that work under this Division is being installed or affected. Foreman shall be a State of Florida licensed Journeyman and shall have a valid Palm Beach County Electrical Journeyman Certificate of Competency.

END OF SECTION

SECTION 26 05 13
BUILDING WIRE AND CABLE

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Building wire and cable

B. Wiring connectors and connections

1.2 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Provide for each cable assembly type.

C. Test Reports: Indicate procedures and values obtained.

D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under Regulatory Requirements.

1.4 QUALIFICATIONS

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

1.5 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.6 FIELD SAMPLES

Where required, provide as per the following:

A. Provide under provisions of Division 1.

B. Submit one length, each 18 inches of cable assembly from each reel.

C. Select each length to include complete set of manufacturer markings.

D. Attach tag indicating cable size and application information.

1.7 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Conductor sizes are based on copper.

C. Wire and cable routing shown on Drawings is approximate unless dimensioned. Route wire and cable as required to meet Project Conditions.

D. Where wire and cable routing is not shown, and destination only is indicated, determine exact routing and lengths required.

1.8 COORDINATION

A. Coordinate Work under provisions of Division 1.

B. Determine required separation between cable and other work.

C. Determine cable routing to avoid interference with other work.

PART 2 – PRODUCTS

2.1 BUILDING WIRE AND CABLE

A. Description: Solid or stranded insulated wire.

B. Conductor: Copper, unless noted otherwise.

C. Insulation Voltage Rating: 600 volts.

D. Insulation: ANSI/NFPA 70, Type THHW/THWN.

E. MC (Metal Clad) cable is acceptable.

2.2 WIRING CONNECTORS

A. Solderless Pressure Connectors

1. Ilsco Model PDB.
2. Substitutions: Under provisions of Division 1.

B. Spring Wire Connectors

1. Ideal
2. Scotchloc
3. Holub
4. Substitutions: Under provisions of Division 1.

C. Compression Connectors

1. Panduit
2. Burndy
3. 3M
4. Substitutions: Under provisions of Division 1.

D. Split-bolt, insulation piercing, or push-in type connectors shall not be used.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions per NEC requirements.

B. All wire shall be installed in conduit unless specifically noted otherwise.

C. Use stranded conductors for control circuits.

D. Use conductor not smaller than 12 AWG for power and lighting circuits.

E. Use conductor not smaller than 12 AWG to supply a single fixture.

F. Use conductor not smaller than 16 AWG for control circuits.

G. Conductors of the essential electrical system shall be run in separate raceways and be isolated from conductors of the normal power system.

H. Use 10 AWG conductors for 20 amperes, 120-volt branch circuits longer than 75 feet.

I. Pull all conductors into raceway at same time.

J. Use suitable wire pulling lubricant for installing all building wire.

K. Protect exposed cable from damage.

L. Use suitable cable fittings and connectors.

M. Neatly train and lace wiring inside boxes, equipment, and panelboards.

N. Clean conductor surfaces before installing lugs and connectors.

O. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.

P. Use antioxidant compound on splices and termination of 2 AWG and larger.

Q. Use sealed weatherproofing kits for underground splices.

R. Provide 8 inches of free conductor at outlet, switch, pull and junction boxes.

S. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 8 AWG and smaller.

T. Use Ilsco or Polaris type bolted lugs with covers for copper conductor taps, and hy-press type sleeves with shrink-sleeve insulation, 6 AWG and larger. Do not splice in underground hand holes.

U. In new conduit installation, do not install more than five wires in the same conduit unless specifically noted otherwise. Conduits containing control wires or switch legs may contain more than 5 wires to a maximum fill of 40%.

V. All bushings shall be installed prior to pulling wire. Any wire pulled-in prior to installation of bushings will be required to be removed and replaced at the Contractor's expense.

W. Each current carrying phase conductor of 120v branch circuits and 277V lighting circuits shall have a dedicated neutral conductor paired with it. Do not “share” neutral conductors among alternate phase conductors.

X. Aluminum conductors may be used for feeders 100A and above only. Use copper conductors where required by individual equipment requirements. Coordinate prior to rough-in with all equipment provided by all trades.

3.4 INTERFACE WITH OTHER PRODUCTS

A. Identify wire and cable under provisions of Division 1.

B. Identify each conductor with its circuit number or other designation indicated on Drawings.

3.5 FIELD QUALITY CONTROL

A. Perform field inspection and testing under provisions of Division 1.

B. Inspect wire and cable for physical damage and proper connection.

C. Measure tightness of bolted connections and compare torque measurements with manufacturer's recommended values.

D. Verify continuity of each branch circuit conductor.

E. Megger all feeders and all branch circuits larger than 200 amp. Coordinate all testing with Section 26 05 70, Testing.

END OF SECTION

SECTION 26 05 26
GROUNDING

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Base Bid:

1. Electrical Contractor provide:
   a. Grounding for Separately Derived Systems
   b. Grounding for equipment.

1.2 SYSTEM DESCRIPTION

A. Ground each separately derived system neutral to structural member of building.

B. Ground raceways and electrical equipment; use double locknuts at all panels; use bonding jumpers where conduits are installed in concentric knockouts. Ground panels, switches, motor frames, motor starters fixtures, and outlets with separate ground conductor in conduit system.

C. Bond together system neutrals, service entrance enclosures, exposed non-current carrying metal parts of electrical equipment, metal raceway systems, grounding conductor in raceways and cables, receptacle ground terminals.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements:

1. Comply with NFPA 70, National Electric Code.
2. UL 467: Grounding and Bonding Equipment.

1.4 SUBMITTALS

A. In accord with Division 1.

B. Test data in accord with 26 05 70.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Materials used for grounding conductors shall be in accordance with N.E.C. Article 250-91.

B Ground Rods: Steel, copper-encased, 3/4-inch O.D. x 10'-0".

C. Connections: Exothermic weld type for inaccessible locations, mechanical clamp type for accessible locations.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Use driven ground rod where shown on drawings.

B. Bond all grounding systems together.

C. Bond building grounding electrode conductor to a minimum of 20-ft. of concrete encased rebar in slab, ground rod, lighting protection system, metal water piping with jumper around any non-conductive valves or piping from main service to maintain an electrically continuous system. Bond grounding system to all piping entering building.

D. Separately Derived Systems: Provide connection to building steel bonded to neutral of transformer.

E. Test and additional ground rods connected to system at a distance of a minimum of 10ft from each other to attain a minimum ground resistance of system to below 25ohms.

F. Provide green equipment grounding conductor sized in accordance with Table 250-95 of the N.E.C., in all raceways including conduits, wireways, ducts, and boxes. Bond equipment grounding conductor to each section of ducts and wireways using a continuous conductor and lay-in type grounding lugs bolted to the housing.

3.2 FIELD QUALITY CONTROL

A. Measure ground resistance in accord with 26 05 70.

END OF SECTION

SECTION 26 05 29
SUPPORTING DEVICES

PART 1 – GENERAL

1.1 WORK INCLUDED

A. Conduit and equipment supports.

B. Fastening hardware.

1.2 COORDINATION

A. Coordinate size, shape, and location of concrete pads with Division Three.

1.3 QUALITY ASSURANCE

A. Support systems shall be adequate for 200% of the weight of equipment and conduit, including wiring, which they carry.

B. Provide signed and sealed structural support calculations for all equipment and device supports by a Florida licensed structural engineer. Exterior mounted supporting devices and structures shall be per Florida Building Code Wind Load withstand requirements.

PART 2 – PRODUCTS

2.1 MATERIAL

A. Support Channel: Galvanized steel.

B. Hardware: Corrosion resistant.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building concrete structure using expansion anchors.

B. Use toggle bolts or hollow wall fasteners in hollow masonry, plaster, or gypsum board partitions and walls; expansion anchors or preset inserts in solid masonry walls; self-drilling anchors or expansion anchor on concrete surfaces; sheet metal screws in sheet metal studs; and wood screws in wood construction.

C. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

D. Do not use powder-actuated anchors.

E. Do not drill structural steel members.

F. Fabricate supports from structural steel or steel channel, rigidly welded, or bolted to present a neat appearance. Use hexagon head bolts with spring lock washers under all nuts.

G. In wet locations install free-standing electrical equipment on concrete pads.

H. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet 3/4 inch off wall.

I. Bridge studs top and bottom with channels to support flush-mounted cabinets and panelboards in stud walls.

END OF SECTION

SECTION 26 05 33
RACEWAYS

PART 1: GENERAL

1.1 SECTION INCLUDES

A. Metal conduit.

B. Flexible metal conduit.

C. Liquidtight flexible metal conduit.

D. Electrical metallic tubing.

E. Fittings and conduit bodies.

1.2 REFERENCES

A. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.

B. ANSI C80.3 - Electrical Metallic Tubing, Zinc Coated.

C. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.

D. ANSI/NFPA 70 - National Electrical Code.

E. NECA "Standard of Installation."

F. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit.

1.3 DESIGN REQUIREMENTS

A. Conduit Size: ANSI/NFPA 70.

1.4 SUBMITTALS

A. Submit under provisions of Division One.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Accurately record actual routing of empty conduits, exterior underground.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle Products to site under provisions of Division One.

B. Accept conduit on site. Inspect for damage.

C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

1.7 PROJECT CONDITIONS

A. Verify that field measurements are as shown on Drawings.

B. Verify routing and termination locations of conduit prior to rough-in.

C. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2: PRODUCTS

2.1 RIGID METAL CONDUIT

A. Description: Rigid Galvanized Steel Conduit: ANSI C80.1.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; material to match conduit; all steel fittings.

2.2 NON-METALLIC CONDUIT

A. Description: Schedule 40 PVC and Schedule 80 PVC, both Sunlight UV resistant.

B. Fittings and Conduit Bodies: Same manufacturer as conduit.

2.3 FLEXIBLE METAL CONDUIT

A. Description: Interlocked steel construction.

B. Fittings: ANSI/NEMA FB 1. Steel or malleable iron type.

2.4 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Description: Interlocked steel construction with PVC jacket.

B. Fittings: ANSI/NEMA FB 1. Steel or malleable iron type.

2.5 ELECTRICAL METALLIC TUBING (EMT)

A. Description: ANSI C80.3; galvanized tubing.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel, set screw or compression type with insulated throat.

2.6 MC (Metal Clad) Cable

A. Description: UL Rated VW-1 Aluminum Interlocked Armored Cable.

PART 3: EXECUTION

3.1 CONDUIT REQUIREMENTS

A. Minimum Size: 3/4 inch unless otherwise specified.

B. Underground Installations:

1. Use rigid galvanized steel (RGS) conduit or Schedule 40 PVC outside building footprint. Paint all RGS conduit, to be installed underground, with two coats of bitumastic paint.
2. Minimum Size: 3/4 inch.
3. Install conduits a minimum of 36 inches below finished grade, unless inside the building line.
4. Terminate conduits with bell ends or bushings at manholes.
5. Duct seal all outdoor conduit terminations, and underground conduits entering a building.
6. PVC conduit shall not be used in any patient care areas.

C. Outdoor Locations, Above Grade: Use rigid steel conduit where exposed to possible physical damage. All other areas, use Schedule 40 PVC.

D. In Slab Above Grade:

1. Rigid steel conduit or electrical metallic tubing.
2. Maximum Size Conduit in Slab: 3/4 inch.

E. Wet Locations: Rigid steel conduit, PVC Schedule 80.

F. Damp Locations: Rigid steel conduit, PVC Schedule 80.

G. Indoor Locations:

1. Concealed: Rigid steel conduit, MC Cable, or electrical metallic tubing.
2. Exposed: Below 4'-0" AFF, use rigid steel conduit. Above 4'-0" AFF, use electrical metallic tubing.

H. Subject to Physical Damage: Galvanized rigid steel conduit.

I. Flexible conduit: 3/8-inch steel (min.).

J. Electrical Metallic Tubing: 1/2 inch, not exceeding 10 feet long at the following conditions:

1. Junction box above ceiling to a single box in furred wall.
2. All other locations, use 3/4" EMT minimum.

K. Steel flexible conduit or liquid tight conduit, 1/2 inch (maximum 3 feet long), to connect equipment where subject to vibration or frequent changing.

3.2 INSTALLATION

A. Install conduit in accordance with NECA "Standard of Installation."

B. All wiring shall be in conduit unless specifically noted otherwise.

C. Arrange supports to prevent misalignment during wiring installation.

D. Secure and/or support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.

E. Multiple parallel runs of suspended conduits shall be supported by steel channel and straps.

F. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.

G. Fasten conduit supports to building structure and surfaces under provisions of Section 26 05 29.

H. Do not support and/or secure conduit with perforated pipe straps. Remove wire used for temporary supports.

I. Do not attach conduit to ceiling support wires. Install additional support wires to support conduits. Conduit must be securely fastened in place.

J. Arrange conduit to maintain headroom and present neat appearance.

K. Route exposed conduit parallel and perpendicular to walls. Exposed conduit below 10 ft above floor in occupied areas, shall have 2-hole straps spaced a maximum of 5 ft.

L. Do not route conduits on floors in areas used for access to any equipment.

M. Route conduit installed above accessible ceilings parallel and perpendicular to walls.

N. Route conduit in and under slab from point-to-point.

O. Do not cross conduits in slab.

P. Maintain adequate clearance between conduit and piping.

Q. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.

R. Cut conduit square using saw or pipe cutter; de-burr cut ends.

S. Bring conduit to shoulder of fittings; fasten securely.

T. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

U. Install no more than equivalent of four 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2-inch size.

V. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.

W. Provide suitable fittings to accommodate expansion and deflection where conduit crosses expansion joints.

X. Provide a 200 lb. test pull string in each empty conduit except sleeves and nipples.

Y. Use suitable caps to protect installed conduit against entrance of dirt and moisture immediately after installation.

Z. Ground and bond conduit under provisions of Section 26 05 26.

AA. Identify conduit under provisions of Section 26 05 29.

BB. New Construction: Conduits run in finished areas shall be concealed. No conduits shall be installed on roof surface.

CC. Do not use threadless connector or couplings on rigid conduit installed above grade.

DD. Do not use "all-thread" conduit nipples.

EE. Terminate all empty conduits in approved type boxes.

FF. Disconnect switches, magnetic starters, contactors, control cabinets and panel boards shall not be used as raceways.

GG. Flexible metal conduit and liquidtight flexible metal conduit shall not exceed 6 feet in length.

HH. Flexible metal conduit and liquid-tight flexible metal conduit shall not penetrate walls or ceilings.

II. All metallic conduits and fittings below grade or in slabs shall be coated with two (2) coats of bitumastic paint prior to installation.

JJ. All conduit terminations shall have insulated throat or appropriate plastic bushing.

KK. All raceway systems shall be complete, and each system shall be totally separate.

LL. All raceway systems shall be complete, and each system shall be totally separate.

MM. MC Cable shall be concealed.

3.3 INTERFACE WITH OTHER PRODUCTS

A. Install conduit to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division Seven.

B. Route conduit through roof openings for piping and ductwork or through suitable roof jack with pitch pocket. Coordinate location with roofing installation.

END OF SECTION

SECTION 26 05 34
BOXES

PART 1: GENERAL

1.1 SECTION INCLUDES

A. Wall and ceiling outlet boxes

B. Floor boxes

C. Pull and junction boxes

1.2 REFERENCES

A. ANSI/NEMA FB 1 - Fittings and Supports for Conduit and Cable Assemblies

B. ANSI/NEMA OS 1 - Sheet-steel Outlet Boxes, Device Boxes, Covers, and Box Supports

C. ANSI/NFPA 70 - National Electrical Code

D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

1.3 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division One.

B. Accurately record actual locations and mounting heights of outlet, pull, and junction boxes.

1.4 REGULATORY REQUIREMENTS

A. Conform to requirements of ANSI/NFPA 70.

B. Furnish products listed and classified by Underwriters Laboratories, Inc., as suitable for purpose specified and shown.

1.5 PROJECT CONDITIONS

A. Verify field measurements are as shown on Drawings.

B. Electrical boxes are shown on Drawings in approximate locations unless dimensioned. Install at location required for box to serve intended purpose.

PART 2: PRODUCTS

2.1 OUTLET BOXES

A. Sheet Metal Outlet Boxes: ANSI/NEMA OS 1, galvanized steel one piece construction, 4 inches x 4 inches x 2.5 inches deep, minimum.

B. Cast Boxes: NEMA FB 1, Type FD cast ferralloy. Provide gasketed cover by box manufacturer. Provide threaded hubs, 4 inches x 4 inches x 1.5 inches deep, minimum.

2.2 PULL AND JUNCTION BOXES

A. Sheet Metal Boxes: NEMA OS 1, galvanized steel one piece construction.

1. Minimum Size Box: 4 x 4 x 2-1/2 inches deep.

B. Surface-Mounted Cast Metal Box: NEMA 250, Type 4; flat-flanged, surface- mounted junction box.

1. Material: Galvanized cast iron.
2. Cover: Furnish with ground flange, neoprene gasket, and stainless-steel cover screws.

2.3 FLOOR BOXES

A. Corrosion resistance (on grade rated, UL listed) 2-gang.

B. UL514 scrub tight rated; cover finish black powder coat.

C. Covers shall be water resistant type.

PART 3: EXECUTION

3.1 INSTALLATION

A. Install electrical boxes as shown on Drawings, and as required for splices, taps, wire pulling, equipment connections and compliance with regulatory requirements.

B. Install electrical boxes to maintain a 6'-6" headroom and to present neat mechanical appearance.

C. Install pull boxes and junction boxes above accessible ceilings and in unfinished areas only.

D. Inaccessible Ceiling Areas: Install outlet and junction boxes no more than 6 inches from ceiling access panel or from removable recessed luminaire.

E. Accessible Ceiling Areas: Install outlets and junction boxes no more than 3'-0" above removable ceiling.

F. Install boxes to preserve fire resistance rating of partitions and other elements, using materials and methods under the provisions of Division One.

G. Align adjacent wall-mounted outlet boxes for switches, thermostats, and similar devices with each other.

H. Use flush mounting outlet boxes in finished areas.

I. Do not install flush mounting boxes back-to-back in walls; provide minimum 6 inch separation. Provide minimum 24 inches separation in acoustic rated and fire rated walls.

J. Secure flush mounting box to interior wall and partition studs. Accurately position to allow for surface finish thickness.

K. Use stamped steel bridges to fasten flush mounting outlet box between studs.

L. Install flush mounting box without damaging wall insulation or reducing its effectiveness.

M. Do not fasten boxes to ceiling support wires.

N. Support boxes from building structure or structural member.

O. Use gang box where more than one device is mounted together. Do not use sectional box.

P. Use 2-gang box with plaster ring for single device outlets.

Q. Use cast outlet box in exterior locations exposed to the weather and wet locations.

R. Use cast floor boxes for installations in slab on grade; formed steel boxes are acceptable for other installations.

S. Set floor boxes level.

T. Large Pull Boxes: Boxes larger than 100 cubic inches in volume or 12 inches in any dimension.

1. Interior Dry Locations: Use hinged enclosure.
2. Other Locations: Use surface-mounted cast metal box.

U. Floor boxes shall not be used for feed through wiring except to another floor box.

V. Cast boxes at the end of a run shall have one additional conduit into slab for support.

W. Pull boxes shall be added, as necessary, to eliminate conduit runs from exceeding 200 feet in length.

X. Box mounting height, unless indicated on drawings:
(All mounting heights shall comply with ADA)

1. Refer to Section 26 27 26, Paragraph 3.4.

Y. A maximum of one extension ring shall be used on a box.

Z. System pull and junction boxes shall be color-coded as specified in Section 26 05 53.

3.2 INTERFACE WITH OTHER PRODUCTS

A. Coordinate locations and sizes of required access doors with Division 8.

B. Locate flush mounting box in masonry wall to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening.

C. Coordinate mounting heights and locations of outlets mounted above counters, benches, and backsplashes.

D. Position outlet boxes to locate luminaries as shown on reflected ceiling plan.

3.3 ADJUSTING

A. Adjust floor box flush with finish flooring material.

B. Adjust flush-mounting outlets to make front flush with finished wallmaterial.

C. Install knockout closure in unused box opening.

END OF SECTION

SECTION 26 05 53
ELECTRICAL SYSTEMS IDENTIFICATION

PART 1: GENERAL

1.1 WORK INCLUDED

A. Nameplates

B. Wire markers

C. Box color coding

D. Lighting and power junction boxes

E. Panel directories.

1.2 SUBMITTALS

A. Submit shop drawings under provisions of Division One.

B. Include schedule for nameplates.

PART 2: PRODUCTS

2.1 MATERIALS

A. Nameplates: Engraved three-layer laminated plastic, white letters on a black background. Equipment and devices at 'critical branch' (emergency) shall have labels with white letters on red background.

B. Underground-Type Plastic Line Marker: Manufacturer's standard permanent, bright-colored, continuous-printed plastic tape with mylar backing, intended for direct-burial service; not less than 6 inches wide x 4 mils thick. Provide tape with printing which most accurately indicates the type of buried conduit.

C. Wire and Cable Markers: Cloth markers, split sleeve, or tubing type.

PART 3: EXECUTION

3.1 INSTALLATION

A. Degrease and clean surfaces to receive nameplates.

B. Install nameplates parallel to equipment lines.

C. Secure nameplates to equipment fronts using stainless steel screws. Secure nameplate to outside face of recessed panelboard doors in finished locations.

D. Embossed tape will not be permitted for any application.

E. Provide underground-type plastic line marker above exterior underground conduits. Bury 6 to 8 inches below finish grade. Provide line markers on each side of trench if wider than 16 inches.

3.2 WIRE IDENTIFICATION

A. Phase Color Coding:

1. 120/208-volt system, "A" phase - black, "B" phase - red, "C" phase - blue, neutral - white, and ground green.
2. 277/480-volt system, "A" phase - brown, "B" phase - orange, "C" phase - yellow, neutral - gray, and ground - green.

B. Maintain A, B, C, phase relation left to right or top to bottom when viewed from front. Maintain color coding throughout entire project.

C. Phase conductors, size #10 and smaller, and neutral and ground conductors, shall have continuous outer finish color as indicated above. Size #8 and larger conductors shall have black insulation and be color coded with a six-inch band of colored tape at all junctions and terminators.

D. Identify each feeder and branch circuit conductor fed from panel and circuit number at each accessible location.

3.3 NAMEPLATE ENGRAVING SCHEDULE

A. Provide nameplates of minimum letter height as scheduled below.

1. Panelboards: 1/2 inch-identify panelboard name. 1/4 inch-identify voltage rating.
2. Individual Circuit Breakers and Switches: 3/8 inch-identify circuit and load served, including location.
3. Safety Switches and Enclosed Switches: ½ inch - identify switch name; 1/4-inch - identify load served.
4. Transformers: 3/8 inch-identify transformer name. 1/4 inch-identify primary and secondary voltages.
5. Electrical Cabinets and Enclosures: 3/8 inch- identify equipment name.
6. System Terminal Cabinets: 3/8 inch-identify equipment or system name.

B. Headwall: 1/8 inch-identify panel and circuit number serving outlet (ex. 'LINA - 2') located above each outlet on headwall.

C. Provide panelboard and circuit number on engraved trim plate, on each receptacle and switch. Engraving shall be deep enough to be visible and legible from a distance of 5'-0". Fasten nameplate to switch coverplate.

3.4 BOX COLOR CODING SCHEDULE

A. Paint junction box and cover, and 6" of all conduits entering/leaving, to match the building’s existing color scheme. If a scheme does not exist, then paint in the following manner:

1. Fire alarm - Red
2. Communications (Data/Telephone/Intercom) - Blue
3. EMS - Purple
4. Access Control - Brown
5. CATV – White
6. IDS – Black
7. Audio visual – Gold.

3.5 LIGHTING AND POWER JUNCTION BOX IDENTIFICATION

A. Identify lighting and power junction box covers with circuit and panelboard number on the outside, using permanent marker.

3.6 PANEL DIRECTORY

A. Shall be typewritten, indicating specific and clear area of control, regardless of the listing in the panel schedules on the drawings. Indicate by room name, equipment, system, etc.

B. Contractor shall provide accurate as-built drawings identifying each device/equipment circuit and updated panel schedules.

END OF SECTION

SECTION 26 05 70
TESTING

PART 1: GENERAL

1.1 WORK INCLUDES

A. Testing of electrical components and equipment as herein specified.

1.2 SYSTEM DESCRIPTION

A. Testing includes:

1. Resistance tests
2. Continuity tests
3. Phase relationship verification
4. Voltage tests
5. Ground fault protection tests
6. Lighting controls commissioning tests.

1.3 QUALITY ASSURANCE

A. Regulatory Requirement

1. Comply with National Electrical Code, (NEC) and Florida Building Energy Code.

1.4 SUBMITTALS

A. Test Reports: All test reports shall be submitted in triplicate, assembled, and bound to Architect/Engineer prior to final acceptance.

PART 2: PRODUCTS

2.1 MATERIALS

A. Furnish all test equipment to perform specified testing.

PART 3: EXECUTION

3.1 TESTS

A. Conduct such tests and adjustment of equipment as necessary to verify performance requirements.

B. Test Reports: Typewritten, listing testing equipment used, person or persons performing the tests, date tested, circuits tested, motor or equipment nameplate data, and results of tests.

C. Insulation resistance tests general:

1. Perform insulation resistance tests on equipment and cables listed herein.
2. Test equipment: Furnished by Contractor.
3. Resistance measured: line-to-ground.
4. Disconnect, prior to testing, any device that could be damaged by application of voltage.

5. Insulation resistance tests shall be conducted per following schedule:

Item Tested	Voltage Of Test (V)	Min. Acceptance Resistance In Megohms
Transformers: No. 2 and larger	500	05
Cables (600V)	1000	50
Panelboards	1000	25

D. Ground Resistance

1. Measure and record ground resistance from system neutral connection at separately derived system, to convenient ground reference point using suitable ground testing equipment. Minimum acceptable resistance: 10 ohms. When resistance exceeds 10 ohms, modify ground connection and/or increase grounding electrode conductor size and repeat test.
2. Test equipment shall be provided with current calibration data indicating date of calibration, and length of test leads used during calibration. Calibration shall have been within the last twelve (12) months.

E. Continuity Test

1. Test branch circuits and control circuits to determine continuity of wiring and connection. Submit written statement that this has been performed.

F. Voltage test shall be made and recorded at the following listed points. Tests shall be conducted under normal load conditions.

1. Distribution feeders at panelboards.
2. Outlets

G. Phase Relationship: Check connections to equipment for proper A-B-C phase relationships.

1. Disconnect, prior to check, any device which could be damaged by application of voltage of reversed phase sequence.

3.2 CORRECTIONS OF DEFECTS

A. If tests disclose any unsatisfactory workmanship or equipment furnished under this contract, Contractor shall repair or replace such defects.

B. If any wiring or equipment is damaged by tests, Contractor shall repair or replace such wiring or equipment.

END OF SECTION

SECTION 26 09 23
LIGHTING CONTROLS

PART 1 – GENERAL

1.1 SUMMARY

A. Section includes a networkable lighting control system comprised of, but not limited to the following components:

1. Wired Networkable Devices
   a. Wall switches, dimmers, and scene controllers.
   b. Graphic wall stations.
   c. Auxiliary input/output devices.
   d. Occupancy and photocell sensors.
   e. Power packs and secondary packs.
   f. Plug load controllers/relays.
   g. Relay panels.
   h. I/O interface relays.

B. The contractor shall provide, install, and verify proper operation of all equipment necessary for proper operation of the system as specified herein, and as shown on applicable drawings.

1.2 RELATED DOCUMENTS

A. Section 26 27 26, “Wiring Devices”.

B. Section 26 51 14, “Interior Lighting”.

C. Section 26 56 00, “Exterior Lighting”.

1.3 SUBMITTALS

A. Submittal shall be provided including the following items:

1. Bill of Materials necessary to install the networkable lighting control system.
2. Product Specification sheets indicating general device descriptions, dimensions, electrical specifications, wiring details, and nomenclature.
3. Riser diagrams showing device wiring connections of system and also typical per room/area type.
4. Other diagrams and Operational Descriptions: As needed to indicate system operation or interaction with other system(s).
5. Contractor Start-up/Commissioning Worksheet (must be completed prior to factory start-up).
6. Service specification sheets indicating general service descriptions, including start-up, training, post-start-up support, and service contract terms.
7. Hardware and Software Operation Manuals.
8. Contractor commissioning report with pre-functional and functional testing; verifying all operations per plans specifications and owner’s requirements.

1.4 QUALITY ASSURANCE

A. Product Qualifications

1. Control electrical components shall be listed or recognized by a nationally recognized testing laboratory (e.g., UL, ETL, or CSA) and shall be labeled with required markings as applicable.
2. Luminaires and controls are certified by manufacturer to have been designed, manufactured, and tested for interoperability.
3. All components shall be subjected to 100% end of line testing prior to shipment to the project site to insure proper device operation.
4. All components and the manufacturing facility where product was manufactured must be RoHS compliant.

B. Installation and Start-Up Qualifications

1. System start-up shall be performed by qualified personnel approved or certified by the manufacturer.

C. Service and Support Requirements

1. Phone Support: toll free technical support shall be available.
2. Remote Support: The bidder shall offer a remote support capability.
3. Onsite Support: The bidder shall offer onsite support that is billable at whole day rates.
4. Service Contract: The bidder shall offer a Service Contract that packages phone, remote, and onsite support calls for the project. Response times for each type of support call shall be indicated in the terms of the service contract included in the bid package.

1.5 WARRANTY

A. The manufacturer shall provide a minimum five-year warranty on all hardware devices supplied and installed. Warranty coverage shall begin on the date of shipment.

B. The hardware warranty shall cover repair or replacement of any defective products within the warranty period.

1.6 MAINTENANCE AND SUSTAINABILITY

A. The manufacturer shall make available to the owner, new parts, upgrades, and/or replacements available for a minimum of 5-years following installation.

PART 2 – EQUIPMENT

2.1 MANUFACTURERS

A. Acuity.

B. Hubbell.

C. Eaton.

D. Legrand.

E. Cooper Lighting (Basis of Design)

2.2 SYSTEM PERFORMANCE REQUIREMENTS

A. System Architecture

1. System shall have an architecture that is based upon three main concepts:
   a. Networkable Intelligent Lighting Control Devices: Shall have individually addressable networkable communication capability and consist of one or more basic lighting control components: occupancy sensor, photocell sensor, relay, dimming output, contact closure input, analog 0-10V input, and manual wall station capable of indicating switching, dimming, and/or scene control. Combining one of more of these components into a single device enclosure shall be permissible so as to minimize overall device count of system.
   b. Standalone Lighting Control Zones using Distributed Intelligence: Lighting control zones consisting of one or more networkable intelligent lighting control devices and shall be capable of providing automatic control from sensors (occupancy and/or photocell) and manual control from local wall stations without requiring connection to a higher-level system backbone; this capability is referred to as “distributed intelligence”.
   c. Optional system Backbone for Remove, Time-Based and Global Operation between Control Zones. System must be capable of interfacing directly with networkable luminaires such that either low voltage networkable cabling or wireless RF communication is used to interconnect networkable luminaires with control components such as sensors, switches, and system backbone (see *Control Zone Characteristics* sections for each type of networkable connection, wired or wireless).
2. The system device shall be capable of providing individually addressable switching and diming control of the control zones to include multiple switch legs or circuits, and relay outputs to provide design flexibility appropriate with sequence of operations required in each project area or typical space type.
3. Lighting control devices shall be capable of being networkable with a higher-level system backbone to provide time-based control, remote control from inputs and/or systems external to the control zone, and remote configuration and monitoring through a software.
4. System shall be capable of “out of box” sequence of operation for each control zone. Standard sequence is:
   a. All switches control all fixtures in a zone.
   b. All occupancy sensors automatically control all fixtures in the control zone with a default timeout.

B. Wired Networkable Control Zone Characteristics

1. Following proper installation and provision of power, all networkable devices connected together with low voltage networkable cable shall automatically form a functional lighting control zone without requiring any type of programming, regardless of the programming mechanism (e.g., software application, handheld remote, pushbutton). The “out of box” default sequence of operation is intended to provide typical sequence of operation so as to minimize the system startup and programming requirements and to also have functional lighting control operation prior to system startup and programming.
2. System shall be able to automatically discover all connected devices without requiring any provisioning of system or zone addresses.

C. Portable Programming Interface for Standalone Control Zones

1. Portable handheld application interface for standalone control zones shall be provided for systems that allows configuration of lighting control settings.
2. Programming capabilities through the application shall include, but not be limited to, the following:
   a. Switch/occupancy/photosensor group configuration.
   b. Manual/automatic on modes.
   c. Turn-on dim level.
   d. Occupancy sensor time delays.
   e. Dual technology occupancy sensors sensitivity.
   f. Photosensor calibration adjustment and auto-setpoint.
   g. Trim level settings.

2.3 WIRED NETWORKABLE DEVICES

A. Wired Networkable Wall Switches, Dimmers, Scene Controllers

1. Wall switches and dimmers shall support the following device options:
   a. Number of control zones: 1, 2 or 4.
   b. Control types supported: On/Off or On/Off/Dimming.
2. Scene controllers shall support the following device options:
   a. Number of scenes: 1, 2 or 4.
   b. Control Types Supported:
      1) On/Off or On/Off/Dimming.
      2) Preset Level Scene Type.
      3) Reprogramming of other devices within daisy-chained zone so as to implement user selected lighting scene.
      4) Selecting a lighting profile to be run by the system's upstream controller so as to implement a selected lighting profile across multiple zones.

B. Wired Networkable Graphic Wall Stations

1. Device shall have a full color touch screen.
2. Device shall enable configuration of all switches, dimmers, and lighting preset scenes via password protected setup screens.
3. Graphic wall stations shall support the following device options:
   a. Number of control zones: Minimum of 16.
   b. Number of scenes: Minimum of 16.
   c. Optional password protection for setup screens.

C. Wired Networkable Auxiliary Input/Output (I/O) Devices

1. Auxiliary Input/Output devices shall be specified as an input or output device with the following options:
   a. Contact closure input.
      1) Input shall be programmable to support maintained or momentary inputs that can activate local or global scenes and profiles, ramp light level up or down, or toggle lights on/off.
   b. 0-10V analog input.
      1) Input shall be programmable to function as a daylight sensor.
   c. RS-232/RS-295 digital input.
      1) Input supports activation of up to 4 local or global scenes and profiles, and on/off/dimming control of up to 16 local control zones.

d. 0-10V dimming control output, capable of sinking a minimum of 20mA or current.
   1) Output shall be programmable to support all standard sequence of operations supported by system.

D. Wired Networkable Occupancy and Photosensors

1. Sensors shall utilize passive infrared (PIR) or passive dual technology (PDT) to detect both major and minor motion as defined by NEMA WD-7 standard.
2. Sensing technologies that are acoustically passive, meaning they do not transmit sound waves of any frequency do not require additional commissioning. Ultrasonic or Microwave based sensing technologies may require commissioning due to the active nature of their technology if factory required.
3. Sensor programming parameter shall be available and configurable remotely from the software and locally via the device.
4. Sensor mounting type shall match project design requirements as shown on plans.
   a. Sensors shall have optional features for photosensor/daylight override, dimming control, and low temperature/high humidity operation.
2. The system shall support the following types of photocell-based control:
   a. On/Off: The control zone is automatically turned off if the photocell reading exceeds the defined setpoint. A time delay or adaptive setpoint adjustable behavior may be used to prevent the system from exhibiting nuisance on/off switching. Full off shall be achievable.
   b. Continuous Dimming: The control zone automatically adjusts its dimming output in response to photocell readings, such that a minimum light level consisting of both electric light and daylight sources is maintained at the task. The photocell response shall be configurable to adjust the photocell setpoint and dimming rates.

E. Wired Networkable Wall Switch Sensors

1. Wall switches sensors shall support the following device options:
   a. User Input Control Types Supported: On/Off or On/Off/Dimming
   b. Occupancy Sensing Technology: Dual Tech
   c. Daylight Sensing Option: Inhibit Photosensor.

F. Wired Networkable Embedded Sensors

1. Embedded sensors shall support the following device options:
   a. Occupancy Sensing Technology: Dual Tech.
   b. Daylight Sensing Option: Occupancy only, daylight only, or combination occupancy/daylight sensor.

G. Distributed System Power, Switching and Dimming Controls

1. Devices shall incorporate one optional Class 1 relay, optional 0-10 VDC dimming output, and contribute low voltage Class 2 power to the rest of the system.
2. Device programming parameters shall be available and configurable remotely from the software and locally via the device pushbutton.
3. Device shall be plenum rated.
4. Devices shall be UL listed for load and load type as specified on the plans.

H. Wired Networkable Relay Panel

1. Relay panel(s) shall be capable of providing the required amount of relay capacity, as required per drawing.

2. Standard relays used shall have the following required properties:
   a. Configurable in the field to operate with normally closed or normally open behavior.
   b. Provides visual status of current state and manual override control of each relay.
   c. Be individually programmable.
3. Panel shall provide a contact closure input that acts as a panel override to activate the normally configured state of all relays (i.e., normally open, or normally closed) in the panel.

PART 3 – EXECUTION

3.1 INSTALLATION REQUIREMENTS

A. Installation Procedures and Verification

1. The successful bidder shall review all required installation and pre-startup procedures with the manufacturer's representative through pre-construction meetings.
2. The successful bidder shall install and connect the networkable lighting control system components according to the manufacturer's installation instructions, wiring diagrams, the project submittals, and plans specifications.
3. The successful bidder shall be responsible for testing of all low voltage networkable cable included in the bid. Bidder is responsible for verification of the following minimum parameters:
   a. Wire Map (continuity, pin termination, shorts, and open connections, etc.).
   b. Length.
   c. Insertion Loss.

B. Documentation and Deliverables

1. The installing contractor shall be responsible for documenting installed location of all networkable devices. This includes responsibility to provide as-built plan drawing showing device addresses corresponding to locations of installed equipment.

3.2 SYSTEM STARTUP

A. Upon completion of installation by the installer, including completion of all required verification and documentation required by the manufacturer, the system shall be started up and programmed by an authorized representative of the manufacturer.

1. Low voltage networkable cable testing shall be performed prior to system startup at the discretion of the manufacturer.

B. System start-up programming shall include:

1. Verifying operational communication to all system devices.
2. Programming the networkable devices into functional control zones to meet the required sequence of operation.
3. Programming and verifying all sequence of operations.
4. Customization of owner's software interfaces and applications.
5. Commissioning secured by the contractor and performed by manufacturer's representative. Provide commissioning report for each space control functional testing.

C. Initial start-up and programming is to occur on-site. Additional programming may occur on-site or remotely over the internet, as necessary.

3.3 PROJECT TURNOVER

A. System Documentation

1. Submit software database file with desired device labels and notes completed.

B. Owner Training

1. Provisions for on-site training for owner and designated attendees to be included in submittal package.

END OF SECTION

SECTION 26 22 10
DRY TYPE TRANSFORMERS

PART 1 – GENERAL

1.1 SECTION INCLUDES:

A. Two winding transformers.

B. Two-winding transformers rated for nonlinear loads.

C. Shielded Transformers.

1.2 REFERENCES

A. NEMA ST 1 - Specialty Transformers.

B. NEMA ST 20 - Dry Type Transformers for General Applications.

C. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS FOR REVIEW

A. Section 01300 - Submittals: Procedures for submittals.

B. Product Data: Provide outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, tap configurations, insulation system type, and rated temperature rise.

C. Test Reports: Indicate loss data, efficiency at 25, 50, 75 and 100 percent rated load, and sound level.

D. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

1.4 DELIVERY, STORAGE, AND HANDLING

A. Division 1 - Material and Equipment: Transport, handle, store, and protect products.

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 in accordance with manufacturer's written instructions. Lift only with lugs provided for that purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

PART 2 – PRODUCTS

2.1 TWO-WINDING TRANSFORMERS

A. Manufacturers:

1. Square D.

2. Eaton.
3. General Electric.
4. Siemens.

B. Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers, shown on the drawings.

C. Primary Voltage: 480 volts, 3 phase.

D. Secondary Voltage: 208/120 volts, 3 phase.

E. Insulation system and average winding temperature rise for rated kVA as follows:

1. 1-15 kVA: Class 185 with 115 degrees C rise.
2. 16-500 kVA: Class 150 with 80 degrees C rise.

F. Case temperature: Do not exceed 35 degrees C rise above ambient at warmest point at full load.

G. Winding Taps:

1. Transformers less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
2. Transformers 15 kVA and Larger: NEMA ST 20.

H. Sound Levels: Maximum sound levels are as follows:

1. 1-5 kVA: 40 dB.
2. 6-25 kVA: 45 dB.
3. 26-150 kVA: 50 dB.
4. 151-225 kVA: 55 dB.
5. 226-300 kVA: 55 dB.
6. 301-500 kVA: 60 dB.

I. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

J. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

K. Mounting:

1. 1-15 kVA: Suitable for wall mounting.
2. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
3. Larger than 75 kVA: Suitable for floor or trapeze mounting.

L. Coil Conductor: Continuous windings with terminations brazed or welded.

M. Enclosure: NEMA ST 20, Type 1 or Type 3R, ventilated or non-ventilated.

N. Isolate core and coil from enclosure using vibration-absorbing mounts.

O. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.2 TWO-WINDING TRANSFORMERS RATED FOR NONLINEAR LOADS

A. Manufacturers:

1. Square D.
2. Eaton.
3. General Electric.
4. Siemens.

B. Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers, ratings as shown on the drawings, designed to supply a 100 percent nonlinear load as noted on the drawings, and have a rating of K-13.

C. Primary Voltage: 480 volts, 3 phase.

D. Secondary Voltage: 208Y/120 volts, 3 phase.

E. Core Flux Density: Below saturation at 10 percent primary overvoltage.

F. Insulation and temperature rise: Class 220 insulation system with 80 degrees C average winding temperature rise.

G. Case temperature: Do not exceed 35 degrees C rise above ambient at its warmest point at full load.

H. Winding Taps:

1. Transformers less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
2. Transformers 15 kVA and Larger: NEMA ST 20.

I. Sound Levels: NEMA ST 20. Maximum sound levels are as follows:

1. 1-5 kVA: 40 dB.
2. 6-25 kVA: 45 dB.
3. 26-150 kVA: 50 dB.
4. 151-225 kVA: 55 dB.
5. 226-300 kVA: 55 dB.
6. 301-500 kVA: 60 dB.

J. Basic Impulse Level: 10 kV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

K. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

L. Mounting:

1. 1-15 kVA: Suitable for wall mounting.
2. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
3. Larger than 75 kVA: Suitable for floor or trapeze mounting.

M. Coil Conductor: Continuous windings with terminations brazed or welded. Individually insulate secondary conductors and arrange to minimize hysteresis and eddy current losses at harmonic frequencies. Size secondary neutral conductor at twice the secondary phase conductor ampacity.

N. Electrostatic Shield: Copper, between primary and secondary windings.

O. Enclosure: NEMA ST 20, Type 1 or Type 3R, ventilated or non-ventilated. Provide lifting eyes or brackets.

P. Isolate core and coil from enclosure using vibration-absorbing mounts.

Q. Nameplate: Include transformer connection data and overload capacity based on rated allowable temperature rise.

2.3 SHIELDED TRANSFORMERS

A. Manufacturers:

1. Square D.
2. Eaton.
3. General Electric.
4. Substitutions: Under provisions of Section 01600.

B. Description: NEMA ST 20, factory-assembled, air-cooled, dry type transformers, ratings as shown on the drawings.

C. Primary Voltage: 480 volts, 3 phase.

D. Secondary Voltage: 208Y/120 volts, 3 phase.

E. Insulation system and average winding temperature rise for rated kVA as follows:

1. 10-15 kVA: Class 185 with 115 degrees C rise.
2. 16-500 kVA: Class 220 with 150 degrees C rise.

F. Case temperature: Do not exceed 50 degrees C rise above ambient at warmest point at full load.

G. Winding Taps:

1. Transformers less than 15 kVA: Two 5 percent below rated voltage, full capacity taps on primary winding.
2. Transformers 15 kVA and Larger: NEMA ST 20.

H. Sound Levels: NEMA ST 20. Maximum sound levels are as follows:

1. 1-5 kVA: 40 dB.
2. 6-25 kVA: 45 dB.
3. 26-150 kVA: 50 dB.
4. 151-225 kVA: 55 dB.
5. 226-300 kVA: 55 dB.
6. 301-500 kVA: 60 dB.

I. Basic Impulse Level: 10 KV for transformers less than 300 kVA, 30 kV for transformers 300 kVA and larger.

J. Ground core and coil assembly to enclosure with visible flexible cooper grounding strap.

K. Winding Shield: Electrostatic, with separate insulated grounding connection.

L. Mounting:

1. 1-15 kVA: Suitable for wall mounting.
2. 16-75 kVA: Suitable for wall, floor, or trapeze mounting.
3. Larger than 75 kVA: Suitable for floor or trapeze mounting.

M. Coil Conductors: Continuous windings with terminations brazed or welded.

N. Enclosure: NEMA ST 20, Type 1 or Type 3R ventilated or non-ventilated. Provide lifting eyes or brackets.

O. Isolate core and coil from enclosure using vibration-absorbing mounts.

P. Nameplate: Include transformer connection data.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Set floor mounted transformers plumb and level on 4" high concrete housekeeping pad.

B. Use liquidtight flexible conduit, under the provisions of Section 26 05 33, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.

C. Mount wall-mounted transformers plumb and level using integral flanges or accessory brackets furnished by the manufacturer. Where bracket mounting is required, the Contractor shall provide a shop drawing of the proposed method indicating material, methods, dimensions, and weights.

D. Mount floor-mounted transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure. Pads shall be installed between the Afeet@ of the transformer enclosure, and the housekeeping pad.

E. Provide grounding and bonding in accordance with Section 26 05 26.

3.2 FIELD QUALITY CONTROL

A. Check for damage and tight connections prior to energizing transformer.

B. Measure primary and secondary voltages and make appropriate tap adjustments.

C. Provide disconnect means, for the primary, adjacent to power transformer.

D. Provide power transformers with a grounding bar attached to the enclosure for all grounding conductors.

END OF SECTION

SECTION 26 24 13
SWITCHBOARDS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract including, but not limited to, General, Special, and Supplementary Conditions and other Division-1 Specification Sections, apply to the work of this Section.

1.2 SCOPE

A. Provide:

1. Factory-assembled, metal-enclosed switchboards for distribution and control of power from incoming line terminals to outgoing feeder terminals, installed, and tested in place.
2. 4" high concrete base for each switchboard.

1.3 STANDARDS AND CODES

A. NEMA PB2-78 (R1981), Dead Front Switchboards

B. ANSI C37.20 - Switchgear Assemblies and Metal Enclosed Bus

C. NEMA ICS-6 - Enclosures for Industrial Controls and Systems

D. NFPA 70 - National Electrical Code (NEC).

E. Underwriters' Laboratories - UL 891 - Dead-Front Electrical Switchboards.

1.4 SUBMITTALS

A. Product Data: On all system components.

B. Certified outline and general arrangement drawings, including estimated weights, dimensional layout, and nameplate schedule.

C. Elementary 3-line diagrams of switchboard, including all potential and current transformer secondary circuits and meters.

D. Instruction Manuals, including:

1. Manufacturer's instructions for tightening bus connections and for cleaning and maintaining switchboard.
2. Nameplate information and shop order numbers.
3. List of recommended spare parts.
4. Time-current curves of main devices.

PART 2 - PRODUCTS

2.1 GENERAL REQUIREMENTS

A. Type: Self-Supporting, dead front, totally enclosed switchboard.

B. Buses:

1. Copper, tin plated, phase and neutral.
2. Copper ground bus required for full length of switchboard.
3. Buses shall be insulated from each other with insulating barriers.
4. Bus arrangement: A-B-C from left to right, top to bottom, front to back.
5. Provide for future extension of bus.

C. Ratings: 480/277 volts, 60 Hz, 3-phase, 4-wire.

1. Main bus rating as indicated in the drawings and 100% rated neutral horizontal buses with fully rated short circuit rating of 65,000 symmetrical amperes minimum.

D. Ambient temperature: Not more than 40-degree C.

E. UL labeled as "suitable for use as service entrance equipment."

F. Color of Finish: Manufacturer's standard light gray; provide 3 one-pint cans of touch-up paint.

G. Construction: NEMA 1, with gaskets. Switchboards shall be aligned front and rear.

H. Physical size of switchboard shall conform to available space limitations of room, maintaining required code clearances. No device or component shall require rear or side access.

I. Manufacturer's standard eyes, yokes and skids for installation and transporting switchboards.

2.2 MAIN SECTION

A. Buses: 3-phase, neutral and ground.

B. Wire compartment in accordance with U.L. requirements.

C. Line and load terminations for the size, number of conductors and conductor material.

D. Lightning Arrester: Distribution Class, U.L. listed for installation within the switchboard.

E. Main Device:

1. Main protective device(s) shall be fixed mount, insulated case, power circuit breaker, rated as indicated on the drawings.
2. Provide breaker with adjustable solid-state trip unit that provides for the following time/current curve shaping adjustments:
   a. Instantaneous setting
   b. Short time pick-up
   c. Short time delay
   d. Long time pick-up
   e. Long time delay
   f. Ground fault trip
   g. Ground fault delay.

2.3 DISTRIBUTION SECTION

A. Buses: 3 phases and 100% neutral.

B. Wiring compartment in accordance with U.L. requirements.

C. Feeder Circuit Breakers:

1. Group-mounted, molded-case, thermal magnetic trip, circuit breakers. All breakers shall be U.L. listed for application in their intended enclosure for 100% of their continuous ampere rating (fully rated).
2. Provide AIC rating as required to meet the indicated RMS Sym. integrated short-circuit rating of the switchboard.
3. Circuit breakers shall have overcenter toggle type mechanisms, providing quick-make quick-break action. Breakers shall have current and interrupting rating as indicated on the plans. Each circuit breaker shall have trip indication by handle position and shall be trip-free. Three pole breakers shall be common trip. Each breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole.
4. When changing bus levels and on feeders greater than 30% of main ampacity, circuit breakers shall have instantaneous adjustable and short time tracking to achieve selectivity.

2.4 INSTRUMENTS

A. Switchboard meter shall be Square-D Power Logic Series 820, solid-state digital metering package. Unit shall be provided factory-installed in the main section and be pre-wired, complete with all potential and current transformers as required. Device shall provide the follow data:

1. Voltage, P-P, P-N
2. Current (amps)
3. KVA
4. Power Factor
5. Frequency (Hz)
6. Demand Watts
7. KWH's
8. THD Current (%)
9. THD Voltage (%)
10. K-Factor.

B. Local operator interface shall be via membrane touch pads with alphanumeric L.E.D. display. Unit shall be accurate to +1%, with true RMS metering, accurate to 31st harmonic. Meter package shall have downloadable firmware and remote communications capability based on RS-485 Communications Standard, or equal.

2.5 NAMEPLATES

A. Material: Plastic laminate or phenolic, black with white core.

B. Lettering: Engraved, approximately 3/16" high.

C. Provide for each section all instrument switches, and secondary switches/circuit breakers. To be attached using two sheet metal screws per nameplate.

2.6 ACCEPTABLE MANUFACTURERS

A. Square D Company (Basis of design).

B. General Electric Company.

C. Eaton.

D. Siemens.

PART 3 – EXECUTION

3.1 INSTALLATION

A. PROVIDE adequate and safe storage space for the switchboard when received from the factory. Follow all handling and storage instructions provided by the manufacturer. Store in a clean, dry place while awaiting installation.

B. REFER to the installation drawings furnished by the manufacturer to coordinate alignment and connection of service bus ducts and locations of conduit entry. Conduits shown on the floor slab and turning up under the bottom of the switchboard are not to be installed until final approved shop drawings are received, in order to coordinate conduit locations with openings in the bottom of the switchboard. This also applies to grounding cable turning up into the bottom of the switchboard.

C. STEEL CONDUITS entering the top or bottom of the switchboard shall each be provided with a steel grounding bushing, which shall be connected to the switchboard ground bus with a stranded copper conductor sized in accordance with Table 250-95 of the NEC. All connections of bond wires to the switchboard ground bus shall be made with bolted compression lugs.

D. THE METAL FRAME OF THE SWITCHBOARD shall be connected to the switchboard ground bus (in at least 2 places) with stranded copper conductors of minimum 3/0 size.

E. THE SWITCHBOARD shall be installed on a 4-inch-high concrete pad.

F. COORDINATE WITH MANUFACTURER'S REPRESENTATIVES to insure that each device in the switchboard has all the characteristics specified.

G. AFTER THE SWITCHBOARD is completely installed, but before energizing, the floor under the switchboard (and the floor throughout the entire main electric room) shall be thoroughly cleaned and all dust, dirt and debris shall be removed. Also, the outside of the switchboard (including the top) shall be thoroughly cleaned. Any factory paint that is damaged before, during or after installation shall be repainted or touched up with same type and color paint.

3.2 TESTING

A. Assemble and thoroughly test in plant of manufacturer by energizing equipment and observing proper operation.

B. Thoroughly test after installation by observing proper operation of equipment.

C. Include the services of a trained factory representative to properly coordinate and adjust all settings on devices in the switchboard to ensure proper operation.

D. Correct deficiencies observed at no additional cost to Owner until equipment operates properly.

END OF SECTION

SECTION 26 24 16
CIRCUIT BREAKER PANELBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Panelboards herein specified and shown on the drawings.

1.2 SUBMITTALS

A. In accord with Division One.

1. Shop Drawings: Panelboards and Dimensional Data
2. Product Data: Circuit breakers.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Panelboards rated 208Y/120 volt shall have aluminum bus structure braced for 65,000 RMS amp's fault current minimum, or as indicated on the drawings, whichever is greater. All copper parts shall be plated to prevent corrosion.

1. All panelboards shall be Dead-Front Safety Type, equipped with thermal-magnetic molded case breakers, and solid neutral bus.
2. Bus bar connections to the branch circuit breakers shall be the "Distributed Phase" or "Phase Sequence" type. Bussing shall be such that adjacent single pole breakers will be on different phases or polarities, and that two or three pole breakers can be installed at any location.
3. Panelboard numbering shall be such that starting at the top, odd numbers shall be used in sequence down the left-hand side and even numbers shall be used in sequence down the right-hand side.

B. Cabinets shall be fabricated of code gauge galvanized steel with gutters per National Electrical Code. Fronts shall have doors with matching one piece trim, be code gauge and be finished with rust inhibiting primer and baked enamel. Fronts shall have adjustable indicating trim clamps completely concealed when door is closed. Provide a circuit directory frame and card with a clear plastic covering on the inside of the doors. Fronts shall have flush locks and be furnished with two keys per lock.

C. Provide circuit breakers, quick-make, quick-break, thermal-magnetic, trip indicating, and common trip on all multi-pole breakers. Branch circuit breakers feeding convenience outlets shall have sensitive instantaneous trip settings of not more than 10 times the trip rating of the breaker. Circuit breakers shall have bolt-on connections to the bus. Ratings are shown on the panelboard schedule. Series rated breakers are acceptable.

D. Main circuit breaker: Circuit breaker ampere rating as shown on drawings, voltage as required, 3-pole, single-throw, front connected. Molded case, thermal-magnetic, common trip, quick-make, quick-break, adjustable magnetic trip elements, with RMS interrupting rating as required to meet the panel's integrated rating. Provide where indicated on drawings.

E. Provide ground fault circuit interrupter circuit breakers rated to trip at 30 milliamperes for circuits as shown on drawings.

F. Panelboards shall be furnished with ground bus and separate insulated neutral bus.

G. Circuit Breaker Panelboards:

1. Acceptable Products:
   a. Square D (Basis of Design)
   b. G.E.
   c. Eaton
   d. Siemens.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate as shown on drawings. Maximum distance from floor to highest breaker: 6 feet - 6 inches.

B. Provide mounting materials required; make connections specified or shown. Use collars around mounting bolts, or equivalent means to provide 1/4" minimum air space between panel and wall for surface mounted panel.

C. Provide nameplate for each panel in accord 26 05 53.

D. Provide typed circuit directory for each panel indicating load served. Leave spare circuit breakers and circuit breaker space blank on directory.

E. Where double panels are indicated, provide single common trim, or allow for two individual covers when mounting cabinets.

END OF SECTION

SECTION 26 24 17
DISTRIBUTION PANELBOARDS

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Base Bid:

1. Electrical Contractor provide:
   a. Circuit breaker type distribution panelboards as called for on the drawings and as described below.

1.2 RELATED WORK

A. Specified Elsewhere

1. Drawings and general provisions of Contract, including, but not limited to, General, Special and Supplementary Conditions and other Division-1 Specification Sections, apply to the work of this Section.
2. Division 23 - applicable sections
3. Division 26 - applicable sections.

1.3 SUBMITTALS

A. In accord with Division 1:

1. Shop Drawings: Panelboards.
2. Product Data: Circuit breakers.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Panelboards shall be dead front safety type equipped with thermal magnetic molded case circuit breakers of trip ratings as shown on the drawings. Provide equipment which is “fully rated” or “series rated” meeting the available short circuit at the point of application 65kAIC or per plans (whichever is greater).

B. Circuit breakers shall be rated as indicated on the drawings.

C. Panelboards bus structure shall be copper and have an assembly rating in excess of the available short circuit current rms symmetrical amps. All copper parts shall be plated to prevent corrosion.

D. Circuit breakers shall be equipped with individually insulated braced and protected connectors. The front faces of all circuit breakers shall be flush with each other.

E. Large, permanent, individual circuit numbers shall be affixed to each breaker in a uniform position (or equip each breaker with a circuit card holder and neatly printed card identifying the circuit). Leave “spare” circuits blank. Tripped indication shall be clearly shown by the breaker handle taking a position between ON and OFF. Provisions for additional breakers shall be such that no additional connectors will be required to add breakers.

F. Main Circuit Breaker: Circuit breaker, ampere rating as shown on drawings, 208-volt or single-throw, front connected. Molded case, thermal-magnetic, common trip, quick-make, quick-break, adjustable magnetic trip elements, section on each pole, RMS interrupting rating, ampere minimum as specified.

G. Panelboard assembly shall be enclosed in a steel cabinet. Where panelboards are located outdoors, they shall be housed in NEMA 4X or NEMA 3R stainless steel enclosures. Enclosure shall be painted manufacturer's standard enamel finish, suitable for exterior exposure. The size of wiring gutters shall be in accordance with UL Standard 67. Fronts shall have door with matching one piece trim, be of code gauge full finished steel with rust inhibiting primer and baked enamel finish. Cabinets to be equipped with spring latch and tumbler-lock on door of trim. Doors over 48" long shall be equipped with three-point latch and vault lock. All locks shall be keyed alike.

H. Panelboards shall be furnished with a ground bus and separate insulated neutral bus.

I. Where indicated, panelboards shall be provided with future breaker mounting space, (vertical space as shown on plans). All future space shall be provided with bus provisions.

J. Acceptable Products:

1. Square D - I-Line
2. Siemens
3. G.E.
4. Eaton.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Locate as shown on drawings. Maximum distance from floor to highest breaker: 6'-6".

B. Provide mounting materials required; make connections specified or as shown. Use collars around mounting bolts, or equivalent means to provide 1/4" minimum air space between panel and wall for surface mounted panel.

C. Provide nameplate for each panel in accord with Section 26 05 53.

D. Provide typed circuit directory for each panel indicating load served. Leave spare circuit breakers and circuit breaker spaces blank in the directory. Indicate rooms, area, type of load.

END OF SECTION

SECTION 26 27 16
CABINETS AND ENCLOSURES

PART 1 – GENERAL

1.1 SECTION INCLUDES:

A. Hinged cover enclosures

B. Cabinets

C. Terminal blocks and accessories.

1.2 REFERENCES

A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum)

B. ANSI/NEMA ICS 1 - Industrial Control and Systems

C. ANSI/NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems

D. ANSI/NEMA ICS 6 - Enclosures for Industrial Control Equipment andSystems.

1.3 SUBMITTALS

A. Submit product data under provisions of Division one.

B. Shop Drawings for Equipment Panels: Include wiring schematic diagram, wiring diagram, outline drawing and construction diagram as described in ANSI/NEMA ICS 1.

PART – PRODUCTS

2.1 HINGED COVER ENCLOSURES

A. Construction: NEMA 250; steel; type as required to meet conditions of installation unless indicated on the Drawings. Where installed outdoors, enclosure shall be NEMA-3R stainless steel.

B. Finish: Manufacturer's standard enamel finish.

C. Covers: Continuous hinge, held closed by flush latch operable by key.

D. Panel for Mounting Terminal Blocks or Electrical Components: 14 gage steel, enamel finish.

2.2 CABINETS

A. Cabinet Boxes: Galvanized steel with removable end walls. Provide 3/4-inch-thick UL Listed Fireproof plywood backboard (exterior fir, type A/C, 7 ply) painted gray on all sides, for mounting terminal blocks.

B. Cabinet Fronts: Screw cover front, concealed hinge and flush lock keyed to match branch circuit panelboard; finish in baked enamel.

2.3 TERMINAL BLOCKS AND ACCESSORIES

A. Terminal Blocks: ANSI/NEMA ICS 4; UL listed.

B. Power Terminals: Unit construction type, closed-back type, with tubular pressure screw connectors, rated 600 volts.

C. Signal and Control Terminals: Modular construction type, channel mounted; tubular pressure screw connectors, rated 300 volts.

2.4 FABRICATION

A. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with ANSI/NEMA ICS 6.

B. Provide knockouts on enclosures.

C. Provide protective pocket inside front cover with schematic diagram, connection diagram, and layout drawing of control wiring and components within enclosure.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install cabinets and enclosures plumb, anchor securely to wall and structural supports at each corner, minimum.

B. Provide accessory feet for free-standing equipment enclosures.

C. Install trim plumb.

END OF SECTION

SECTION 26 27 26
WIRING DEVICES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Wall switches.

B. Receptacles.

C. Device plates and decorative box covers.

1.2 REFERENCES

A. NEMA WD 1 - General Purpose Wiring Devices.

B. NEMA WD 6 - Wiring Device Configurations.

1.3 SUBMITTALS

A. Submit under provisions of Division One.

B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.

C. Manufacturer's Instructions:

1. Indicate application conditions and limitations of use stipulated by product testing agency specified under regulatory requirements.
2. Include instructions for storage, handling, protection, examination, preparation, operation, and installation of product.

1.4 QUALIFICATIONS

A. Maa minimum offer: Company specializing in manufacturing products specified in this Section with minimum three (3) years experience.

PART 2 – PRODUCTS

2.1 WALL SWITCHES - Specification Grade - 20A, 125v/277v, grounding type. Switches on the critical branch and life safety branch shall be red.

A. Single Pole Switch:

1. Legrand
2. Leviton
3. Arrow-Hart.

B. Three-way Switch:

1. Legrand
2. Leviton
3. Arrow-Hart.

C. Four-way Switch:

1. Legrand
2. Leviton
3. Arrow-Hart.

2.2 RECEPTACLES - Specification Grade - 20A, 125V, 3W, Tamper-resistant Grounding type.

A. Single Convenience Receptacle:

1. Legrand
2. Leviton.
3. Arrow-Hart.

B. Duplex Convenience Receptacle:

1. Legrand
2. Leviton
3. Arrow-Hart.

C. GFCI Receptacle:

1. Legrand
2. Leviton
3. Arrow-Hart.

D. Surge Protected Receptacle:

1. Legrand
2. Leviton.

2.3 WALL PLATES

A. Decorative Cover Plate: Stainless steel type 302/304 satin finished, non-magnetic.

B. Weatherproof Cover Plate: Gasketed stainless steel with lockable hinged gasketed device cover, equal to Sierra Model WP-26L.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify existing conditions.

B. Verify outlet boxes are installed at proper height.

C. Verify wall openings are neatly cut and will be completely covered by wall plates.

D. Verify branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

3.2 PREPARATION

A. Provide extension rings to bring outlet boxes flush with finished surface.

B. Clean debris from outlet boxes.

3.3 INSTALLATION

A. Install products in accordance with manufacturer's instructions.

B. Install devices plumb and level.

C. Install switches with OFF position down.

D. Install receptacles with grounding pole on bottom, or to the left when mounted horizontally.

E. Connect wiring device grounding terminal to branch circuit equipment grounding conductor.

F. Install decorative plates on switch, receptacle, and blank outlets in finished areas.

G. Connect wiring devices by wrapping conductor around screw terminal. Do not “back-wire” any devices.

H. Install galvanized steel plates on outlet boxes and junction boxes in unfinished areas, above accessible ceilings, and on surface mounted outlets.

I. Any exterior receptacles or within six feet of a sink shall be a GFCI type.

J. Devices on 'emergency' circuits shall be red in color. Devices on normal power circuits shall be the color as specified by the Architect.

K. When GFCI is specified, use only GFCI receptacles. Do not protect "down stream" receptacles with GFCI receptacles.

L. Do not use push-in connections on any device.

M. All devices, receptacles, and switches shall have a separate grounding terminal.

N. Identify each outlet and switch in accordance with Section 26 05 53.

3.4 MOUNTING HEIGHTS

A. Coordinate locations of outlet boxes provided under Section 26 05 34 to obtain mounting heights specified herein or indicated on Drawings.

B. Install wall switch 42-inches, to center, above finished floor, or as dimensioned on the drawings.

C. Install convenience receptacle 18-inches, to center, above finished floor.

D. Install convenience receptacle 6-inches to center, above backsplash of counter.

E. Install telecommunications outlet 18-inches, to center, above finished floor, or as dimensioned on the drawings.

3.5 FIELD QUALITY CONTROL

A. Inspect each wiring device for defects.

B. Operate each wall switch with circuit energized and verify proper operation.

C. Verify that each receptacle device is energized.

D. Test each receptacle device for proper polarity.

E. Test each GFCI receptacle device for proper operation.

3.6 ADJUSTING

A. Adjust devices and wall plates to be flush, plumb, and level.

END OF SECTION

SECTION 26 28 00
SURGE PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including, but not limited to, General, Special and Supplementary Conditions and other Division-1 Specification Sections, apply to the work of this Section.

1.2 SCOPE

A. The work required under this section consists of providing all necessary tools, equipment, material, labor, and auxiliaries required to furnish and install complete surge protective devices (SPD) for the protection of all building electrical and electronics systems from the effects of lightning induced currents, substation switching transients and internally generated transients resulting from induction or capacitive load switching.

1.3 QUALITY ASSURANCE

A. Surge protective device shall conform to these specifications and drawings.

B. All surge protective devices shall be manufactured by a company engaged in the design, development, and manufacture of such devices for more than twenty-five years. The said firm shall offer a ten (10) year warranty.

C. The surge suppressor manufacturer shall offer technical assistance through support by a factory representative and local stocking distributor or local direct factory distribution warehouse.

D. Suppressors shall be listed in accordance to UL 1449 4th Edition, 2016, Standard for Safety, Surge Protective Devices. Protective modes shall be as follows: Wye = L-N, L-G, N-G; Delta = L-G, L-L.

E. Suppressors shall be tested with Category C3 high exposure waveform (20KV, 10 KA, 8/20~~0~~ µs waveform) per ANSI/IEEE C62.41-2002.

F. Surge suppression devices shall be installed and located in accordance with requirements of all National Fire Protection Association, (NFPA) codes.

1.4 SUBMITTALS

Surge suppression submittals shall include:

A. Three (3) copies of complete maintenance and installation manuals and a list of replacement parts.

B. Dimensional drawing of each suppressor type indicating mounting arrangements.

C. Schematic data on each suppressor type indicating component types.

D. UL 1449 stipulation for fused SPD – The manufacturer's authorized representative is required to submit the following:

1. Certify that the SPD system is UL 1449 listed (UL Card) with UL Card.

2. Indicate the type of internal or external fusing that is incorporated in the SPD system and what impact the fusing has on the performance of the device with respect to surge capacity and clamping levels.

E. Manufacturer's performance data on each suppressor type including Category C3 (20KV, 10KA) test results and UL 1449 4th Edition clamp voltage documentation which includes an oscillogram of the tested device.

1.5 WARRANTY

A. All surge suppression devices shall be warranted to be free from defects from materials and workmanship under normal use for a period of ten (10) years. This warranty will include unlimited replacement of SPD modules during the warranty period.

B. Any suppressor with shown evidence of failure or incorrect operation during the warranty period shall be required or replaced by the manufacturer at no cost to the Owner.

1.6 CODES AND STANDARDS

The following standards and publications are referenced in various parts of this specification and shall apply.

A. UL 1449-4th Edition – Surge Protective Devices. Include Electromagnetic Interference filter which provides noise attenuation.

B. ANSI/IEEE C62.41- 2002 (IEEE 587) - Guide for Surge Voltages in Low Voltage AC Power Circuits.

C. ANSI/IEEE C62.1- 2002 - Standard for Testing Heavy Duty Service Entrance Surge Arrester.

D. ANSI/IEEE C62.45- 2002 - IEEE Guide for Surge Testing for Equipment Connected to Low-Voltage AC Power Circuits.

E. EIA/TIA, BICSI Standards

F. The fusing element must be capable of allowing the suppressor's rated single impulse current to pass through the suppressor at least one time without failure. The system shall be tested to 1,000 sequential per C62.45-2002 section B.38 referencing C62.41.1 and C62.41.2 category C3 combination wave transients. The category C3 combination wave is defined as a 1.2 x 50µs wave at 20,000-volt open circuit voltage waveform and 8 x 20µs wave at 10,000 ampere short circuit current waveform. In addition, the system components shall be tested repetitively 1,000 times testing based on an IEEE C62.33 (MOV test) and C62.35 (SAD test) without failure or degradation exceeding +/-10%.

G. All manufacturers must comply with above listed standards and any additions current revisions of industry standards. All products that do not comply with current industry standards will not be accepted.

1.7 REQUIRED SUPPRESSOR LOCATIONS

A. At locations as indicated on the drawings.

PART 2 - PRODUCTS

2.1 TYPE "I"

A. For 3-phase, 4-wire configurations, suppressors shall provide suppression elements, between each phase conductor and system ground, between each phase conductor and system the system neutral, and between the neutral conductor and ground.

B. Visible indication of proper suppressor connection and operation shall be provided. Suppressor shall also monitor incoming power, internal module status and indicate if suppressor has disable button enabled.

C. Suppressor shall have dry contacts, surge counter, audible alarm with disabled button, individual indicator LEDs for each replaceable module.

D. Suppressors shall be designed for close nipple installation. The mounting position of the suppressor shall permit a straight and short lead length connection between the suppressor and the point of connecting to the panel board. Other suppressor connections will not be acceptable.

E. Suppressor's lead length must be less than five (5) feet and utilize a 3 pole 60 amps breaker.

F. Suppressors shall meet or exceed the following criteria:

1. Maximum single impulse current rating: 100,000 amperes per phase (8/20 usec. waveform).

NOTE: Unit shall not utilize internal fuses in their design; any suppressor with internal fuses shall not be accepted.

2. Pulse life rating: Cat. C (8/20 usec. waveform): 3,500 occurrences with no clamping drift.
3. UL 1449 4th Edition Voltage Protection Rating (VPR) is assigned to each mode of protection using a combination wave generator at a setting of 6kV, 3kA. SPD shall have a nominal discharge test rating (In) of 10kA or 20kA.
4. Suppressors shall have turn-on and turn-off times of less than one nanosecond.
5. Suppressors shall be of the solid-state componentry and shall operate bi-directionally.
6. The SPD shall be constructed using surge current modules (MOV based). The status of each module shall be monitored on the front of the SPD enclosure as well as on the module.
7. Terminals shall be provided for all of the necessary power and ground connections. Each terminal shall accommodate wire sizes of #14 to 1/O AWG.
8. The SPD shall be equipped with an audible alarm which shall actuate when any one of the surge current modules has failed. An alarm on/off switch shall be provided to silence the alarm. Both switches and audible alarm shall be located on the front cover of the SPD enclosure.

2.2 TYPE "II"

A. For 3-phase, 4-wire configurations, suppressors shall provide suppression elements between each phase conductor and the system neutral, between each phase conductor and the system ground, and between the neutral conductor and ground, for a total of seven suppression modes.

B. Visible indication of proper suppressor connection and operation shall be provided. Suppressor shall also monitor incoming power and indicate if suppressor has disable button enabled.

C. Suppressor shall have dry contacts, surge counter, audible alarm with disable button.

D. Suppressors shall be designed for close nipple installation. The mounting position of the suppressor shall permit a straight and short lead length connection between the suppressor and the point of connection to the panel board. Other suppressor connections will not be acceptable.

E. Suppressor's lead length must be less than one and a half (1.5) feet and utilize a 3 pole 30 amps breaker.

F. Suppressors shall meet or exceed the following criteria:

1. Maximum single impulse current rating: 100,000 amperes per phase (8/20 usec. waveform).

NOTE: Unit shall not utilize internal fuses in their design; any suppressor with internal fuses shall not be accepted.

2. Pulse life rating: Category C (8/20 usec. waveform): 3,500 occurrences, with no clamping drift.
3. UL 1449 4th Edition Voltage Protection Rating (VPR) is assigned to each mode of protection using a combination wave generator at a setting of 6kV, 3kA. SPD shall have a nominal discharge test rating (In) of 10kA or 20kA.

G. Suppressors shall have turn-on and turn-off times of less than one nanosecond.

H. Suppressors shall be of the solid-state componentry and shall operate bi-directionally.

2.3 TYPE "III"

A. For 3-phase, 4-wire configurations, suppressors shall provide suppression elements between each phase conductor and the system neutral, between each phase conductor and the system ground, and between the neutral conductor and ground, for a total of seven suppression modes.

B. Visible indication of proper suppressor connection and operation shall be provided. Suppressors shall also monitor internal status.

C. Suppressor shall have dry contacts, and audible alarm with disable button.

D. Suppressors shall be designed for close nipple installation. The mounting position of the suppressor shall permit a straight and short lead length connection between the suppressor and the point of connection to the panel board. Other suppressor connections will not be acceptable.

E. Suppressor's lead length must be less than one and a half (1.5) feet and utilize a 3 pole 30 amps breaker.

F. Suppressors shall meet or exceed the following criteria:

1. Maximum single impulse current rating: 50,000 amperes per phase (8/20 usec. waveform).

NOTE: Unit shall not utilize internal fuses in their design; any suppressor with internal fuses shall not be accepted.

2. Pulse life rating: Category C (8/20 usec. waveform): 2,000 occurrences, with no clamping drift.
3. UL 1449 4th Edition Voltage Protection Rating (VPR) is assigned to each mode of protection using a combination wave generator at a setting of 6kV, 3kA. SPD shall have a nominal discharge test rating (In) of 10kA or 20kA.

G. Suppressors shall have turn-on and turn-off times of less than one nanosecond.

H. Suppressors shall be of the solid-state componentry and shall operate bi-directionally.

2.4 ACCEPTABLE MANUFACTURERS PROVIDING SPECIFICATIONS ARE MET

A. Manufacturers

1. APT
2. L.E.A. International
3. Surgelogic – Schneider Electric
4. Atlantic Scientific
5. PQ Protection.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install the proper "level" of suppressor at each switchboard/panelboard as indicated on the power one-line diagram.

B. Suppressor shall be installed on the equipment to be protected, per the manufacturer's installation instructions.

C. Conductors between suppressor and point of attachment to the panelboard shall be kept as short and straight as possible.

D. Suppressor's ground shall be bonded to the service entrance ground or point of ground for the respective panelboard. Must have grounding of 25 Ohms (NEC 250.56) or less.

E. Include the costs for the manufacturer's certified representative to inspect and approve the installation upon completion of the project.

END OF SECTION

SECTION 26 28 13
FUSES (600 VOLTS & BELOW)

PART 1 - GENERAL

1.1 Furnish and install fuses of the types and sizes as indicated on the drawings and/or as specified herein. All fuses furnished and installed under this specification shall be as specified; shall be new, unused fuses; shall be delivered to the job site in manufacturer's original boxes or cartons whether furnished by the Contractor or by the manufacturer of equipment. All fuses shall have a minimum interrupting rating of 200,000 amperes. Should utilization, conversion, or distribution equipment provided under any division of these specifications require fuse classes offering a higher degree of protection or different ampere ratings than fuses specified, such fuse classes and ampere ratings may be used.

1.2 Mounting bolts or nuts shall be evenly torqued to ASTM recommendations for type and diameter of mounting bolts or studs provided. The inside of each fuse enclosure shall contain a durable, readily visible label which shall clearly indicate the correct type and size of replacement fuse. Label shall not cover or interfere with equipment manufacturer's instructions.

1.3 Fuses shall be made by one of the following manufacturers:

A. Reliance Fuses

B. Gould Shawmut

C. Littlefuse

D. Bussmann

E. Substitutions: Should the Contractor propose to provide fuses other than those specified, at least six weeks prior to the installation of the fuses, he shall furnish the Engineer complete technical data sufficient for the Engineer to determine whether system function will be adversely affected, whether proposed fuses meet this specification and whether they are equal in quality. Proposal for substitution shall state the dollar cost savings to the Owner and reason for proposed substitution.

1.4 To assure selective coordination of protective devices, all fuses shall be of the same manufacturer.

PART 2 - PRODUCTS

2.1 Fuses for service, switchboard mains, feeders and branch circuits.

A. 0 to 600 amperes. Except as specified fuses 0 to 600 amperes shall be UL listed RK1 dual-element, time-delay fuses with ampere ratings indicated on the drawings except as may be modified by these specifications.

B. Fuses for motor branch circuits 600 amperes and below, whether individual or grouped (MCC), shall be class RK1 fuses. Fuse ratings for motor branch circuits shall be determined by actual full-load currents of motors provided, not by NEC Table of Standard Motor Full Load Ampere. EXCEPTION: Fuses in motor control centers may be time-delay Class CC fuses if MCC manufacturer's standard designs are for these fuses. Fuse manufacturer's recommendations shall be followed for Class CC fuses.

C. Fuses for motor branch circuits requiring fuses over 601 amps, whether individual or grouped (MCC), shall be Class L fuses.

2.2 FUSING OF CONTROL CIRCUITS

A. General: Fuses shall be RK1 or time-delay Class CC fuses installed in Class CC fuse blocks.

B. Control Power Transformers: Primary circuit of all control power transformers shall be fused. Fuse ratings shall be in accordance with NEC requirements. Fuses shall be RK1, or time-delay UL Class CC fuses installed in Class CC fuse blocks.

2.3 FUSES FOR METERING CENTERS, LOAD CENTERS AND FOR BACK-UP PRODUCTION OF CIRCUIT BREAKERS

A. Fuses for above purposes shall be RK1 or Class L fuses. Fuse ampere ratings shall not exceed maximum recommended by equipment manufacturer.

2.4 INITIAL START-UP

A. Contractor shall replace all fuses opened during start-up and testing. At contract completion, all fuse holders shall contain serviceable fuses as specified.

PART 3 - EXECUTION

3.1 INSTALLATION

A. All circuits shall be completely de-energized prior to installing any fuses.

END OF SECTION

SECTION 26 28 16
CIRCUIT AND MOTOR DISCONNECTS

PART 1: GENERAL

1.1 WORK INCLUDES

A. All disconnect switches for each piece of electrically operated equipment shown on the Drawings or herein specified.

1.2 SUBMITTALS

A. In accord Division One.

1. Product Data: All disconnect switches.
2. Shop Drawings: Dimensional Data.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Provide switches fusible or non-fusible as indicated, heavy duty, and incorporate a quick-make, quick-break operating mechanism. Cover shall be interlocked with handle and be suitable for padlocking in "OFF" position using up to three padlocks.

B. Switches shall be furnished in NEMA 1 general purpose enclosures. If located outdoors, they shall be in NEMA 3R Stainless Steel (SS) enclosures. Covers on NEMA 1 enclosures shall be attached with pin type hinges. NEMA 3RSS covers shall be securable in the open position. NEMA 3RSS enclosures for switches thru 200 amperes shall have provisions for interchangeable bolt-on hubs. NEMA 3RSS enclosures shall be manufactured from stainless steel. Enclosures shall have a gray baked enamel finish, electro-deposited on cleaned, phosphatized steel.

C. Switches shall be horsepower rated for ac and/or dc as indicated by the plans. All fusible switches rated 100 thru 600 amperes at 240 volts and 30 thru 600 amperes at 600 volts shall have a UL approved method of field conversion from standard Class H fuse spacing to Class J fuse spacing. The switch also must accept Class R fuses and have provisions for field installation of a UL listed rejection feature to reject all fuses except Class R. The UL listed short circuit rating of the switches shall be 200,000 rms symmetrical amperes when Class R or Class J fuses are used with the appropriate rejection scheme. The UL listed short circuit rating of the switch, when equipped with Class H fuses, shall be 10,000 rms symmetrical amperes. 800 and 1200 ampere switches shall have provisions for Class L fuses and shall have a UL listed short circuit range of 200,000 rms symmetrical amperes.

2.2 ACCEPTABLE MANUFACTURERS

A. Square D

B. General Electric

C. Eaton

D. Siemens.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Mount switches 5‘-0” inch to top. Provide anchoring point at each mounting hole provided in enclosure.

B. Provide nameplate in accord with 26 05 53 to indicate equipment served or function of switch.

C. Mounting Method:

1. Wall Mounting: Use expansion anchors and bolts. Install collars around mounting bolts or mount on channel, to provide air space between wall and device enclosure.
2. Do not mount unit onto air handling units.
3. Floor Mounting: Install on 4" high concrete equipment pad, in plumb and level attitude. Use expansion anchors and bolts as required.
4. Where wall or floor-mounting is not possible, erect framework using steel channel or angle-iron to adequately support unit. Provide bracing to prevent sway.

END OF SECTION

SECTION 26 28 17
OVERCURRENT PROTECTIVE DEVICES

PART 1 - GENERAL

1.1 WORK INCLUDES

A. Fuses for all fusible equipment installed on the project regardless of which contractor has provided the equipment.

B. Enclosed circuit breakers as indicated on the drawings and herein specified.

C. Circuit breakers for existing panelboards for new branch circuit overcurrent protection.

1.2 SUBMITTALS

A. In accord with Division 1.

1. Shop Drawings: All enclosed circuit breakers with dimensional data.
2. Product Data:
   a. Fuses
   b. Enclosed circuit breakers
   c. Circuit breakers for installation into existing panelboards.

1.3 COORDINATION STUDY

A. At the time the Contractor procures the electrical distribution equipment and Overcurrent protective devices, the Contractor shall also procure an Arc Flash, Fault, and coordination study of said devices from the respective equipment manufacturer. The study shall be signed and sealed by a Florida Licensed Engineer and shall be submitted to the Project Engineer. The Contractor shall also obtain the assistance of the manufacturer's field service technician as may be required to properly set the adjustable trip devices in the field. The coordination study shall be based on the exact devices installed in the field.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Fuses rated 15 to 600 amperes (except for motor branch circuit protection), 600 volt and below, U.L. listed Class RK-1 current limiting type, 200,000 amperes RMS interrupting.

1. Acceptable Products
   a. Bussman Limitron - Type KTS-R
   b. Little Fuse - Type KLSR
   c. Gould Shawmut - Type A2K (250 vac)/A6K (600 vac).

B. Fuses for motor branch circuit and transformer protection U.L. listed Class RK-5 dual element type, 200,000 amperes RMS interrupting.

1. Acceptable Products
   a. Bussman Fusetron - Type FRS-R
   b. Little Fuse - Slo-Blo, Type FLS-R
   c. Gould Shawmut - Type TR (250 vac)/TRS (600 vac).

C. Furnish and install individually enclosed circuit breakers as indicated on the plans. All circuit breakers shall meet Federal Specification W-C-375B, and both the circuit breaker and the enclosure shall be UL listed.

1. Circuit breakers shall have over-center toggle type mechanisms, providing quick-make, quick-break action. Breakers shall have current and interrupting rating as indicated on the plans. Each circuit breaker shall have trip indication by handle position and shall be trip-free. Two and three pole breakers shall be common trip. Each breaker shall have a permanent trip unit containing individual thermal and magnetic trip elements in each pole.
2. Enclosures shall be of the NEMA type indicated on the plans.
3. NEMA 1 enclosures shall be furnished with knockouts where practical and shall be fabricated from sheet steel which conforms to UL 50. The enclosure shall be given an electrodeposited, gray baked enamel finish. Padlocking provisions shall be provided to allow locking the circuit breaker in the "OFF" position. Enclosures shall be UL listed.
4. NEMA 3RSS enclosures for circuit breakers rated through the 225-ampere frame size shall be furnished with provisions for interchangeable, bolt-on hubs. Enclosures shall be fabricated from stainless steel and shall be given an electrodeposited, gray baked enamel finish. Enclosure covers shall be securable in the open position. Padlocking provisions shall be provided to allow locking the enclosure cover closed. Enclosures shall be UL listed.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Distribution system is designed to provide selectivity, coordination, and component protection. To guarantee this system, all fuses or circuit breakers shall be from the same manufacturer. Substitution provisions are specified in Division One.

B. Place a fuse identification label showing the size and type of fuses installed inside the cover of each switch.

C. Furnish Owner at completion of project, one spare set (3) of each size of fuse rated over 100 amperes. Obtain a written receipt for same from the Owner.

D. Provide a nameplate for each enclosed circuit breaker in accordance with Section 26 05 53.

END OF SECTION

SECTION 26 28 39
COMBINATION MOTOR STARTERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.2 SCOPE

A. Furnish materials, labor and supervision necessary to install individually mounted Combination Motor Starters.

1.3 CODES AND STANDARDS

A. Combination starters shall be in accordance with NEMA Standards, sizes and horsepower ratings.

1.4 QUALIFICATIONS

A. Acceptable Manufacturers:

1. Square D
2. General Electric
3. Eaton
4. Siemens.

1.5 SUBMITTALS

A. Product Data: On all combination starters.

B. Shop Drawings: Dimensioned outline drawings of all typical units.

PART 2 - PRODUCTS

2.1 GENERAL

A. Combination starters shall be of the fusible type except where Drawings indicate non-fusible type.

B. Enclosures shall be NEMA-1 for indoor use, NEMA-3R for outdoor use.

C. All starters shall be equipped with integral control transformers when required. Use of separate control circuit shall not be permitted.

2.2 OVERCURRENT PROTECTIVE DEVICES

A. Fusible type disconnects shall be equipped with blade type horsepower-rated switches with Class H, J, or R fuse clips. Molded case switches with separate fuse clips may be used for the higher amperage ratings.

1. Each disconnect switch shall have the following features:
   a. Switch mechanism shall be the quick-make, quick-break type.
   b. Copper blades, visible in the "OFF" position.

c. An arc chute for each pole.
d. External operating handles shall indicate "ON" and "OFF" positions and shall have lock-open padlocking provisions.
e. Mechanical interlock shall permit opening of the door only when the switch is in the "OFF" position, defeatable by a special tool to permit inspection.

2.3 STARTERS

A. Combination starters shall be used wherever a starter is required.

B. Units shall be furnished with the following devices:

1. Fused disconnect switch on the incoming line, fuse as per NEC for motor being served.
2. "HAND-OFF-AUTO" selector switch in cover.
3. 120-volt control transformer.
4. Adjustable solid state overloads with phase loss protection. (Thermal BI-metal overloads are not acceptable).
5. Minimum of two N.O. and two N.C. electrical interlocks.
6. Appropriate red (running) and green (power) indicator lights in cover.

C. Provide undervoltage, voltage imbalance, and phase-failure protection on all starters for motors 5HP and larger.

2.4 MANUAL MOTOR STARTERS

A. Fractional Horsepower Manual Motor Starters shall be single-pole toggle type with thermal overload protection and trip free operation. Provide starter in NEMA 1 flush or surface enclosure unless otherwise specified or required. Provide unit with red pilot light.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install combination motor starters for motors.

B. Prior to purchasing starters and overload units, obtain from Owner and other Contractors a schedule of horsepower and full load currents for the motors actually furnished which require starters. Any additional costs associated with substitute motors shall be the responsibility of the Contractor supplying the equipment. No additional costs shall be passed on to the Owner.

C. Furnish overloads based on the nameplate rating of the motor to be controlled.

D. Each motor shall be supplied by an individual branch circuit in separate branch conduit, except where otherwise shown.

E. All final connections to motor shall be made with liquidtight flexible conduit, not less than 12 inches or more than 24 inches long. Provide ground wire to motor frame. Conduit shall be adequately supported at each motor.

F. Proper direction of rotation of all motors shall be the responsibility of this Contractor.

G. All disconnects, combination starters, and control devices, etc., shall have nameplates or legends indicating the equipment served and/or the functions of the device. These nameplates or legends shall be sized relative to the device, be made of engraved phenolic compound, and properly secured to the device using sheet metal screws.

H. It is understood that motor sizes called for in schedules and locations of same are for estimating purposes only, and it shall be the responsibility of the Contractor for work under this Section to confer with the Contractors of other trades involved and provide connections of proper capacity at proper locations thereof. This Contractor shall be fully responsible to furnish and install proper fuses, starters, conduit, thermal heaters, and conductors to the individual starters, leaving same ready for operation.

I. Where starters and other devices are furnished with the equipment, this Contractor shall receive these starters and other devices in connection with the units and do all necessary power field wiring between equipment and starters. This work is to be done under the supervision of the respective Contractor, or Subcontractor, who shall be fully responsible for providing adequate and correct wiring diagrams and instructions.

J. Install motor starters as follows:

1. Location: Approximately as shown. Choose precise location to provide ample space for operation and maintenance.
2. Mounting Method:
   a. Wall Mounting: Use expansion anchors and bolts. Install collars around mounting bolts or mount on channel, to provide air space between wall and device enclosure.
   b. Do not mount unit onto air handling units.
   c. Floor Mounting: Install on 4" high concrete equipment pad, in plumb and level attitude. Use expansion anchors and bolts as required.
   d. Where wall or floor-mounting is not possible, erect framework using steel channel or angle-iron to adequately support unit. Provide bracing to prevent sway.

END OF SECTION

SECTION 26 29 10
ELECTRIC CONTROLS AND RELAYS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Pushbutton and selector switches

B. Control stations

C. Relays

D. Time-delay relays

E. Control power transformers

F. Control panels.

1.2 REFERENCES

A. NEMA ICS 1 - General Standards for Industrial Control Systems.

B. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers and Assemblies.

C. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

D. NEMA ST 1 - Standard for Specialty Transformers (Except General Purpose Type).

1.3 SUBMITTALS

A. Submit shop drawings.

B. Submit shop drawings to NEMA ICS 1 indicating control panel layouts, wiring connections and diagrams, dimensions, support points.

C. Submit product data under provisions of Division 1.

D. Submit product data for each component specified.

1.4 PROJECT RECORD DOCUMENTS

A. Submit record documents.

B. Accurately record actual locations of control equipment. Revise diagrams included in Drawings to reflect actual control device connections.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation data.

B. Include instructions for adjusting and resetting time-delay relays, timers, and counters.

C. Submit maintenance data.

D. Include recommended preventive maintenance procedures and materials.

1.6 QUALIFICATIONS

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

PART 2 - PRODUCTS

2.1 CONTROL SWITCHES AND STATIONS

A. Contacts: NEMA ICS 2; Form C.

B. Contact Ratings: NEMA ICS 2; as scheduled.

C. Pushbutton Operator: NEMA ICS 2; as scheduled.

D. Control Stations: NEMA ICS 2; as scheduled.

2.2 CONTROL RELAYS

A. Contacts: NEMA ICS 2; Form C.

B. Contact Ratings: NEMA ICS 2; as scheduled.

C. Coil Voltage: as scheduled.

2.3 TIME-DELAY RELAYS

A. Contacts: NEMA ICS 2; as scheduled.

B. Contact Ratings: NEMA ICS 2; Class A150.

C. Coil Voltage: as scheduled.

D. Time-Delay Relays: NEMA ICS 2; as scheduled.

2.4 CONTROL POWER TRANSFORMERS

A. Transformer: NEMA ST 1; machine tool transformer with isolated secondary winding.

B. Power Rating: 500 va.

C. Voltage Rating: as required.

2.5 ENCLOSURES

A. Control Station Enclosure: NEMA ICS 6; Type as required to meet conditions of installation unless indicated on the Drawings.

B. Relay Enclosure: NEMA ICS 6; Type as required to meet conditions of installation unless indicated on the Drawings.

2.6 FABRICATION

A. Control Panels: Shop fabricate control panels to NEMA ICS 1.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install devices and equipment in accordance with manufacturer's instructions.

B. Install individual relays and time delay relays in enclosures.

C. Make electrical wiring interconnections as shown on Drawings.

3.2 COMMISSIONING SUPPORT

A. Perform all required commissioning. The contractor shall designate an individual to serve on the commissioning team and shall cooperate as required concerning all commissioning related activities, meetings, documentation, field tests, etc. The contractor shall provide all technically qualified personnel, equipment, instrumentation, and materials on a continuous basis in order to perform their required tasks at the required time period and provide all required or requested assistance by the commissioning provider to complete the commissioning process. The contractor is required per referenced specifications to complete all applicable Pre-Functional Test Report forms on the systems being commissioned. This may include start-up check list forms.

END OF SECTION

SECTION 26 29 14
CONTACTORS

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. General purpose contactors.

B. Lighting contactors.

1.2 REFERENCES

A. ANSI/NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

B. NEMA ICS 2 - Industrial Control Devices, Controllers, and Assemblies.

C. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

A. Submit under provisions of Division 1.

B. Product Data: Include dimensions, size, voltage ratings and current ratings.

1.4 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Accurately record actual locations of each contactor and indicate circuits controlled.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1.

B. Maintenance Data: Include instructions for replacing and maintaining coil and contacts.

1.6 QUALIFICATIONS

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

PART 2 - PRODUCTS

2.1 MANUFACTURERS - GENERAL PURPOSE CONTACTORS

A. Square D

B. General Electric

C. Allen-Bradley

D. Eaton

E. Siemens.

2.2 GENERAL PURPOSE CONTACTORS

A. Description: NEMA ICS 2, AC general purpose magnetic contactor

B. Coil Voltage: 120 volts, 60 Hertz

C. Poles: As indicated

D. Size: As indicated

E. Enclosure: ANSI/NEMA ICS 6, Type as required to meet conditions of installation, unless indicated on the Drawings.

F. Accessories:

1. Pushbutton: ON/OFF
2. Selector Switch: ON/OFF
3. Indicating Light: RED.
4. Auxiliary Contacts: 2, (1) normally open and (1) normally closed, field convertible.

2.3 MANUFACTURERS - LIGHTING CONTACTORS

A. Square D

B. General Electric

C. Allen-Bradley

D. Eaton

E. Siemens.

2.4 LIGHTING CONTACTORS

A. Description: NEMA ICS 2, magnetic lighting contactor

B. Configuration: Electrically held

C. Coil Voltage: 120 volts, 60 Hertz

D. Poles: As indicated

E. Contact Rating: Match branch circuit overcurrent protection, considering derating for continuous loads.

F. Enclosure: ANSI/NEMA ICS 6, Type as required to meet conditions of installation unless indicated on the Drawings.

G. Accessories:

1. Selector Switch: ON/OFF/AUTOMATIC
2. Indicating Light: RED

3. Auxiliary Contacts: 2, (1) normally open and (1) normally closed, field convertible.

2.5 ACCESSORIES

A. Pushbuttons and Selector Switches: NEMA ICS 2, heavy duty type

B. Indicating Lights: NEMA ICS 2, type

C. Auxiliary Contacts: NEMA ICS 2, Class A300.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 26 29 23
ADJUSTABLE FREQUENCY (VARIABLE SPEED) DRIVE UNITS

PART 1 - GENERAL

1.1 WORK INCLUDED

A. Provide adjustable frequency drives as indicated on the drawings and specified herein.

1.2 RELATED WORK

A. Specified Elsewhere:

1. Drawings and general provisions of Contract, including, but not limited to, General, Special and Supplementary Conditions and other Division 1 Specification Sections, apply to the work of this Section.
2. Division 23 - applicable sections.
3. Division 26 - applicable sections.

1.3 SUBMITTALS

A. In accord with Division 1.

1. Shop Drawing: Adjustable frequency drives and enclosures.
2. Product Catalog Data: All components.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Adjustable frequency drive units shall be complete UL listed assemblies as specified herein and shall be rated for continuous duty at maximum service factor and full load horsepower as indicated on the drawings. Provide AHU drives with full bypass feature. All adjustable frequency drives supplied shall be of the same manufacturer and model.

B. Unit shall operate in conditions of 0 to 90% non-condensing humidity and 0 to 40 degrees C ambient temperature.

C. The adjustable frequency drive shall be housed in a NEMA 1 vented and filtered enclosure finished with the manufacturer's standard paint system. Ventilation shall be via fan forced air by integral fans provided in the enclosure. All power and control electronics shall be of modular construction for ease of maintenance and replacement.

D. Power input to the unit shall be 480 VAC (+ or - 10%), 3-phase. Provide 3%-line reactors on the input and an RLC (dV/dt) type RFI filter on the output. The filter shall return energy to the DC bus - dissipative type devices are not acceptable. The drive's carrier frequency shall be below 10 kHz. Efficiency of the unit shall be 95% minimum at rated load and speed. Unit power factor shall not be less than 95% lagging throughout the speed range.

E. The inverter unit shall be the two-step (AC to DC, DC to AC) pulse width modulated type, or voltage vector control (VVC) technology with full bypass. Power electronics components shall not be paralleled and shall be rated to withstand maximum short circuit conditions without damage. Unit shall be capable of catching a motor spinning in the forward or reverse direction upon starting. A separate grounding connection for the

inverter output shall be provided. Unit output shall include full voltage, non-reversing NEMA rated output motor starter for line (and by-pass) modes, to provide a positive disconnection means. Where by-pass is provided, drive shall be completely isolated in by-pass mode to allow replacement or maintenance of drive while totally de-energized. Inverter output shall be constant volts per Hertz as follows:

Volts	0 to 460 VAC, 3-phase, 3 wire plus ground
Frequency	4 to 120 Hertz + or - 2 Hertz
Service Factor	1.15
Overload	110% for 1-minute

F. Unit fault conditions shall de-energize output and require manual reset by an operator. Output shall be protected against faults with front panel indication provided for each of the following conditions:

DC bus under/overvoltage
Short circuit
Overload
Phase Loss
Phase Imbalance
Over/Underfrequency
Overtemperature

G. Loss of line voltage or phase-imbalance shall de-energize the outlet. Upon restoration of line power, unit shall automatically restart motor after a pre-determined time lapse. Time lapse setting shall be adjustable, either manually or via programming.

H. Unit shall include a microprocessor-based control system with non-volatile memory. Control power shall be electrically isolated from the power electronics using a dedicated step-down control power transformer, power supplies, and filters. All electrical interfaces between the unit and other control equipment shall be made on dedicated and labeled terminal blocks. All manual operation interfaces and indications shall be front panel mounted. Provide the following readily accessible interface inputs and outputs:

INVERTER ON-OFF-INVERTER BY-PASS selector switch
MANUAL/AUTO selector switch
RUN-STOP Pushbuttons (Manual Mode)
RESET pushbuttons
Local speed adjustment potentiometer (Manual Mode)
Remote RUN-STOP input (dry contact closure)
0 to 10 VDC remote speed reference
External Trip (dry contactor closure)
RUN /BY-PASS / STOP / pilot lights
Output speed (0 to 10 VDC)
Output current (0 to 10 VDC)
Run Output Contact (Dry Form C)
Fault Output Contact (Dry Form C)

I. Provide the following readily accessible user adjustments:

Minimum frequency
Maximum frequency
Speed default upon loss of speed reference signal
Acceleration time
Deceleration time
Overload current

Speed input reference signal bias
Speed input reference signal gain
Minimum speed dwell time (0 to 18 seconds)
Motor noise reduction via carrier frequency or
Volts per Hertz linear/reduced

J. The following communication features shall be provided to interface with the Energy Management System (EMS):

1. Communications interface hardware. A communications interface board which provides communications capability between the drive and the FMS. shall be provided. It shall be able to access all drive set up parameters and all diagnostic information with the proper software program.
2. Communications interface software. A software program for setting up all drive operating parameters and accessing all diagnostic information shall be provided for interface with the FMS.

K. Units shall be factory pre-tested prior to shipment including operation at full load and speed for 24 hours.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Unit shall be mounted in accordance with manufacturer’s recommendations in locations shown on the drawings, plumb and level. Provide for additional components in cabinets separate from the unit, such as filters, reactors, etc.

B. Adjustable frequency drive shall be energized and tested by original equipment manufacturer's certified and qualified technician. These services shall be included in the base bid cost. Testing shall be documented on test forms and witnessed by the Owner’s Representative. Test adjustable frequency drive in accordance with manufacturer's requirements and include the following operational tests:

1. Verify proper operation and indications for manual operation including run/stop and full range manual speed control.
2. Verify automatic operations and indications including run/stop and full range speed control.
3. De-energize unit and verify non-volatile memory and reset.

C. Include 4 hours of on-site training by a factory certified technician for 2 of Owner’s employees.

D. Final acceptance shall depend upon the satisfactory performance of the motor-control centers and adjustable frequency drive under test.

E. Contractor shall verify size of unit and clearly indicate in the shop drawing submittal data. Contractor shall notify the Engineer of any available mounting space problems, prior to submitting the data for review, or placing the order for the drive with the manufacturer.

F. Contractor shall verify that local disconnect switches at motors controlled by a drive, shall have an auxiliary contact and circuitry as required to shut down the drive prior to disconnecting power to the motor.

END OF SECTION

SECTION 26 35 13
STANDBY POWER GENERATOR SYSTEM

PART 1 - GENERAL

1.1 INCLUDES

A. Contractor shall provide:

1. Electric generating set rated for standby service as described herein. The generator plant shall consist of a natural-gas fuel driven engine generator set. System shall be provided as an integrated package, from a single manufacturer, complete with a micro-processor based control system and associated software. Package shall be compliant with NFPA 110.
2. Transfer switches as shown on the drawings and as specified herein including all power and control wiring.
3. Battery/charger system and associated accessories for support of the standby power generator system.
4. Complete exhaust piping, silencer(s), and insulation as shown on the drawings.
5. Weatherproof, hurricane rated enclosure.
6. One (1) year warranty against defects in materials and workmanship.
7. Start-up and testing as specified herein.

1.2 RELATED WORK

A. Specified Elsewhere:

1. Drawings and general provisions of contract, including, but not limited to, General, Special, and Supplementary Conditions and other Division Specification Sections apply to the work of this section.
2. Division 23 - applicable sections.
3. Division 26 - applicable sections.

1.3 QUALITY ASSURANCE

A. Comply with specified ANSI, NEMA, NFPA, and UL requirements for generator set components and installation.

B. Comply with the appropriate current edition of the following codes and standards for gas piping:

1. ANSI Compliance: Comply with applicable ANSI standards pertaining to materials, products, and installation of Natural Gas Piping.
2. Underwriters' Laboratories, Inc. (UL) for generator, components, and piping.
3. National Fire Protection Association (NFPA 54) Natural Fuel Gas Code.
4. National Fire Protection Association (NFPA 110) Emergency and Standby Power Systems.
5. State of Florida Rules, Regulations, and Laws.
6. Local Codes.

1.4 SUBMITTALS

A. In accord with Division 1.

1. Shop Drawings:
   a. Certified outline and installation drawings, including exhaust system piping.

b. Performance data and operating characteristics.
c. Arrangement drawings showing piping, controls, and accessory equipment.
d. Drawings on non-standard components and accessories.
e. Drawings on associated piping, from the gas service to the generator.

2. Product Data:
   a. Catalog data on all components, marked to indicate materials being furnished.

B. In accord with Division 1.

1. Operating and Maintenance Data:
   a. Instructions Manuals, Maintenance and Operational Manuals.

1.5 SINGLE SUPPLIER

A. The supplier shall be the manufacturer's authorized distributor, who shall provide initial start-up services, conduct field acceptance testing, and warranty service. The supplier shall have 24-hour service availability and factory-trained service technicians authorized to do warranty service on all warrantable products.

PART 2 - PRODUCTS

2.1 EQUIPMENT

A. The generator package shall be provided in accordance with the following:

1. Natural Gas Engine-Generator Set: 4-cycle, 1800 rpm, natural gas engine generator set. Generator set ratings: KW/KVA rating as shown on the drawings at 0.8 PF, standby rating, based on site conditions noted below. System voltage of 120/208 Volts AC, Three phase, Four-wire, 60 hertz. Site Conditions: Altitude 20 ft. (6.1 meters), ambient temperatures up to 122 degrees F.
   a. The generator set shall include inherent overcurrent, short circuit and overload protection, digital and analog AC metering equipment, sensor failure detection, and remote monitoring and control capability. No exceptions or deviations to these requirements will be permitted.
2. Prototype Tests and Evaluation: Prototype tests shall have been performed on a complete and functional unit; component level type tests will not substitute for this requirement. Prototype testing shall comply with the requirements of NFPA 110 for Level 1 systems.
3. Performance: Voltage regulation shall be +/- 0.5 percent for any constant load between no load and rated load.
   a. Frequency regulation shall be isochronous from steady state no load to steady state rated load. Random frequency variation with any steady load from no-load to full-load, shall not exceed plus or minus 0.25%.
   b. The engine-generator set shall be capable of single step load pick up of 100% nameplate kW and power factor, less applicable de-rating factors, with the engine-generator set at operating temperature.
   c. The generator set shall be capable of sustaining a minimum of 90% of rated no load voltage with the specified kVA load at near zero power factor applied to the generator set.
4. Unit Package: The engine shall be natural gas, 4 cycle, radiator and fan cooled. The horsepower rating of the engine at its minimum tolerance level shall be sufficient to drive the alternator and all connected accessories. Two cycle engines are not acceptable. Engine accessories and features shall include:

a. An electronic governor system shall provide automatic isochronous frequency regulation. The engine governing system shall not utilize any exposed operating linkage.
b. Skid-mounted radiator and cooling system rated for full load operation in 122 degrees F (50 degrees C) ambient as measured at the generator air inlet. Radiator shall be provided with a duct adaptor flange. The cooling system shall be filled with 50/50 ethylene glycol/water mixture by the equipment supplier. Rotating parts shall be guarded against accidental contact per OSHA requirements.
c. An electric starter(s) capable of three complete cranking cycles without overheating.
d. Positive displacement, mechanical, full pressure, lubrication oil pump. Full flow lubrication oil filters with replaceable spin-on canister elements and dipstick oil level indicator.
e. Replaceable dry element air cleaner with restriction indicator.
g. Engine mounted battery charging alternator, 45 ampere minimum, and solid-state voltage regulator.

5. AC Generator: The AC generator shall be synchronous, four pole, 2/3 pitch, revolving field, drip-proof construction, single pre-lubricated sealed bearing, air cooled by a direct drive centrifugal blower fan, and directly connected to the engine with flexible drive disc.
   a. All insulation system components shall meet NEMA MG1 temperature limits for Class H insulation system. Actual temperature rise measured by resistance method at full load shall not exceed 105 degrees Centigrade.
   b. The generator shall be capable of delivering rated output (kVA) at rated frequency and power factor, at any voltage not more than 5 percent above or below rated voltage.
   c. A permanent magnet generator (PMG) shall be included to provide a reliable source of excitation power for optimum motor starting and short circuit performance. The PMG and controls shall be capable of sustaining and regulating current supplied to a single phase or three phase fault at approximately 300% of rated current for not more than 10 seconds.
6. Engine-Generator Set Control: The generator set shall be provided with a microprocessor-based control system which is designed to provide automatic starting, monitoring, and control functions for the generator set. The control system shall also by designed to allow local monitoring and control of the generator set, and remote monitoring and control as described in this specification. The control shall be mounted on the generator set for 600 volt and lower applications. When mounted on the generator set, the control shall be vibration isolated, and prototype tested to verify the durability of all components in the system under the vibration conditions encountered. The control shall be UL508 labeled, CSA282-M1989 certified, and meet IEC8528 part 4. All switches, lamps and meters shall be oil-tight and dust-tight, and the enclosure door shall be gasketed. There shall be no exposed points in the control (with the door open) that operate in excess of 50 volts. The controls shall meet or exceed the requirements of Mil-Std 461C, part 9, and IEC Std 801.2, 801.3, and 801.5 for susceptibility, conducted, and radiated electromagnetic emissions. The entire control shall be tested and meet the requirements of IEEE587 for voltage surge resistance and be provided with surge protectors on all control wiring between structures. The generator set mounted control shall include the following features and functions:
   a. Three position control switch labeled RUN/OFF/AUTO. In the RUN position, the generator set shall automatically start, and accelerate to rated speed and voltage. In the OFF position the generator set shall immediately stop, bypassing all time delays. In the AUTO position, the generator set shall be ready to accept a signal from a remote device to start and accelerate to rated speed and voltage.
   b. Red “mushroom-head” push-button EMERGENCY STOP switch. Depressing the emergency stop switch shall cause the generator set to immediately shut down and be locked out from automatic restarting.

c. Push-button RESET switch. The RESET switch shall be used to clear a fault and allow restarting the generator set after it has shut down for any fault condition.
d. Push-button PANEL LAMP switch. Depressing the panel lamp switch shall cause the entire panel to be lighted with DC control power. The panel lamps shall automatically be switched off 10 minutes after the switch is depressed, or after the switch is depressed a second time.

7. Generator Set AC Output Metering: The generator set shall be provided with a metering set with the following features and functions:
   a. 2.5-inch, 90-degree scale analog voltmeter, ammeter, frequency meter, and kilowatt (KW) meter. These meters shall be provided with a phase select switch and an indicating lamp for upper and lower scale on the meters. Ammeter and KW meter scales shall be color coded in the following fashion: readings from 0-90% of generator set standby rating: green; reading from 90-100% of standby rating: amber; readings in excess of 100%: red.
   b. Digital metering set, 0.5% accuracy, to indicate generator RMS voltage and current, frequency, output current, output KW, KW-hours, and power factor. Generator output voltage shall be available in line-to-line and line-to-neutral voltages and shall display all three phase voltages (line-to-neutral or line-to-line) simultaneously.
8. Generator Set Alarm and Status Message Display: The generator set shall be provided with alarm and status indicating lamps to indicate non-automatic generator status, and existing alarm and shutdown conditions. The lamps shall be high-intensity LED type. The lamp condition shall be clearly apparent under bright room lighting conditions. The generator set control shall indicate the existence of the following alarm and shutdown conditions on a digital display panel:
   a. Low oil pressure (alarm)
   b. Low oil pressure (shutdown)
   c. Oil pressure sender failure (alarm)
   d. Low coolant temperature (alarm)
   e. High coolant temperature (alarm)
   f. High coolant temperature (shutdown)
   g. Engine temperature sender failure (alarm)
   h. Low coolant level (alarm or shutdown-selectable)
   i. Fail to crank (shutdown)
   j. Overcrank (shutdown)
   k. Overspeed (shutdown)
   l. Low DC voltage (alarm)
   m. High DC voltage (alarm)
   n. Weak battery (alarm)
   o. High AC voltage (shutdown)
   q. Low AC voltage (shutdown)
   r. Under frequency (shutdown)
   s. Over current (warning)
   t. Over current (shutdown)
   u. Short circuit (shutdown)
   v. Ground fault (alarm) (optional-when required by Code or specified)
   w. Overload (alarm)
   x. Emergency stop (shutdown).
9. In addition, provisions shall be made for indication of two customer-specified alarm or shutdown conditions. Labeling of the customer-specified alarm or shutdown conditions shall be of the same type and quality as the above specified conditions. The non-automatic indicating lamp shall be red and shall flash to indicate that the generator set is not able to automatically respond to a command to start from a remote location.

10. Engine Status Monitoring: The following information shall be available from a digital status panel on the generator set control:
    a. Engine oil pressure (psi or kPA)
    b. Engine coolant temperature (degrees F or C; both left and right bank temperature)
    c. Shall be indicated on V-block engines.
    d. Engine oil temperature (degrees F or C)
    e. Engine speed (rpm)
    f. Number of hours of operation (hours)
    g. Number of start attempts
    h. Battery voltage (DC volts).
11. Control Functions: The control system provided shall include a cycle cranking system, which allows for user selected crank time, rest time, and # of cycles. Initial settings shall be for 3 cranking periods of 15 seconds each, with 15 second rest period between cranking periods.
    a. The control system shall include an idle mode control, which allows the engine to run in idle mode in the RUN position only. In this mode, the alternator excitation system shall be disabled.
    b. The control system shall include an engine governor control, which functions to provide steady state frequency regulation as noted elsewhere in this specification. The governor control shall include adjustments for gain, damping, and a ramping function to control engine speed and limit exhaust smoke while the unit is starting. The governor control shall be suitable for use in paralleling applications without component changes.
    c. The control system shall include time delay start (adjustable 0-300 seconds) and time delay stop (adjustable 0-600 seconds) functions.
    d. The control system shall include sender failure monitoring logic for speed sensing, oil pressure, and engine temperature which is capable of discriminating between failed sender or wiring components, and an actual failure conditions.
12. Alternator Control Functions: The generator set shall include an automatic voltage regulation system which is matched, and prototype tested with the governing system provided. It shall be immune from mis-operation due to load-induced voltage waveform distortion and provide a pulse width modulated output to the alternator exciter. The voltage regulation system shall be equipped with three-phase RMS sensing and shall control buildup of AC generator voltage to provide a linear rise and limit overshoot. The system shall include a torque-matching characteristic, which shall reduce output voltage in proportion to frequency below a threshold of [58-59] HZ. The voltage regulator shall include adjustments for gain, damping, and frequency roll-off. Adjustments shall be broad range, and made via digital raise-lower switches, with an alpha-numeric LED readout to indicate setting level.
    a. Controls shall be provided to monitor the output current of the generator set and initiate an alarm when load current exceeds 110% of the rated current of the generator set on any phase for more than 60 seconds. The controls shall shut down and lock out the generator set when output current level approaches the thermal damage point of the alternator.
    b. Controls shall be provided to monitor the KW load on the generator set and initiate an alarm condition when total load on the generator set exceeds the generator set rating for in excess of 5 seconds.
    c. An AC over/under voltage monitoring system which responds only to true RMS voltage conditions shall be provided. The system shall initiate shutdown of the generator set when alternator output voltage exceeds 110% of the operator-set voltage level for more than 10 seconds, or with no intentional delay when voltage exceeds 130%. Under voltage shutdown shall occur when the output voltage of the alternator is less than 85% for more than 10 seconds.

d. A battery monitoring system shall be provided which initiates alarms when the DC control and starting voltage is less than 25VDC or more than 32VDC. During engine starting, the low voltage limit shall be disabled, and if DC voltage drops to less than 14.4 volts for more than two seconds, a “weak battery” alarm shall be initiated.
e. When required by the National Electrical Code or indicated on project drawings, the control system shall include a ground fault monitoring relay. The relay shall be adjustable from 100-1200 amps and include an adjustable time delay of 0-1.0 seconds. The relay shall be for indication only and not trip or shut down the generator set. Note bonding and grounding requirements for the generator set and provide relay which will function correctly in system as installed.

13. Control Interfaces for Remote Monitoring: All control and interconnection points from the generator set to remote components shall be brought to a separate connection box. No field connections shall be made in the control enclosure or in the AC power output enclosure. Provide the following features in the control system:
    a. Form “C” dry common alarm contact set rated 2A@30VDC to indicate existence of any alarm or shutdown condition on the generator set.
    b. One set of contacts rated 2A@30VDC to indicate generator set is ready to load. The contacts shall operate when voltage and frequency are greater than 90% of rated condition.
    c. A fused 10 amp switched 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit whenever the generator set is running.
    d. A fused 20-amp 24VDC power supply circuit shall be provided for customer use. DC power shall be available from this circuit at all times from the engine starting/control batteries.
    e. The control shall be provided with provisions for connection of remote monitoring equipment as described herein or shown on the drawings.
14. Base: The engine-operator set shall be mounted on a heavy-duty steel base to maintain alignment between components. The base shall incorporate a battery tray with hold-down clamps within the rails.
15. Provide the following Generator Set Auxiliary Equipment and Accessories:
    a. Engine mounted, thermostatically controlled, jacket water heater(s) for each engine. The heater(s) shall be sized as recommended by the generator set manufacturer. Heater voltage shall be as shown on the project drawings.
    b. Vibration isolators, spring/pad type, quantity as recommended by the generator set manufacturer. Isolators shall include seismic restraints if required by site location.
    c. Starting and Control Batteries: Starting battery bank, calcium/lead antimony type, 24-volt DC, sized as recommended by the generator set manufacturer, shall be supplied for each generator set with battery cables and connectors.
    d. Battery Charger: A UL listed/CSA certified 10-amp voltage regulated battery charger shall be provided for each engine-generator set. The charger may be located in an automatic transfer switch, or may be wall mounted, at the discretion of the installer. Input AC voltage and DC output voltage shall be as required. Chargers shall be equipped with float, taper, and equalize charge settings. Operational monitors shall provide visual output along with individual form C contacts rated at 4 amps, 120 VAC, 30VDC for remote indication of:
        1) Loss of AC power - red light
        2) Low battery voltage - red light
        3) High battery voltage - red light
        4) Power ON - green light (no relay contact)
    e. Analog DC voltmeter and ammeter, 12 hours equalize charge time, AC and DC fuses shall also be provided on the charger.

f. Remote Annunciator: Provide and install a 20-light LED remote alarm annunciator with horn, located as shown on the drawings or in a location which can be conveniently monitored by facility personnel. The remote annunciator shall provide all the audible and visual alarms called for by NFPA Standard 110 level 1 systems; and in addition, shall provide indications for high battery voltage, low battery voltage, and loss of normal power to the charger. Spare lamps shall be provided to allow future addition of other alarm and status functions to the annunciator. Provisions for labeling of the annunciator in a fashion consistent with the specified functions shall be provided. Alarm silence and lamp test switch(es) shall be provided. LED lamps shall be replaceable and indicating lamp color shall be capable of changes needed for specific application requirements. Alarm buzzer shall be provided and be switchable for all annunciation points. Alarm buzzer (when switched on) shall sound for first fault, and all subsequent faults, regardless of whether first fault has been cleared, in compliance with NFPA 110 3-5.6.2.

g. Automatic exercising clock with astronomical dial (may be integral to ATS).

h. Complete exhaust piping and exhaust muffler(s) shall be provided for each engine, size and type as recommended by the generator set manufacturer. The mufflers shall be critical grade. Exhaust system shall be completely insulated and installed according to the generator set manufacturers recommendations and applicable Codes and Standards.

i. Remote Generator Stop: Provide an emergency generator stop push-button at location indicated on the drawings, or as required by AHJ. Device shall be labeled “Generator Emergency Stop”, using an engraved phenolic nameplate attached with stainless steel sheet metal screws, and be within a weather protective housing if located outdoors.

j. Generator mounted circuit breaker(s). Unit(s) shall be provided with adjustable solid-state trip modules for L.S.I.A., so as to allow for proper coordination with downstream devices.

k. Weather-proof enclosure: Unit shall be aluminum and rated for 180 MPH wind loading. Entire unit shall be painted with an enamel powder coat finish, color to be selected by the Architect. The enclosure shall provide a 25db reduction in mechanical noise, measured at 23 feet from the generator. Critical grade silencer(s), (provided with the generator), shall be mounted on the roof of the enclosure. Intake hoods/louvers and exhaust hoods/louvers shall be provided as necessary to properly ventilate the engine-generator set. Contractor shall confirm actual field conditions around genset to ensure proper air flow can be provided. Enclosure shall be mounted to an integral lifting base so that generator set, enclosure, and base can be lifted as a single package for transporting and setting unit on its concrete slab at the project site. Provide 4-point lifting provisions on enclosure to accommodate crane handling. Fuel lines shall be coordinated with the enclosure base for extension to fuel storage tank. Day tank/sub-base tank and main over-current protective device(s) shall be located within the weather-proof enclosure. Conduits shall be stubbed up through the concrete slab for feeder connections to the main circuit breaker(s). Provide access panels at all points of frequent maintenance and as necessary to service the engine-generator set. Enclosure shall be as manufactured by “Tramont”, or equal.

2.2 ACCEPTABLE MANUFACTURERS (Subject to meeting all project requirements)

A. Cummins

B. MTU Onsite Energy

C. Generac

D. Kohler

E. Caterpillar.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Contractor shall install equipment, devices, and wiring to conform to manufacturers written installation requirements and in accord with State and Local Codes, and UL Standards.

B. All gas piping shall be installed in accordance with manufacturer's written instructions and in accord with applicable referenced standards, codes, and ordinances.

C. Generator set shall be shimmed and leveled and bolted to concrete base.

D. Provide pre-start-up service as recommended by manufacturer, including but not limited to, coolant system with anti-freeze solution for freeze protection to -zero deg. F., all oil reservoirs filled.

E. Include the services of the manufacturer’s representative to check final connections, inspect the installation, and supervise start-up and testing of the system.

F. Demonstrate at site functional capability under manual and automatic modes of operation. Perform a “cold-start” full load test using load bank to provide 100% specified KW rating for a 4-hour test period, and a two-step (50%, 100%) rated load pick-up test in accordance with NFPA-110. Correct all defects that occur during load testing. Log the following data at 15 min. intervals during the 4-hour load bank test – load (kw), voltage, current, oil press, engine temp., and runtime.

G. Generator set factory tests on the equipment to be shipped, shall be performed at rated load and rated PF. Generator sets that have not been factory tested at rated PF will not be acceptable. Tests shall include run at full load, maximum power, voltage regulation, transient and steady-state governing, single step load pickup, and safety shutdowns. Provide a copy of the certified test report showing that the generator set was tested at the 0.8 rated power factor prior to shipment, in accordance with Section 5-13.2.5 of NFPA 110.

H. Instruct Owner's personnel on the complete operation and maintenance of system. Instruction shall consist of a minimum of two (2)-hour sessions.

I. Install transfer switches in accordance with manufacturer’s recommendations. Fully test in presence of the Owner’s representative and engineer, all positions/functions of the switches.

J. Manufacturer’s trained field technician shall be on-site to assist during the Final AHJ survey. At the time of the survey, provide all required test documentation, including a statement that the installation is complete, and the generator is fully operational. Coordinate time and date with the contractor.

END OF SECTION

SECTION 26 36 23
AUTOMATIC TRANSFER SWITCH

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Automatic transfer switch.

1.2 REFERENCES

A. NEMA ICS 1 - General Standards for Industrial Control and Systems.

B. NEMA ICS 2 - Standards for Industrial Control Devices, Controllers, and Assemblies.

C. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.

1.3 QUALITY ASSURANCE

A. Manufacturer: Company specializing in automatic transfer equipment with three years' experience.

1.4 SUBMITTALS

A. Submit product data under provisions of Division 1.

B. Submit product data for transfer and isolation/bypass switches showing overall dimensions, electrical connections, electrical ratings, and environmental requirements.

C. Submit manufacturer's installation instructions under provisions of Division 1.

1.5 OPERATION AND MAINTENANCE DATA

A. Submit operation and maintenance data under provisions of Division 1.

B. Include instructions for operating equipment.

C. Include instructions for operating equipment under emergency conditions.

D. Identify operating limits which may result in hazardous or unsafe conditions.

E. Document ratings of equipment and each major component.

F. Include routine preventive maintenance and lubrication schedule.

G. List special tools, maintenance materials, and replacement parts.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Asco

B. Kohler

C. Caterpillar

D. Cummins

E. Russelectric

F. Generac.

2.2 AUTOMATIC TRANSFER SWITCH

A. Description: NEMA ICS 2; automatic transfer switch.

B. Configuration: Electrically operated, mechanically held transfer switch.

C. Transfer switches shall be provided with Withstand and Close on Rating (WCR) consisting of instantaneous and time-based ratings to meet the available short circuit shown on the plans.

D. Transfer switches being fed from an upstream breaker with a short time response, shall be provided with a short time rating per UL1008 8th edition

2.3 AUTOMATIC SEQUENCE OF OPERATION

A. Initiate Time Delay to Start Alternate Source Engine Generator: Upon initiation by normal source monitor.

B. Time Delay to Start Alternate Source Engine Generator: 0 to 5 seconds, adjustable.

C. Initiate Transfer Load to Alternate Source: Upon initiation by normal source monitor and permission by alternate source monitor.

D. Time Delay Before Transfer to Alternate Power Source: 0 to 10 seconds, adjustable. Allow 2 second delay between “break” and “make” of normal and emergency power, and vice-versa.

E. Initiate Retransfer Load to Normal Source: Upon permission by normal source monitor.

F. Time Delay before Transfer to Normal Power: 0\to 60 seconds, adjustable; bypass time delay in event of alternate source failure.

G. Time Delay before Engine Shut Down: 0\to 30 minutes, adjustable, of unloaded operation.

H. Engine Exerciser: Start engine every 7 days; run for 30 minutes before shutting down. Bypass exerciser control if normal source fails during exercising period.

I. Alternate System Exerciser: Transfer load to alternate source during engine exercise period.

2.4 ENCLOSURE

A. Enclosure: ICS 6; Type as required to meet conditions of installation unless indicated on the Drawings.

2.5 ACCESSORIES

A. Indicating Lights: Mount in cover of enclosure to indicate NORMAL SOURCE AVAILABLE, ALTERNATE SOURCE AVAILABLE, SWITCH POSITION.

B. Test Switch: Mount in cover of enclosure to simulate failure of normal source.

C. Return to Normal Switch: Mount in cover of enclosure to initiate manual transfer from alternate to normal source.

D. Transfer Switch Auxiliary Contacts: One normally open; One normally closed.

E. Normal Source Monitor: Monitor each line of normal source voltage and frequency; initiate transfer when voltage drops below 90 percent or frequency varies more than 3 percent from rated nominal value.

F. Alternate Source Monitor: Monitor alternate source voltage and frequency; inhibit transfer when voltage is below 90 percent or frequency varies more than 3 percent from rated nominal voltage.

G. Switched Neutral: Overlapping contacts.

PART 3 - EXECUTION

3.1 EXAMINATION

A. Verify that surfaces are ready to receive work.

B. Verify field measurements are as shown on Drawings.

C. Verify that required utilities are available, in proper location, and ready for use.

D. Beginning of installation means acceptance of existing conditions.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Provide training for owner’s maintenance staff on transfer switch operation. Time allotted shall be a minimum of 2-hours of training for each transfer switch installed.

END OF SECTION

SECTION 26 41 00
LIGHTNING PROTECTION FOR STRUCTURES

PART 1 – GENERAL

1.1 SECTION INCLUDES

A. Provision and installation of a complete lightning protection system on the generator and roof mounted equipment, by a licensed and U.L. approved installer.

B. Grounding and bonding for lightning protection.

1.2 RELATED SECTIONS

A. Division 7: Roofing systems.

1.3 REFERENCES

A. LPI-175 – Lightning Protection Installation Standard.

B. LPI-176 – Lightning Protection System Material and Components Standard.

C. LPI-177 – Inspection Guide for LPI Certified Systems.

D. NFPA 780 – Lightning Protection Code.

E. UL 96 – Lightning Protection Code.

F. UL 96A – Installation Requirements for Lightning Protection Systems.

1.4 SYSTEM DESCRIPTION

A. Lightning Protection Systems: Conductor system protecting equipment consisting of air terminals on generator, roof-mounted mechanical equipment, bonding of structure and other metal objects; grounding electrodes; and interconnecting conductors with existing building system.

1.5 SUBMITTALS

A. Division 1 – Submittals: Procedures for Submittals.

B. Shop Drawings: Indicate layout of air terminals, grounding electrodes, and bonding connections to structure and other metal objects. Include terminal, electrode, and conductor sizes and connection and termination details.

C. Product Data: Provide dimensions and materials of each component and include indication of listing in accordance with UL 96.

1.6 PROJECT RECORD DOCUMENTS

A. Submit under Provisions of Division 1.

B. Record actual locations of air terminals, grounding electrodes, bonding connections, and routing of system conductors in project record documents.

1.7 QUALITY ASSURANCE

A. Perform work in accordance with NFPA 780.

B. Perform work in accordance with UL 96A and provide master label.

C. Perform work in accordance with LPI-175 and provide LPI certification.

D. Maintain one (1) copy of each document on site.

1.8 QUALIFICATIONS

A. Manufacturer: Company specializing in lightning protection equipment with minimum three (3) years documented experience, and member of the Lightning Protection Institute.

B. Installer: Authorized installer of manufacturer with minimum three (3) years documented experience and certified by the Lightning Protection Institute.

1.9 FIELD MEASUREMENTS

A. Verify that field measurements are as indicated on shop drawings.

1.10 COORDINATION

A. Coordinate work with roofing and exterior and interior finish installations.

PART 2 – PRODUCTS

2.1 COMPONENTS

A. Air Terminals: Solid aluminum with adhesive bases for single-ply roof installations.

B. Cable: Aluminum.

C. Inspection well.

D. Grounding Rods: Copper clad steel.

E. Ground Plate: Copper.

F. Down Conductors: Copper.

G. Connectors and Splicers: Bronze.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install in accordance with NFPA 780, UL 96A, and LPI-175.

B. Installation methods shall match those existing. Protect adjacent construction elements and finishes from damage.

C. Bond exterior metal bodies on building to lightning protection system and provide intermediate level interconnection loops 60-feet on center. This shall apply to walkway canopies throughout the project.

3.2 FIELD QUALITY CONTROL

A. Obtain the services of Underwriters Laboratories, Inc. to provide inspection and labeling of the lightning protection system in accordance with UL 96A. Provide framed copy of label certificate in electric room.

B. Perform inspection and testing in accordance with LPI-177.

3.3 DOCUMENTATION

A. Provide a written statement confirming the work on the LP system is complete and was installed in accordance with NFPA 780.

END OF SECTION

SECTION 26 51 14
INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

1.2 SCOPE

A. Provide lighting fixtures, accessories, labor, and supervision necessary to install a complete Interior Lighting System.

1.3 STANDARDS AND CODES

A. Except where otherwise required by this Section, the following Standards and Codes shall govern:

1. NEC Article 410
2. UL Listed
   a. 1310 and 8750 – Light Emitting Diode (LED) equipment for use in lighting products.
3. American National Standards Institute (ANSI)
   a. ANSI C82.11 – Performance requirement for high frequency ballasts.
   b. ANSI/IES RP-16-10 – Nomenclature and definitions for illuminating engineering.
   c. ANSIE1.20 - Remote Device Management over DMX512 Networks.
   d. ANSI C62.41 – Recommended practice in low power circuits.
4. International Electrotechnical Commission (IEC)
   a. IEC 61347-1–General and safety requirements for lamp control gear.
   b. IEC 61347-2-13–Particular requirements for electronic control gear for LED modules.
   c. IEC 62384 - DC or AC supplied electronic control gear for LED modules – performance requirements.
   d. IEC 61000-3-2 - Harmonic current emissions.
   e. IEC 61547 - EMC immunity requirements.
   f. IEC 62386-101/102/207–Digital addressable lighting interface (DALI).
5. Federal Communications Commission (FCC) rules – Part 15 Class B: Radio Frequency Devices
   a. Commercial rated.
6. Entertainment Services and Technology Association
   a. ESTA E1.3 - Entertainment Technology - Lighting Control System - 0 to 10V Analog Control Protocol.

1.4 SUBMITTALS

A. Submit catalog cuts giving complete description of fixtures to include photometric curves and method of installation.

B. Submit index listing all fixtures and complete model with submittal.

C. Provide normal and emergency lighting photometric calculations for each space.

1.5 QUALIFICATION

A. The lighting fixtures listed in the fixture schedule are the basis of design for the lighting systems. Substitutions will be considered per the General Conditions in Division 1 of this specification.

B. Final review for fixtures will be when shop drawings are submitted. The Architect reserves the right to reject any fixtures which, in his opinion, do not meet the overall lighting system design. Upon request, the fixture supplier shall submit sample fixtures.

PART 2 - PRODUCTS

2.1 LED FIXTURES

A. LED fixture housings shall be die-formed of cold rolled steel of not less than 22 gauge. Construction shall provide an approved method of locking lens, shielding in place, and integral lensing. Enamel finish for light reflectance shall have a hardness between H and 3H. Before enamel is applied, the metal shall be cleaned and prepared by "Bonderizing" or an equivalent process. All paint shall have a minimum reflectivity of 88%.

B. Plastic lenses for fixtures shall be 100% virgin acrylic, not less than 1/8" nominal thickness. All lenses in kitchen and damp areas shall have smooth side down and shall have triple gaskets.

C. Temperature around ballast and in fixture housing shall not exceed manufacturer’s recommendations with ambient room temperature of 27-degrees C.

D. All LED fixtures shall be equipped with a ground screw or lug to ensure mechanical bond.

E. All LED fixtures shall have an "in-line" fuse on the ungrounded primary contactor of each ballast. They shall be buss type GLR holders with GLR fuses of size required.

F. Recessed fixtures in plaster ceilings shall be furnished with plaster frames.

G. Fixtures that, according to drawing symbol list, are to have emergency battery back-up shall have a Bodine "BSL" series unit or equivalent installed. The unit shall be UL approved according to "UL-924" and provide a minimum of 1400 lumen output while on battery power for a minimum of 90 minutes. It shall mount in fixture wireway, be compatible with standard and energy saving lamps, and have dual primary leads for use on either 120-volt circuits.

H. Prior to placing orders for recessed LED fixtures, Contractor shall verify the types of ceilings and suspension systems that have been approved for the project and shall order fixtures with flanges as required to fit in the approved ceilings.

I. Where multi-level switching is shown, the correct number of drivers shall be provided in each fixture to accommodate the switching scheme.

2.2 LAMPS

A. LED shall have an integral thermal management system for protection and long life.

B. TM-21 & LM-70 testing.

C. SDCM color binning and warranty for color consistency over the life.

2.3 LED DRIVERS - EQUIPMENT

A. Basis of design Manufacturer: Acuity

B. LED dimming shall be equal in range and quality to a commercial grade incandescent dimmer. Quality of dimming to be defined by dimming range, freedom from perceived flicker or visible stroboscopic flicker, smooth and continuous change in level (no visible steps in transitions), natural square law response to control input, and stable when input voltage conditions fluctuate over what is typically experienced in a commercial environment. Demonstration of this compliance to dimming performance will be necessary for substitutions or prior approval.

C. Ten-year expected life while operating at maximum case temperature and 90 percent non-condensing relative humidity.

D. Driver must limit inrush current.

1. Base specification: Meet or exceed NEMA 410 driver inrush standard of 430 Amps per 10 Amps load with a maximum of 370 $Amps^2$ – seconds.
2. Preferred Specification: Meet or exceed $30mA^2s$ at 277VAC for up to 50 watts of load and 75A at 240us at 277VAC for 100 watts of load.

E. Withstand up to a 1,000-volt surge without impairment of performance as defined by ANSI C62.41 Category A.

F. No visible change in light output with a variation of plus/minus 10 percent line voltage input.

G. Total Harmonic Distortion is less than 20% percent and meet ANSI C82.11 maximum allowable THD requirements at full output. THD shall at no point in the dimming curve allow imbalance current to exceed full output THD.

H. Driver must support automatic adaptation, allowing for future luminaire upgrades and enhancements and deliver improved performance:

1. Adjustment of forward LED voltage, supporting 3V through 55V.
2. Adjustment of LED current from 200mA to 1.05A at the 100 percent control input point in increments of 1Ma.Adjustment for operating hours to maintain constant lumens (within 5 percent) over the 50,000-hour design life of the system and deliver up to 20 percent energy savings early in the lifecycle.

I. Driver must be able to operate for a (+/- 10%) supply voltage of 120V through 277VAC at 60Hz.

J. Driver should be UL Recognized under the component program and shall be modular for simple field replacement. Drivers that are not UL Recognized or not suited for field replacement will not be considered.

K. Driver shall include ability to provide no light output when the analog control signal drops below 0.5V or the DALI/DMX digital signal calls for light to be extinguished and shall consume 0.5 watts or less in this standby. Control deadband between 0.5V and 0.65V shall be included to allow for voltage variation of incoming signal without causing noticeable variation in fixture-to-fixture output.

2.4 LED DRIVERS – LIGHT QUALITY

A. Over the entire range of available drive currents, driver shall provide step-free, continuous dimming to black from 100 percent to 0.1 percent and 0% relative light output, or 100 – 1% light output and step to 0% where indicated. Driver shall respond similarly when raising from 0% to 100%.

1. Driver must be capable of 20-bit dimming resolution for white light LED drivers or 15 bit resolution for RGBW LED drivers.

B. Driver must be capable of configuring a linear or logarithmic dimming curve, allowing fine grained resolution at low light levels.

C. Drivers to track evenly across multiple fixtures at all light levels and shall have an input signal to output light level that allows smooth adjustment over the entire dimming range.

1. Driver and luminaire electronics shall deliver illumination that is free from objectionable flicker as measured by flicker index (ANSI/IES RP-16-10). At all points within the dimming range from 100-0.1 percent luminaire shall have:
2. LED dimming driver shall provide continuous step-free, flicker free dimming similar to incandescent source.
3. Base specification: Flicker index shall less than 5% at all frequencies below 1000 Hz.
4. Preferred specification: Flicker index shall be equal to incandescent, less than 1% at all frequencies below 1000 Hz.

2.5 LED DRIVERS – CONTROL INPUT

A. 4-Wire (0-10V DC Voltage Controlled) Dimming Drivers:

1. Must meet IEC 60929 Annex E for General White Lighting LED drivers.
2. Connect to devices compatible with 0 to 10V Analog Control Protocol, Class 2, capable of sinking 0.6 ma per driver at a low end of 0.3V. Limit the number of drivers on each 0-10V control output based on voltage drop and control capacity.
3. Must meet ESTA E1.3 for RGBW LED drivers.

B. Digital (DALI Low Voltage Controlled) Dimming Drivers:

1. Must meet IEC 62386.

C. Digital Multiplex (DMX Low Voltage Controlled) Dimming Drivers:

1. Must meet DMX / RDM: USITT DMX512A and ANSI E1.20 (Explore & Address).
2. Capable of signal interpolation and smoothing of color and intensity transitions.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install fixtures; coordinate exact location with Architect's reflected ceiling plan.

B. Recessed fixtures in removable ceilings shall be connected to the branch circuit with 1/2" minimum flexible conduit and branch circuit wire no smaller than No. 12 from an accessible junction box. Where fixture housings are connected, use 90 degree C wire for branch circuit feed through fixture channels. All flex fittings shall be case hardened locknuts with insulated throats.

C. Fixtures shall be grounded. Lamp sockets shall be wired so that the outer shell is connected to the neutral grounded conductor.

D. Fixtures recessed in furred ceiling shall be installed so that they can be removed from below the ceiling.

E. Fixtures installed in plastered ceiling shall not be supported directly from the ceiling. Support fixtures from the ceiling supports.

F. Fixtures installed in acoustical tile ceilings shall be attached to the ceiling grid at all four corners with Hurricane Clips. The main runners of the ceiling grid shall be supported within 6" of each corner of the fixture.

G. Lighting control system vendor shall provide commissioning, programming, and 4 hours of on-site training of the owner’s representative.

H. To be installed per manufacturers prescribed methods.

I. Driver may be remote mounted up to 300 ft. (100 m) depending on power level and wire gauge.

J. 0-10V input shall be protected from line voltage mis-wire and shall be immune and output unresponsive to induced AC voltage on the control leads.

END OF SECTION

SECTION 26 52 00
EMERGENCY LIGHTING EQUIPMENT

PART 1 - GENERAL

1.1 WORK INCLUDED:

A. Emergency integral LED fixture power supply lighting units.

B. Emergency LED exit signs.

C. Emergency power supplies.

1.2 REFERENCES

A. FS W-L-305 - Light Set, General Illumination (Emergency or Auxiliary).

B. NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.

C. NEMA WD1 - General-Purpose Wiring Devices.

1.3 SUBMITTALS

A. Submit product data under provisions of Division 1.

B. Provide product data on emergency lighting units, exit signs, and emergency LED lamp power supply units.

PART 2 - PRODUCTS

2.1 EMERGENCY INTEGRAL LED FIXTURE POWER SUPPLY LIGHTING UNITS

A. Emergency Lighting Unit: Self-contained unit with rechargeable storage batteries, transfer switch, charger, and lamps.

B. Battery: Nickel-cadmium type, with 1.5-hour capacity to supply the connected lamp load.

C. Charger: Dual-rate charger, capable of maintaining the battery in a full-charge state during normal conditions and capable of recharging discharged battery to full charged within 12-hours.

D. Lamps: LED.

E. Unit Housing: Injection molded, flame retardant, high impact thermoplastic housing.

F. Indicators: Provide lamps to indicate AC ON and RECHARGING.

G. Provide switch to transfer unit from normal supply to battery supply.

H. Electrical Connection: Knockout for conduit connection.

I. Unit shall be provided with self-exercising/testing circuit programmed for 90- minute test every 30-days.

2.2 SELF-CONTAINED EMERGENCY POWER LED EXIT SIGNS

A. Type: Exit signs with integral battery-operated emergency power supply, including power failure relay, test switch, AC ON pilot light, battery, and fully- automatic two-rate charger. Unit shall be provided with self- exercising/testing circuit programmed for 90-minute test every thirty (30)days.

B. Battery: Nickel-cadmium, requiring no maintenance or replacement for 10 years under normal conditions.

C. Integral battery supply is not required where circuit supplying power to the fixture is backed up by an emergency generator.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install units plumb and level.

END OF SECTION

SECTION 26 52 01
WIRING FOR EQUIPMENT FURNISHED BY OTHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

B. Drawings and/or information provided by equipment vendor.

1.2 SCOPE

A. Provide materials, labor, and supervision necessary to install electric services for equipment furnished by Mechanical Contractor, Equipment Contractor, and Owner.

B. In general, the equipment to be wired shall include but not be limited to the following:

1. Mechanical Equipment.
2. Owner Equipment.

C. Provide equipment connections in accordance with the information provided on the drawings. Provide all conduit, conductors, boxes, outlets, devices, switches, etc. for a complete connection to make equipment operable.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide services and make final connections for motors and equipment. Make final connections except where notes on drawings state "rough-in only" or "final connections by others." Where final connections are to be made by others, install outlet box, pull in conductors, and leave 8" pigtail for each conductor.

B. Conductors shall be dead-ended and taped, and appropriate cover plate installed over box.

C. Furnish safety disconnects unless indicated to be supplied by Division 23 for motors and equipment, so as to make service complete to each item of equipment.

D. Specific attention is made to the miscellaneous equipment to be installed throughout the space. The Contractor shall consult the equipment drawings and product information, and coordinate with the local representative, to ensure a complete understanding of the scope of work. All systems shall be provided complete and operational, in their entirety under this contract.

E. Prior to roughing-in conduit, the Electrical Contractor shall consult with Mechanical Contractors, Equipment Contractors and Owner, and shall verify with them the exact locations for rough-ins, and the exact size and characteristics of the services required

and shall obtain from the Mechanical and Equipment Contractors and Owner a schedule of electrical loads for the equipment furnished by them. These schedules shall be used for verifying services, motor starters, disconnects, fuses, and overload protection.

F. The Owner reserves the right to relocate connection point of their equipment, 10'- 0" in any direction from the location shown, at no additional cost. Final location must be established prior to conduit rough-in.

G. Changes required in the work, due to the Contractor's failure to comply with these requirements, shall be made by the Electrical Contractor at no additional cost to the Owner.

END OF SECTION

SECTION 26 56 00
EXTERIOR LIGHTING

PART 1 - GENERAL

1.1 SECTION INCLUDES:

A. Exterior luminaires and accessories.

1.2 REFERENCES

A. ANSI C78.379 - Electric Lamps - Incandescent and High-Intensity Discharge Reflector Lamps - Classification of Beam Patterns.

B. ANSI/NFPA 70 - National Electrical Code.

C. Local City Ordinances and Amendments.

1.3 DESIGN REQUIREMENTS

A. Design and layout lighting system in conformance with IES recommended procedures.

1.4 SUBMITTALS

A. Submit under provisions of Division 1.

B. Shop Drawings: Indicate dimensions and components for each luminaire which is not a standard product of the manufacturer.

C. Product Data: Provide dimensions, ratings, and performance data.

D. Test Reports: Indicate measured illumination levels.

E. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency specified under "Regulatory Requirements".

F. Normal and emergency lighting photometric calculations.

1.5 PROJECT RECORD DOCUMENTS

A. Submit under provisions of Division 1.

B. Accurately record actual locations of each luminaire.

1.6 OPERATION AND MAINTENANCE DATA

A. Submit under provisions of Division 1.

B. Maintenance Data: Include instructions for maintaining luminaires.

1.7 QUALIFICATIONS

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

1.8 DELIVERY, STORAGE, AND HANDLING

A. Deliver, store, protect, and handle products to site under provisions of Division 1.

B. Accept products on site. Inspect for damage.

PART 2 – PRODUCTS

2.1 LUMINAIRES

A. Furnish products as specified on Drawings.

B. Substitutions: Under provisions of Division 1.

C. Full cut-off with house side shields as required.

2.2 LAMPS

A. Lamp Manufacturers:

1. General Electric
2. Sylvania
3. Philips Lighting Company.

B. Provide fixtures with integral LED lamp and driver type integral with the luminaire.

C. Reflector Beam Patterns: ANSI C78.379.

D. Color temperature shall match building exterior sconce fixtures.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine each luminaire to determine suitability for lamps specified.

3.2 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install lighting at locations indicated.

C. Install plumb.

D. Bond luminaires and metal accessories to branch circuit equipment grounding conductor.

3.3 FIELD QUALITY CONTROL

A. Operate each luminaire after installation and connection. Inspect for improper connections and operation.

B. Measure illumination levels to verify conformance with performance requirements.

C. Take measurements during night sky, without moon or with heavy overcast clouds effectively obscuring moon.

3.4 ADJUSTING

A. Adjust work under provisions of Division 1.

B. Aim and adjust luminaires to provide illumination levels and distribution as directed.

C. Re-lamp luminaires which have failed lamps at Date of Substantial Completion.

3.5 CLEANING

A. Clean work under provisions of Division 1.

B. Clean electrical parts to remove conductive and deleterious materials.

C. Remove dirt and debris from enclosure.

D. Clean photometric control surfaces as recommended by manufacturer.

E. Clean finishes and touch up damage.

END OF SECTION

SECTION 27 05 00
TELEPHONE AND DATA RACEWAY SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

B. Conduit and underground ducts shall be as specified elsewhere in Division 26.

1.2 SCOPE

A. Provide materials, equipment, labor and supervision necessary to install conduit system only, for installation of telephone (voice), computer (data), communication cabling and outlet devices. Cabling and device to be provided and installed by Owner.

PART 2 – PRODUCTS

2.1 MATERIAL

A. Conduit

1. Interior conduits concealed in partitions and exposed above 4' - 0" aff shall be EMT, 1" minimum. Conduits in or under slab shall be RGS, 1" minimum.

B. Outlet Boxes

1. Telecommunication outlet boxes concealed in partitions shall be 4" x 4" x 2-1/8" DP, galvanized sheet metal. Provide with single-gang dry-wall ring mounted vertically. For telecommunication outlets, stub 1" conduit up into ceiling space.
2. Provide single-gang blank plate on each unused outlet opening, to match other device plates.

PART 3 – EXECUTION

3.1 INSTALLATION

A. Install wall outlets where shown on drawings at same height as convenience outlets in same room. Install outlets for wall mounted telephones at 48" above finished floor, and at 48" above finished floor for handicapped public telephones.

B. Provide 200 pound pull-line in all empty conduits.

END OF SECTION

SECTION 27 41 00
CABLE TV RACEWAY SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this Section. The General Requirements apply to the work of this Section.

B. Conduit and underground ducts shall be as specified elsewhere in Division 26.

1.2 SCOPE

A. Provide materials, equipment, labor, and supervision necessary to install conduit system only, for installation of T.V. antenna communication cabling. Cabling and devices to be provided and installed by Owner.

B. Coordinate with the Owner's TV systems vendor for all rough-in requirements and outlet box locations.

PART 2 - PRODUCTS

2.1 MATERIAL

A. Conduit

1. Provide #6 AWG insulated copper grounding conductor from TV equipment backboard, to ground bus in room, or to building electrical ground as required.
2. Interior conduits concealed in partitions and exposed above 4' - 0" AFF shall be EMT, 3/4" minimum. Conduits in or under slab or exposed below 4'-0" AFF shall be RGS, 3/4" minimum, painted with two (2) coats of bitumastic paint.

B. Outlet Boxes

1. T.V. outlet boxes concealed in partitions shall be 4-11/16" x 2-1/8" DP, galvanized sheet metal. Provide with single-gang dry-wall ring mounted vertically. For cable TV, stub 3/4" conduit from box, up into ceiling space, and continue to nearest telecommunications closet.
2. Provide single-gang blank plate on each unused outlet opening. Color shall match all other device plates.
3. Provide outlet boxes and conduit rough-in for audio/video systems as indicated on the plans.

C. TV Term. Backboards: Of a size indicated, shall be furnished, and installed. Backboards shall be 3/4" exterior grade plywood Grade B-C. The B face shall be exposed. Terminal boards shall be painted with grey enamel before attachment of any surface mounted equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Consult with Cable TV Company prior to installing the service entrance conduit system and verify the exact requirements before proceeding with the work. Install ducts as required.

B. Install wall outlets where shown on drawings at same height as convenience outlets in same room. Install TV outlets 6" below finished ceiling where indicated for bracket-mounted monitors high on wall.

C. Provide 200-pound pull-line in all empty conduits.

END OF SECTION

SECTION 27 41 16
SOUND SYSTEM RACEWAY SYSTEM

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The other Contract Documents complement the requirements of this section. The General Requirements apply to the work of this section.

B. Conduit and underground ducts shall be as specified elsewhere in Division 26.

1.2 SCOPE

A. Provide materials, equipment, labor and supervision necessary to install conduit system only, for installation of a sound system and outlet devices. Cabling, devices, and speakers to be provided by the Owner.

B. Contractor shall fully coordinate with the Owner's contractor to ensure all raceways, boxes, and 120V power requirements are included in the base bid. Contractor shall obtain all rough-in details, conduit size and quantities, box information, etc., prior to beginning work.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Conduit

1. Provide #6 AWG insulated copper grounding conductor from sound system equipment backboard to ground bus in room, or to building electrical ground as required.
2. Interior conduits concealed in partitions and exposed above 4'-0" AFF shall be EMT, 1 inch minimum. Conduits in our under slab or exposed below 4'-0" AFF shall be RGS, 1" minimum, painted with two (2) coats of bitumastic paint.

B. Outlet Boxes

1. Paging outlet boxes concealed in partitions shall be 4-11/16" x 2-1/8" DP, galvanized sheet metal. Provide with single-gang drywall ring mounted vertically. For mic, volume controls, etc., stub 1" conduit from box, up into ceiling space to cable tray.
2. Speaker backboxes concealed in ceilings shall be sized per Owner's sound system contractor/vendor and made of galvanized sheet metal. Provide drywall trim and/or speaker grille unless specified otherwise. Run 1-inch conduit between speaker backboxes in ceiling space to backboard.
3. Provide single-gang blank plate on each unused outlet opening. Color shall match all other device plates.

C. SOUND SYSTEM TERMINAL CABINETS: Of a size indicated, shall be furnished and installed. Terminal cabinets shall be lockable, hinged door with backboards, 3/4" exterior grade plywood Grade B-C. The B face shall be exposed. Terminal boards shall be painted with gray enamel before attachment of any surface mounted equipment.

PART 3 - EXECUTION

3.1 EXECUTION

A. Consult with sound system contractor/vendor prior to installing the conduit system and verify the exact requirements before proceeding with the work. Install as required.

B. Install outlets where shown on drawings, at height to be designated by security vendor. Coordinate related 120V power receptacle with system rough-in boxes.

C. Provide 200-pound pull-line in all empty conduits.

END OF SECTION

SECTION 28 16 00
SECURITY RACEWAY SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of Contract, including, but not limited to, General, Special and Supplementary Conditions and other Division-1 Specification Sections, apply to the work of this section.

1.2 SCOPE

A. Provide materials, equipment, labor, and supervision necessary to install conduit system only, for installation of complete security system to be provided by Owner. Raceway system is intended to accommodate access control, intrusion detection, and video surveillance system (CCTV), as would be provided by the Owner's vendors. Conduit system shall accommodate all wiring, devices, control panel, and interconnections to other systems.

1.3 QUALITY ASSURANCE

A. Regulatory Requirements

1. National Electrical Code, (NEC).

1.4 SUBMITTALS

A. Product Data: N/A.

B. Shop Drawings: N/A.

PART 2 - PRODUCTS

2.1 MATERIALS

A. Raceways

1. J-Hooks: Static load limit of 75 lbs. galvanized steel construction. Caddy "Cablecat" or equal.
2. Provide #6 AWG insulated copper grounding conductor from each system control panel enclosure/rack, to ground bus in room.
3. Interior conduits concealed in partitions and exposed above 4'-0" aff shall be EMT, ¾-inch minimum. Conduits in or under slab or exposed below 4'-0" aff shall be RGS, ¾-inch minimum, painted with two (2) coats of bitumastic paint.

B. Outlet Boxes

1. Outlet boxes concealed in partitions shall be 4-11/16" x 2-1/8" DP, galvanized sheet metal. Provide with single-gang drywall ring mounted vertically. Stub ¾-inch conduit from box, up into ceiling space.
2. Provide single-gang blank plate on each unused outlet opening. Color shall match all other device plates.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Provide 200-pound test line in all empty conduits.

B. Ensure a complete pathway for cabling is possible from each outlet device, back to the respective security system control panel. Provide sleeves through firewalls/partitions as necessary to provide for future cabling.

END OF SECTION

SECTION 28 31 00
ADDRESSABLE FIRE ALARM DETECTION SYSTEM

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. The provisions of the General Conditions, Supplementary Conditions, and the Sections included under Division 1, General Requirements, are included as a part of this Section as though bound herein.

1.2 SUMMARY

A. The work described herein and, on the drawings, consists of all labor, materials, equipment, and services necessary and required to provide and test an automatic fire detection and alarm system. Any material not specifically mentioned in this specification or not shown on the drawings but required for proper performance and operation shall be provided.

B. Drawings and specifications comply to the best of the Engineer's knowledge with all applicable codes at the time of design. However, it is this Contractor's responsibility to coordinate/verify (prior to bid) the requirements of the Authority Having Jurisdiction over this project and bring any discrepancies to the Engineer's attention at least seven (7) days prior to bid. No changes in contract cost will be acceptable, after the bid, for work and/or equipment required to comply with the Authority Having Jurisdiction.

C. Contractor is advised that circuit routing for this system is not necessarily shown on the project drawings. Contractor shall provide and install all raceways, wiring and cabling required for a complete and fully functional system as intended by these specifications. All wiring and/or cabling shall be in conduit. Contractor shall provide and install a properly sized, flush mounted outlet box for every device. Contractor shall size and route raceways to accommodate the proper installation of the system cabling. T-Tapped cabling shall not be acceptable. In locations where raceway and/or conduit is not accessible after completion of the project, conduit shall be routed from device to device or fire rated access panels shall be installed to provide access to junction and pull boxes. Routing of raceway from device to device shall only be acceptable where the wiring scheme of the system, as recommended by the manufacturer, requires cable to pass from device to device. Contractor shall properly terminate each device according to the manufacturer’s recommendations. Provide and install firestopping where penetrations are made through rated walls and floors. Firestopping is to be performed under Division 7 Section Firestopping.

D. This Specification describes a fully addressable, common fire alarm system, with remote power supplies, remote voice evacuation panel.

E. Contractor shall provide and install the fire alarm system (including all equipment, wiring, etc.) in accordance with the manufacturer’s recommendations.

1. Installation of devices shall be in accordance with the manufacturer’s requirements as well as the requirements of the Contract Documents. Recommendations by the Manufacturer for the proper installation of the fire alarm system and its equipment shall not preclude the requirement for the Contractor to comply with the requirements of the Contract Documents.
2. Termination of fire alarm circuits shall be in accordance with the manufacturer’s recommendations, applicable requirements of the National Electrical Code (NFPA 70), National Fire Alarm Code (NFPA 72), ADA, other applicable Codes, and the Contract Documents.
3. Fire alarm Installer shall be responsible for ensuring that prior to bidding the project the Electrical Contractor understands the raceway requirements for the project. Claims by the

Contractor after award of the project in regard to additional raceway required either by the fire alarm system manufacturer's recommendations for proper installation of the system and its associated equipment, or for compliance with the requirements of the Contract Documents, shall not be allowed.

4. Contractor shall note that the drawings show fire alarm remote panels (FARP) in various locations. FARP's are intended to be equipment (remote control panels, power supplies, voice evacuation panels, addressable modules, power, grounding, and any other equipment or materials) necessary for a remote extension of the fire alarm system. FARP's shall be connected to the campus FACP via a signal line circuit (SLC) and other circuits specifically recommended by the fire alarm manufacturer and required to meet the intent of the project documents. An individual FARP shall provide the necessary circuitry (notification appliance circuits (NAC), initiating device circuits (IDC), DC power circuits required by various devices, etc.) to the fire alarm devices within its coverage area. The FARP shall provide interconnection services between the device circuits in its area of coverage and the FACP just as if those device circuits were directly connected to the FACP.

1.3 DESCRIPTION

A. The Contractor shall furnish and install a complete addressable analog fire detection system. The system shall include but not be limited to:

1. Main Fire Alarm Control Panel (FACP) includes all required power supplies.
2. Fire Alarm Annunciator Panel (FAAP).
3. Manual Pull Stations.
4. Smoke Detectors.
5. Duct Detectors.
6. Heat Detectors.
7. Horns.
8. Combination Audible/Visual devices (indoor and outdoor weatherproof as indicated on the drawings).
9. Visual Devices (indoor and outdoor weatherproof as indicated on the drawings).
10. Remote Fire Alarm Control Panels (Network Nodes).
11. Remote Power Supplies (Remote power supplies shall be in a UL Listed assembly and be provided by the same manufacturer as the Fire Alarm Control Panel (FACP)).
12. Modem for remote service capabilities.
13. Surge Suppression.
14. Programming.
15. Grounding
16. Firestopping (Firestopping is to be performed under Division 7 Section Firestopping).
17. Wire and Cable Labeling.
18. Electrical power required to comply with all functions and operations called for in this section of the specifications. Contractor shall provide and install all 120 VAC circuits as required.
19. Conduit, wire, wire fittings, terminal cabinets with plywood and terminal strips, and all accessories required to provide a complete operating system.
20. A complete and accurate schematic/drawing of the fire alarm system to be placed adjacent to the fire alarm annunciator panel and the main fire alarm panel.

B. Contractor shall furnish and install all equipment (raceways, wire/cable, circuit breakers, modules, relays, etc.) necessary, and as required by applicable code, to accomplish incidental functions of the fire alarm system including but not limited to the following:

1. Monitoring of sprinkler system and/or fire protection system flow and tamper switches.
2. Monitoring of sprinkler system and/or fire protection system valve supervisory switches.
3. Monitoring of post indicator valve (PIV) switches.
4. Gas/Fuel valve shutoff.
5. HVAC system control and/or shutdown.

6. Ventilation system (supply fans, exhaust fans, fan terminal boxes, etc.) control and/or shutdown.
7. Control of fire, smoke, and/or combination fire/smoke dampers.
8. Fire suppression and or extinguishing systems.
9. Monitoring of kitchen hood fire suppression systems.
10. Control of fire and/or smoke doors, dampers, shutters, etc.
11. Control of door hold open devices.
12. Control of time out room door lock devices.
13. Connection to phone lines for universal dialer.

C. System shall operate as a non-coded, continuous ringing system which will sound all audible devices, evacuation devices, and activate all visual devices until it is manually silenced.

D. System shall be wired as a Class B system for all circuits.

E. System is to be a complete analog addressable.

F. All portions of fire alarm system shall be installed in conduit.

G. Fire alarm system shall not share a raceway, junction box, enclosure, manhole or device with any other system.

H. Provide and install wiring, equipment, etc. for connection to devices furnished under other divisions of the work.

I. Provide and install wiring, equipment, etc. as required to deactivate power in air handling units.

J. Provide and install wiring, equipment, etc. as required to deactivate power to lab power panels and air conditioning equipment by automatic or manual devices as shown on plans.

K. In buildings, two or more floors provide communication equipment, in accordance with all applicable codes, for Areas of Rescue Assistance.

L. Although they may not be indicated on the fire alarm system diagram and/or drawings, all required control and interlock wiring between the fire alarm system and building equipment shall be provided. Controls are required to/for/from:

1. Fire/smoke air and duct detectors.
2. Fire, smoke and/or combination fire/smoke dampers.
3. Supply/Return fans, Exhaust fans, and/or Terminal Boxes (TB).
4. Sprinkler and/or Fire Protection system components.
5. Access Control.

M. Provide wiring for Post Indicator Valve Alarms, in each instance in which these are provided under work of Other Trades, connected to Fire Alarm System.

N. Provide and install all as required for a complete and operational fire alarm system, complying with all applicable codes and all requirements, and coordinated with all divisions of specifications.

O. Provide terminal cabinets sized to house terminal strips and surge suppression equipment.

P. Surge Suppression

1. The contractor shall have equipment installed on the AC voltage supply and other lines taking care to arrest damaging electrical transient and spikes which can cause damage to the microprocessor components of the system. Telephone lines shall have equipment

installed to arrest high voltages from electrical and/or lightning from entering the system and causing damage.

2. Provide and install all materials, labor and auxiliaries required to furnish and install complete surge suppression for the protection of building fire alarm system from the effects of induced transient voltage surge and lightning discharge as indicated on drawings or specified in this section.
3. Provide surge suppression equipment at the following locations:
   a. On each conductor pair and cable sheath entering or leaving a building.
   b. On each conductor associated with fire protection (sprinkler) system fire alarm connections.
   c. On any and all telephone lines.
   d. In other locations where equipment sensitivity to surges and transients requires additional protection beyond that inherent to the design of the equipment. Where equipment being protected has internal surge suppression equipment, the surge protection equipment herein specified is required to be installed in addition to internal equipment protection.

1.4 STANDARDS, CODES, REFERENCES, AND REGULATORY REQUIREMENTS

A. Equipment and installation shall comply with the current or applicable provisions of the following standards:

1. ANSI S3.41 American National Standard Audible Emergency Evacuation Signal
2. National Fire Protection Association Standards:
   a. NFPA 70 National Electrical Code (including but not limited to Article 760, Fire Alarm Systems, Article 770, and Article 800)
   b. NFPA 72 National Fire Alarm Code
   c. NFPA 101 Code for Safety to Life from Fire in Buildings and Structures
   d. NFPA 90A Installation of Air Conditioning and Ventilating Systems.
3. Underwriters Laboratories Inc. System and all components shall be listed by Underwriters Laboratories Inc. for use in fire protective signaling system under the following standards as applicable:
   a. UL 864 (Category UOJZ) APOU Control Units and Accessories for Fire Alarm Systems. All Control Equipment shall be listed under UL category UOJZ.
   b. UL 268 Smoke Detectors for Fire Alarm Systems
   c. UL 268A Smoke Detectors for Duct Application
   d. UL 217 Smoke Detectors Single and Multiple Station Smoke Alarms
   e. UL 521 Heat Detectors for Fire Protective Signaling Systems
   f. UL 228 Door Closers-Holders with or without Integral Smoke Detectors
   g. UL 464 Audible Signal Appliances
   h. UL 1638 Visual Signaling Appliances – Private Mode Emergency and General Utility Signaling
   i. UL 1481 Power Supplies for Fire-Protective Signaling Systems
   j. UL 1480 Speakers for Fire Alarm, Emergency, and Commercial and Professional Use
   k. UL 1424 Cables for Power Limited Fire Alarm Circuits
   l. UL 1971 Signaling Devices for the Hearing Impaired
   m. UL 1449, 4th Edition Standard for Safety for Surge Protective Devices
   n. UL 497 Protectors for Paired-Conductor Communications Circuits
   o. UL 497A Secondary Protectors for Communications Circuits
   p. UL 497B Protectors for Data Communications and Fire-Alarm Circuits.
4. All fire alarm equipment, including accessories to the system and including all wires and cable unless otherwise noted, shall be listed by the Underwriters Laboratories product directory.
5. Each item of the fire alarm system shall be listed and classified by UL as suitable for purpose specified and indicated.

6. System controls shall be UL listed for Power Limited Applications per NEC 760. All circuits must be marked in accordance with NEC article 760.
7. All equipment supplied as part of the Fire Alarm System shall be provided by a single manufacturer and shall comprise a complete UL Listed Fire Alarm System.
8. IEEE: Fire alarm system includes solid state electronic components. Therefore, the equipment manufacturer shall provide certification that all such equipment is internally protected from, or can withstand, power line surge voltages and currents as specified in Table 1, Location Category a High Exposure of ANSI/IEEE Standard C62.41 1991.

B. Equipment and installation shall comply with the current or applicable provisions of the following codes and laws:

1. Americans with Disabilities Act (ADA).
2. Local and State Building Codes.
   a. Florida Building Code – 2020, 7th edition.
   b. Florida Administrative Code. All applicable chapters including but not limited to:
      1) Chapter 69A Rules, including but not limited to:
         a) Ch 69A-3 Fire Prevention - General Provisions
         b) Ch 69A-46 Fire Protection System Contractors and Systems
         c) Ch 69A-48 Fire Safety Standards for the Fire Alarm Systems.
   c. Florida Fire Prevention Code – 2020.
   d. Authority Having Jurisdiction:
      1) General: The system shall comply with all applicable Codes, Ordinances and Standards as interpreted and enforced by the local Authority Having Jurisdiction.
      2) Fire Department/ Fire Marshall
      3) Building Official.

C. Surge Suppression

1. Equipment Certification: When available by any one manufacturer, all surge suppression equipment shall be listed by Underwriters Laboratories, shall bear the UL seal and be marked in accordance with referenced standard. Such surge suppression equipment shall be UL listed and labeled for intended use.
2. Comply with all standards and guides as listed under "References" above.

1.5 RELATED SECTIONS

A. All applicable sections of Division 0, Division 01, Divisions 26, 27 and 28.

B. Applicable sections of these specifications with regard to, but not limited to:

1. Doors
2. Exhaust hoods
3. Standpipe and fire hose systems
4. Sprinkler systems
5. Extinguishing systems
6. Ductwork accessories: smoke dampers
7. Building control systems
8. Local Area Sound System
9. Intrusion Detection System
10. Access Control System.

1.6 QUALITY ASSURANCE

A. Manufacturer: Company specializing in manufacturing the products specified in this section with minimum ten (10) years experience and with service facilities within 50 miles of Project.

B. Installer:

1. Company specializing in installing the products specified in this section with minimum ten (10) years experience.
2. The Installer shall be currently licensed by the Electrical Contractors Licensing Board as a Certified Alarm System Contractor I (EF).
3. The installing Contractor shall be a direct sales division of, or the authorized and designated distributor for, a fire alarm system manufacturer.
4. Installing Contractor shall maintain a local staff of specialists, including a Fire Alarm Planning Superintendent, for planning, installation, and service.
5. The installing Contractor shall maintain an office within fifty (50) miles of the project with capability to provide emergency service 7-days-a-week, 24-hour days. The installing Contractor shall have been actively engaged in the business of selling, installing, and servicing fire alarm systems for at least ten (10) consecutive years going back from date of bid.

C. Surge Suppression

1. All surge suppression devices shall be manufactured by a company normally engaged in the design, development, and manufacture of such devices for electronics/communications systems equipment.
2. The surge suppressor manufacturer shall offer technical assistance through support by a factory representative and local stocking distributor.
3. Verify proper clearances, space, etc. is available for surge suppressor.

D. Coordination/Project Conditions

1. Verify proper grounding is in place.
2. The fire alarm contractor shall provide a coupling conductor within the fire alarm underground raceway system to run alongside fire alarm conductors. Coupling conductors shall be sized according to applicable codes and standards.

E. Acceptable Manufacturers:

1. Fire-Lite (Existing system to network to and match for addition/expansion)

1.7 SUBMITTALS

A. Submit in accordance with Division 01 and Section Common Work Results.

B. In addition to requirements of above, the contractor shall submit:

1. Narrative of operation of System as provided. (Submittal will not be reviewed by the A/E without this narrative.)
2. Manufacturer's data on all products, including but not limited to:
   a. Catalog cut sheets.
   b. Roughing-in diagrams.
   c. Installation instructions. Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
   d. Operation and maintenance manuals.
   e. Typical wiring diagrams and risers.
   f. The contractor shall submit test reports, manufacturers' specifications, and any other information necessary to determine compliance with material and equipment specifications described herein.

3. Submit floor plans to locate all devices. Wiring diagrams shall include wire and raceway sizes, fire alarm control panels, riser wiring and associated raceway sizes, wiring details, connections, and terminal identification. All devices shall be identified by the same applied identification symbol as shown on the contract documents.
4. Submit all load calculations and cable/wire sizing for each branch of the individual fire alarm field circuits. Wire sizing calculations to prove maximum three percent (3%) voltage drop at all AC voltages and maximum eight percent (8%) voltage drop at all DC voltages.
5. Battery sizing calculations.
6. Submit a detailed step by step testing procedure for a component-by-component system functional checkout and test.
7. Point to point wiring diagrams and block diagrams of system to be installed.
8. Riser diagrams and floor plans showing conduit runs and number of wires. All devices shall be identified by the same applied identification symbol as shown on the drawings.
9. Surge Suppression
   a. Surge protective data for 120-volt power source, power circuit, outside signaling circuit, and exterior incoming circuits from other buildings (if any), and outgoing circuits to other buildings (if any).
   b. Submit Product Data for each type of suppressor:
      1) Dimensions.
      2) Means of mounting.
      3) Compliance with UL Standards referenced.
      4) Compliance with IEEE Standards referenced.
      5) Design type (Hybrid, MOV).
      6) Size of wire leads.
      7) Warrantee.
      8) Performance data showing compliance with performance as specified herein.
      9) Complete schematic data on each suppressor type indicating component values, part number, conductor sizes, etc.
      10) Manufacturer's certified test data on each suppressor type.
      11) Test data from an independent test laboratory.
10. Name, qualifications, etc. of company providing and installing system.
11. Qualifications of installer. Submit proof installer meets specified requirements.
12. Proof of UL Listing. Indicate the UL listing, the UL classification, and NEC insulation type used for each type of wire to be used in installation of fire alarm and communications system.
13. Manufacturer's drawings showing all dimensions (height, width, and depth) for all cabinets used to house system components. Provide catalog pages, mounting details and specification sheets for all fire alarm system components and rough-in boxes.
14. Submit Florida Registered Firm certificate number.
15. Submit Florida Fire Alarm Contractor's license number.
16. Submit Fire Alarm Technician(s) manufacturer's certification.
17. Detailed drawing of the Fire Alarm Control Panels layout indicating the exact arrangement of all zones, including expansion zones.
18. Coordination Drawing: Coordination CAD drawing of building equipment layout as shown on drawings, with all panel and rack footprints, using actual manufacturer's dimensions, indicating proper clearances.
19. Network:
    a. Complete description data indicating UL listing for all network components.
    b. Complete sequence of operation of all functions of the network.
    c. A list of every network node address.
    d. A list of every address of every device connected to a network node that is provided for purposes of alarm initiation, status monitoring, supervised notification appliance circuits, and auxiliary control.
    e. Complete network wiring diagrams for all components and interfaces to equipment supplied by others.
20. All drawings required herein shall be on AutoCAD Release 2006 or higher.

21. Where required by Authority Having Jurisdiction submit signed and sealed documents as required by Authority Having Jurisdiction. Where Authority Having Jurisdiction requires shop drawings to be signed and sealed by a FL Licensed Engineer, Contractor is required to submit same and include in his bid all costs associated with having a FL Licensed Engineer other than the design Engineer of Record perform signing and sealing.

1.8 PROJECT RECORD DOCUMENTS

A. Submit in accordance with Division 01, Section Common Work Results and Section Operation and Maintenance Manuals.

B. In addition to the requirements above, the contractor shall submit:

1. Updated and revised contract documents to record actual locations (as-installed) of all equipment, devices, initiating devices, signaling appliances, and end-of-line devices.
2. Record actual type, size, and routing of cables installed.
3. Record all cable identifications.
4. Drawings required herein are in addition to those required under "OPERATION AND MAINTENANCE DATA".
5. All drawings required herein to be on AutoCAD Release 2006 or higher.

1.9 OPERATION AND MAINTENANCE DATA

A. Submit in accordance with Section Common Work Results and Section Operation and Maintenance Manuals.

B. In addition to the requirements of Sections above, the contractor's O & M Manuals shall include:

1. A complete as-installed equipment list, listed by room, with manufacturers' names, model numbers, serial numbers, and quantities of each item.
2. A complete and correct system schematic, showing detailed connections for all parts of the system, including wire numbers, terminal block numbers and layouts, and other designations and codings (point-to-point wiring diagrams). System performance measurements shall be documented as noted elsewhere in this specification.
3. Riser diagrams showing as-installed conduit with pull boxes, outlet boxes, physical cable layouts, part numbers of cable types used, and number of circuits in each conduit.
4. Repair parts list for each and every major equipment item furnished.
5. Service manuals for each and every major equipment item furnished.
6. Manufacturer's warranties and operating instructions for each and every equipment item furnished. Include a copy of the certificate of warranty, signed by both parties.
7. Technical Systems Operations Manual, custom-written by the Contractor, for the purpose of instructing the Owner's operating personnel in the detailed step-by-step operation of the system and preventive maintenance procedures. This manual shall include descriptions of the system components and their relationship to system function. This manual shall be bound separately and labeled appropriately.
8. Surge Suppression
   a. O & M data to include:
      1) All accepted shop drawings, product data, and/or cutsheets.
      2) Installation, connection, and maintenance information on each type of surge suppression.
      3) Procedure and/or timetable for recommended periodic inspection of devices to determine continued usefulness.
9. Complete equipment rack layouts showing locations of all rack mounted equipment items.
10. CAD floor plans, prepared at a scale of not less than 1/16" = 1'-0" showing detectors, speaker locations and orientation, rack locations, and all other related device locations.

11. The Contractor/Installer shall video record the entire training session(s) and submit the recording with the Operational Manual.

C. Drawings required herein are in addition to those required under Project Record Documents:

1. All drawings required herein shall be on AutoCAD Release 2006 or higher.

1.10 WARRANTY

A. Contractor shall warrant the equipment to be new and free from defects in material and workmanship, and will, within one year from date of Final Completion, repair or replace any equipment found to be defective.

1. No charges shall be made by the installer for any labor, equipment, or transportation during this period to maintain functions.
2. Respond to trouble call within twenty-four (24) hours after receipt of such a call.

B. Contractor shall guarantee all wiring and raceways to be free from inherent mechanical or electrical defects for one (1) year from date of Final Completion.

C. Surge Suppression

1. All surge suppression devices shall be warranted to be free from defects in materials and workmanship for a period of five (5) years.
2. Any suppressor which shows evidence of failure or incorrect operation during the warranty period shall be repaired or replaced by the manufacturer and installer at no cost to the Owner.
3. Equipment that is damaged by surges during the warranty period shall be replaced at no expense to the Owner.

1.11 ADDITIONAL DEVICES FOR JURISDICTIONAL COMPLIANCE

A. Prior to bid, Contractor shall review plans and specifications carefully for compliance with all codes and in particular, the ADA Requirements and NFPA 72. Contractor shall include in bid price any devices required to provide a fully compliant system. Said additional devices shall be shown on shop drawings submitted by contractor.

1.12 MAINTENANCE SERVICE

A. Furnish service and maintenance of fire alarm system for one (1) year from date of Final Completion.

1. No charge shall be made by the installer and/or contractor for any labor, equipment, or transportation during this period to maintain functions.
2. Respond to trouble call within twenty-four (24) hours after receipt of such call.

B. Provide annual testing and inspection of fire alarm system at end of first year in accordance with NFPA 72. Correct any deficiencies found at no cost to the Owner. Affix fire alarm tag to panel.

1.13 MAINTENANCE MATERIALS

A. Provide six (6) keys of each type.

B. Provide three (3) of each type of automatic smoke detector without base.

C. Provide three (3) of each type of surge suppression device.

1.14 PROGRAMMING

A. Contractor shall provide all programming (one (1) original copy on disk or CD ROM of the programming software as provided by the manufacturer) EPROM burners, specialty hardware (excluding generic computer), all access codes and copyrighted software needed for adding, deleting, and changing devices in the program, for the Owner's use.

1.15 SYSTEM OPERATION

A. System shall receive and transmit alarm signals to existing facility Fire alarm system via Notifier Network, Notifier Net. System operation shall meet the operation requirements of all codes and regulatory requirements.

B. Upon activation of the Fire Alarm System by a manual station, smoke detector, or any other automatic device the following shall take place:

1. Energize all alarm signaling devices.
2. Sound all audible (horn or speaker) alarms and flash visual signals throughout the campus.
3. Cause alarm to be displayed on the annunciator section of the control panel.
4. Cause alarm to be displayed on remote annunciator.
5. Close all doors or fire shutters, held open by automatic release devices throughout the facility, (coordinate with architect and door hardware supplier, provide all electrical required).
6. Unlock all electrically locked time-out or access control doors (coordinate with the architect and door hardware supplier, provide all electrical required).
7. Shut down all air handlers, exhaust fans supplying or exhausting air, and fan terminal boxes (FTB).
8. Shut all fire and/or smoke dampers in ducts associated with the air handling units and exhaust fans which are shut down.
9. Transmit signals to the building automation system to tell system that the fire alarm system has taken control of respective mechanical system.
10. Send a signal to all dimming and lighting relay/control systems. Fire alarm signal shall initiate dimming system controls to drive all dimmed circuits to immediate full-on output. Fire alarm signal shall initiate lighting relay/control system to turn on all emergency lighting circuits.
11. Send a signal to all non-fire alarm sound reinforcement systems (i.e., Auditorium, Multi-Purpose Room, etc.). Fire alarm signals shall override all other sound systems. Alarm notification signals shall take precedence over all other signals. Operation of other sound systems shall resume after fire alarm system clears alarm.
12. Activate the system dialer and transmit the signal to the monitoring contractor, to notify the local Fire Department.

C. System supervisory faults, such as shorts, opens, and grounds in conductors, operating power failure, or faults within supervised devices, shall place the system in the trouble mode, which causes the following system operations:

1. Visual and audible trouble signal indicated by zone at the fire alarm control panel.
2. Visual and audible trouble signal indicated at remote annunciator panel.
3. Trouble signal transmitted to central station.

4. Manual acknowledgement function at fire alarm control panel shall silence audible trouble signal; visual signal shall be displayed until initiating failure or circuit trouble is cleared.

D. Alarm Reset: The system shall remain in the alarm mode until manually reset with a key accessible reset function. The system shall reset only if the initiating circuits are cleared.

E. Lamp Test: manual lamp test function causes alarm indication at each lamp on the fire alarm control panel and the remote annunciator.

F. When the fire alarm system is activated as a drill, all incidental functions shall be exercised including notification of the fire department.

G. Where required by codes or Authority Having Jurisdiction:

1. When system is silenced by silence switch in control panel, audible alarm is to silence but visual alarm devices are to continue to operate.

H. Fire sprinkler valve tamper switch, when closed, shall annunciate a supervision signal at the fire alarm control panel and annunciator panels, if any. This supervision signal shall not cause a general alarm.

I. Operation of auxiliary contacts in control panel to shut all smoke dampers in ducts associated with air handling units and exhaust fans which are shut down. (These shall not be controlled from detector unit contacts.)

J. Fire Pump Controller:

1. Fire Alarm system shall monitor fire pump controller status outputs and indicate trouble signals at control panel, annunciator, and central monitoring station.

1.16 ZONING

A. Alarm Zones

1. Regardless of the number of zones shown on drawings, the minimum alarm zones required are:
   a. One per building, per floor for pull stations.
   b. One per building, per floor for automatic devices.
   c. One for each duct smoke detector.
   d. Each device shall be individually annunciated/addressable.

B. Notification Zones

1. Regardless of the number of zones shown on drawings the minimum notification zones (speakers and strobe lights) required are:
   a. One (or more) circuit(s) for administration building
   b. One (or more) circuit(s) for exterior speakers
   c. One (or more) circuit(s) for each 5000sqft voice evacuation zone.
2. Breakdown circuits as required for load and distances involved.

PART 2 – PRODUCTS

2.1 GENERAL EQUIPMENT AND MATERIAL REQUIREMENTS

A. All equipment shall be new and unused. All components and systems shall be designed for uninterrupted duty. All equipment, materials, accessories, devices, and other facilities covered by this specification or noted on the contract drawings shall be best suited for the intended use and shall be UL Listed for operation with other system components.

2.2 RACEWAYS

A. General:

1. All raceways (conduit, wireways, pullboxes, outlet boxes, etc.) shall comply with applicable requirements of sections within Division 26 of these specifications.
2. All raceways (conduit, wireways, pull boxes, outlet boxes, etc.) shall comply with all requirements of the manufacturer of the fire alarm system.

B. Conduit: Comply with Section Conduit except as noted below:

1. Pull Cords: Install pull cords in all raceways runs that are installed without cable.
2. Size: Minimum size shall be 3/4" conduit.

C. Boxes:

1. All outlet boxes, junction boxes, pull boxes, etc. shall comply with applicable section of these specifications.
2. Boxes shall be sized as required by the fire alarm system manufacturer and NEC for cables and/or device installed.

2.3 TERMINATION CABINETS

A. Terminal cabinets are to comply with applicable sections of these specifications.

2.4 "SYSTEMS" AND "LOCAL" GROUND BUS

A. Bus to comply with applicable sections of these specifications.

2.5 FIRE ALARM CONTROL PANEL (FACP)

A. General

1. Fire alarm control panel shall be of dead front construction and be modular in design. Control panel shall be capable of future expansion and shall provide active signal initiating as noted on drawings (or as herein) specified with zones as noted on drawings (or as herein specified). Control panel shall provide provisions for future expansion. Fire alarm control panel shall be surface mounted (unless otherwise noted on drawings) and located as shown on the drawings. Fire alarm control panel shall be alarm and central station notification listed with FACP network capability to future FACP panels.

B. System Capability

1. Communication with addressable devices: The system must provide communication with all initiating and control devices individually. All of these devices are to be individually annunciated at the control panel. Annunciation shall include "Alarm", "Trouble", "Open", "Short", "Ground", "Device Fail" or "Incorrect Device" conditions for each point.
2. All addressable devices are to have the capability of being disabled or enabled individually.
3. Each Signal Line Circuit (SLC) two-wire loop shall be capable of addressing a minimum of ninety-nine (99) addressable devices and ninety-eight (98) monitor or control modules.
4. Identification of Addressable Devices: Each addressable device must be uniquely identified by an address code entered on each device at time of installation. The use of jumpers to set address will not be acceptable due to the potential of vibration and poor contact.

5. Wiring Type, Distances, Survivability and Configurations: The system must allow up to 2,500 feet wire length to the furthest addressable device. Style 4 Signaling Line Circuit (as defined by NFPA-72) communications will be provided.
6. System shall be capable of addressable devices and conventional devices within the same system.
7. All system circuits shall be inherently power limited per NEC 760.
8. System shall be capable of communication with a minimum of fifteen (15) spare (future) remote module locations.

C. Master Controller

1. Master controller shall be an integral part of the control panel and be microprocessor-based.
2. Master controller shall store all programming in non-volatile memory.
3. Master controller shall have an event log capable of storing a minimum of two hundred fifty-five (255) events in non-volatile memory.
4. Master controller shall include an eighty (80) character Liquid Crystal Display.
5. Master controller shall include, as a minimum, switches to accomplish Alarm/Trouble Acknowledge, Alarm Silence, Trouble Silence and System Reset.
6. Master controller shall include, as a minimum, LEDs to indicate System Alarm, System Trouble, Supervisory Alarm and System Silence.
7. Master controller shall support connection of serial remote annunciators.
8. Master controller shall provide a minimum of two (2) notification appliance circuits (Class A or B, Style Z or Y).
9. Master controller shall be capable of being expanded as necessary to accommodate all required modules.

D. Notification Appliance Circuits

1. Notification Appliance Circuits Module shall provide fully supervised style Z or Y (Class A or B) indicating circuits. These circuits shall be supervised, provide power or audio to horns, strobes, and speakers. Horns and strobes with polarity reversing loops containing up to 1.75 amperes of 24 Volt notification devices. Speaker circuits with 25 or 70 Vrms containing up to a 40 Watts speaker load.
2. Module shall be provided with plugable contact wiring terminal strips for ease of installation and service. The terminal strips shall be UL listed for 12 AWG wiring.

E. Power Supply

1. Power supply for the panel and all fire alarm peripheral shall be integral to the control panel. Power supply shall provide all control panel and peripheral power needs. Audio-visual power may be increased as needed by adding additional modular expansion power suppliers. All power supplies shall be designed to meet UL and NFPA requirements for power-limited operation on all external signaling lines, including initiating circuits and indicating circuits.
2. Circuit breakers or other over-current protection on all power outputs.
3. Input power shall be 120 VAC, 60 Hz. Power supply shall provide internal batteries and charger. Internal battery capacity shall be as required.
4. Battery pack shall provide maximum normal operating and supervisory power for:
   a. 24 hours per NFPA 72
   b. Provide low maintenance gel cell type batteries with sufficient ampere-hour rating to meet the above NFPA Standard and to operate all alarm signals for a duration of 15 minutes at the end of the required period of time.

F. Modem

1. A modem shall be provided as an integral part of the fire alarm control panel (FACP). The modem shall provide the Owner with the ability to accomplish the following functions:
   a. View device sensitivity information.
   b. View system activity in real time.
   c. Access and view the system history log.
2. Modem shall not allow changes to system programming.
3. Modem shall operate at a minimum speed of 9600 baud.
4. Modem shall provide an RJ-11 connector for connection to a telephone line.
5. Fire alarm contractor shall coordinate with the Premise Distribution System (PDS) contractor and/or the Telephone System contractor for interconnection to a telephone line. Telephone interconnection wiring up to the modem shall be provided by the PDS or Telephone contractor.
6. The modem shall mount inside the fire alarm control panel (FACP).

G. Wall Mount Equipment Enclosure

1. The control panel, and all associated equipment, shall be housed in an enclosure designed for mounting directly to a wall or vertical surface. The back box and door shall be constructed of 16-gauge steel with provisions for electrical conduit connections into the sides and top. The door shall provide a key lock and shall include a glass or other transparent opening for viewing of all indicators.
2. The enclosure(s) shall be of sufficient size to house all equipment required for this project. All equipment shall be mounted in the enclosure(s) as designed by the manufacturer. Provide enclosures in quantities as required to provide a complete, UL Listed Fire Alarm system.

2.6 REMOTE ANNUNCIATOR

A. Fire Alarm Annunciator Panel (FAAP) shall be a serial annunciator panel and must be capable of being mounted in a remote location.

B. Annunciator shall be modular using low current circuitry. The annunciator shall be capable of operating on nominal 24 Vdc and be battery backed up.

C. Annunciator modules shall be capable of activating local or remote LED's, relays, or graphic panels.

D. All switches shall be a point in the system and be capable of controlling any system output or functions. All LED's and outputs shall be capable of being controlled by any change of state in the system or as a result of a time control, sequence or logic function. LED's and switches shall be able to be clearly marked by the end user.

E. Modular components of the annunciator shall be mounted in a recessed cabinet with hinged door and a lexan window with keylock.

2.7 MANUAL STATION (NON-BREAK GLASS)

A. Manual fire alarm stations shall be non-code, non break glass type providing noncoded signals and operating with a double action motion. Upon actuation, they shall not be restorable to normal except by use of a key. The key shall also allow stations to be tested nondestructively. The stations shall be constructed of metal, with operating directions provided on the cover in highlighted, embossed lettering. The words "FIRE ALARM" shall appear on the door in embossed letters one-half inch high or larger. Mount at 48" above finished floor to top and in accordance

with NFPA and handicap standards. Manual stations shall be UL listed. Unit shall be equipped with an addressable interface module. Stations constructed of plastic will not be acceptable.

2.8 PHOTOELECTRIC SMOKE DETECTOR

A. The contractor shall furnish and install Analog addressable photoelectric smoke detectors, as called for on drawings. The combination detector head and twist-lock base shall be UL-listed compatible with a UL-listed fire alarm panel.

B. Smoke detector shall have a flashing, status-indicating LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady and at full brightness. The detector may be reset by actuating the control panel reset switch.

C. Sensitivity of the detector shall be monitored without removal of the detector head. Metering test points shall be accessible on the exterior of the detector head. Field adjustment of the sensitivity shall be possible when conditions require a change.

D. It shall be possible to perform a functional test of the detector without the need to generate smoke. Test method must simulate effects of products of combustion in the chamber to ensure testing of all detector circuits.

E. To facilitate installation, detector shall be non-polarized. By using a furnished wire jumper, it shall be possible to check circuit loop continuity prior to installing the detector head.

F. Voltage and RF transient suppression techniques shall be employed to minimize false alarm potential. A gated alarm output shall be used for additional detector stability.

2.9 DUCT MOUNTED SMOKE DETECTOR

A. Duct Mounted Smoke Detector for the fire and smoke detection system shall be a high velocity rated Analog addressable series smoke detector intended for use with ventilation and conditioning ducts.

B. Detector shall provide detection of combustion gases and smoke in air conditioning ducts in compliance with NFPA 90A. Detector shall be UL-listed specifically for the use in air handling systems.

C. Detector shall operate at air velocities ranging from 300 feet per minute to 4000 feet per minute without requiring compensation for operation at specific air velocities. Sampling tubes of proper length shall be provided and installed to match duct width at the installed location.

D. Whether shown on drawings or not, a remote alarm indicator/test station shall be provided for each duct mounted smoke detector to annunciate smoke detector operation remotely. Mount unit in ceiling or wall near respective remote smoke detectors (in an occupied space).

E. Detector shall be zoned so that when either the supply or the return detector senses smoke it will cause a supervisory/trouble indication at the main fire alarm panel and immediately shut down the air handler. The duct mounted detectors are NOT to cause a general alarm to sound.

2.10 HEAT DETECTORS

A. Contractor shall furnish and install Analog addressable heat detectors, as called for on drawings. Combination detector head and twist-lock base shall be UL-listed compatible with a UL-listed fire alarm panel.

B. Heat detector shall have a flashing, status-indicating LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady and at full brightness. Detector may be reset by actuating the control panel reset switch.

C. Fixed temperature automatic heat detectors shall be rated at 135°F (unless otherwise noted or required due to ambient conditions). Fixed temperature element shall use dual thermistor technology. Detectors shall have a smooth ceiling rating of 900 square feet. When required, detectors shall be equipped with two Form 'A' contacts with rating of 3 amps at 6 to 125 volts A.C. and 1 amp at 6 to 28 volts DC.

D. Detectors shall be installed in accordance with appropriate articles of the National Fire Protection Association and the spacing rating assigned by the Underwriters Laboratories and located as shown on the drawings. Automatic heat detectors shall be Underwriters Laboratories and Factory Mutual approved.

E. Where indicated on the drawings, the Contractor shall provide heat detectors rated, by the manufacturer, as explosion proof. If not an integral part of the heat detector assembly, the addressable module shall be located outside the area protected by the explosion proof heat detector (but interior to the building) in an accessible area. If the addressable module is located above a gypsum board ceiling the Contractor shall provide a fire rated access panel.

2.11 ADDRESSABLE MODULE

A. Analog addressable device shall be furnished as required to monitor fire alarm or supervisory initiating devices or control auxiliary functions. Each module shall contain address switches to assign a unique input point for programming or control by the system.

2.12 RELAYS

A. Relays required for control (i.e., Air Handler shutdown, Supply Fan shutdown, Exhaust Fan shutdown, Fan Terminal Box shutdown, Door Lock release, Fire Shutter release, Smoke Damper closure, Fire Damper closure, Smoke/Fire Damper closure, or any other interface required by these specifications or applicable codes) shall be UL Listed relays suitable for use in Fire Alarm systems.

B. Per NFPA, relays used for control of other systems shall be located within 3 feet of the device to be controlled.

C. Relays shall be analog addressable devices powered and controlled by the fire alarm system. Each relay shall contain address switches to assign a unique input point for programming or control by the system.

D. Each relay shall provide at least one set of Form "C" dry relay contacts.

2.13 AUDIBLE NOTIFICATION DEVICES

A. Audible notification devices shall be wall mounted at each location designated on the drawings and/or as specified herein.

B. The audible notification device shall include screw terminals for in-out field wiring. The device shall surface mount to a standard 4-inch sq. x 2 -1/8-inch backbox.

C. The audible notification devices shall be UL listed for fire protective service and shall provide 24 VDC inputs and sound output of not less than 75 dBA at 10 feet, or more than 120 dBA at the minimum hearing distance from the audible appliance.

1. Audible notification device shall be compliant with ANSI S3.41 for signal character conformance.

D. Audible notification devices located on the exterior of a building, or in a damp or wet location, shall be a weatherproof version and rated, by the manufacturer, for use in wet locations.

2.14 VISUAL NOTIFICATION DEVICES

A. Visual notification devices shall be wall mounted at each location designated on the drawings and/or as specified herein. Visual notification devices shall be of the flashing type in compliance with Americans with Disabilities Act.

B. Visual notification devices shall comply with the Americans with Disabilities Act which includes the following:

1. Lamp shall be a xenon strobe type or equivalent.
2. Lens shall be clear.
3. Maximum pulse duration shall be two-tenths of one second (0.2 sec) with a maximum duty cycle of 40 percent. Pulse duration is defined as the time interval between initial and final points of 10 percent of maximum signal.
4. Intensity shall be a minimum of 75 candela. Unless noted otherwise.
5. Flash rate shall be a minimum of 1 Hz and a maximum of 3 Hz.
6. Fire alarm system strobes within same room shall flash in synchronization as required by NFPA.
7. More than two visible notification appliances in the same room or adjacent space within the field of view must flash in synchronization. This requirement shall not preclude synchronization of appliances that are not within the same field of view.

C. A suitable polycarbonate cover shall be provided to protect devices at locations where they may be subject to damage.

2.15 HORN/VISUAL NOTIFICATION DEVICES

A. Horn/visual notification devices shall be wall/ceiling mounted at each location designated on the drawings and/or as specified herein.

B. Audible/visual notification device shall include screw terminals for in-out field wiring. The device shall surface mount to a standard 4-inch sq. x 2 -1/8-inch backbox.

C. Horn portion of the audibler/visual notification devices shall be UL listed for fire protective service and shall provide sound output of not less than 85 dBA at 10 feet.

D. Visual portion of the audible/visual notification devices shall comply with the Americans with Disabilities Act which includes the following:

1. Lamp shall be a xenon strobe type or equivalent.
2. Lens shall be clear.
3. Maximum pulse duration shall be two-tenths of one second (0.2 sec) with a maximum duty cycle of 40 percent. Pulse duration is defined as the time interval between initial and final points of 10 percent of maximum signal.
4. Intensity shall be a minimum of 75 candela. Unless noted otherwise.
5. Flash rate shall be a minimum of 1 Hz and a maximum of 3 Hz.

E. More than two visible notification appliances in the same room or adjacent space within the field of view must flash in synchronization. This requirement shall not preclude synchronization of appliances that are not within the same field of view.

F. A suitable polycarbonate cover shall be provided to protect devices at locations where they may be subject to damage such as Gymnasiums.

2.16 PULL STATION SECURITY COVER

A. Provide where pull station devices are required to be protected as indicated on the drawings.

B. Shall be UL Listed.

C. Constructed of clear polycarbonate.

D. Provide with battery operated warning horn.

E. For flush or surface mount devices.

F. Provide with weather gasket.

G. Spacers for additional depth as required.

H. Provide with tamper proof screws.

I. Design criteria:

1. Safety Technology International, Inc. #1100 Series.

2.17 DOOR HOLDERS

A. Electromagnetic door holder/releases shall be installed on each door as detailed on the drawings and/or as specified herein. Holder/releases shall consist of wall mounted and floor mounted electromagnets and a door mounted armature with an adjustable contact plate. Electromagnets shall have a force of attraction of 24 pounds when energized and less than 3 pounds residual power disconnected. Armature contact plates shall have a horizontal adjustment of 25 degrees. The holding force of holder/releases shall be totally electromagnetic and without the use of mechanical linkage or other moving parts, and they shall normally be energized, and a release accomplished, by interrupting the circuit. Electromagnetic holder/releases shall be controlled by either automatic or manual alarm. Operating voltage shall be 24-volt DC.

B. Electromagnetic door holder/releases, where required, to be supplied and installed by the Contractor and wired into fire alarm system by systems contractor. Electromagnetic holder/releases shall be controlled by either automatic or manual alarm. Operating voltage shall be 24-volt DC.

2.18 SURGE SUPPRESSION

A. Non-Addressable Initiation Devices:

1. Plug-in replacement modular design with associated female wiring connector.
2. UL 497B listed and labeled.
3. Multi-stage hybrid protection circuit.
4. Fail short/fail safe.
5. Surge Capacity: 10KA with 8 x 20 μs waveform, 500A per line with 10 x 700 μs waveform.
6. Clamp Voltage: 150% of circuit peak operating voltage with 100-amp 10 x 700 μs waveform.
7. Maximum Continuous Operating Voltage: 125% of peak operating voltage, minimum.
8. Capacitance: 1500 pf.

B. Addressable Initiation Devices and Data Loops:

1. Plug-in replacement modular design with associated female wiring connector.
2. UL 497B listed and labeled.
3. Multi-stage hybrid protection circuit.
4. Fail short/fail safe.
5. Surge Capacity: 10KA with 8 x 20 μs waveform, 500A per line with 10 x 700 μs waveform.
6. Clamp Voltage: 150% of circuit peak operating voltage with 100-amp 10 x 700 μs waveform.
7. Maximum Continuous Operating Voltage: 125% of peak operating voltage, minimum.
8. Capacitance: 50 pf.

C. Horn, Strobe, Control Power (Low Voltage):

1. Plug-in replacement modular design with associated female wiring connector.
2. UL 497B listed and labeled.
3. Multi-stage hybrid protection circuit.
4. Fail short/fail safe.
5. Surge Capacity: 5KA with 8 x 20 μs waveform.
6. Clamp Voltage: 150% of circuit peak operating voltage with 100-amp 10 x 700 μs waveform.
7. Maximum Continuous Operating Voltage: 125% of peak operating voltage, minimum.
8. Series Resistance: 0.2 ohms total per pair.

D. Power Circuit (120 volt):

1. UL 1449 listed.
2. 15 amp, 120V rated.
3. Suppressors shall be tested per IEEE, C62.41-1991 for Categories A and B.
4. Normal mode (L-N), and common mode (L+N-G) protection.
5. Internal fusing.
6. Hybrid design.
7. Indicators for normal operation and failure indication.
8. Enclosure:

    a. Fire retardant high impact, phenolic or plastic housing or metal enclosure.

9. Clamping voltage UL 1449, Line to Neutral, Category B Impulse At (3KA, 8 x 20 μs): 385V @ 120V.
10. Maximum Surge Capacity: 20,000 amps.
11. Maximum Continuous Operating Voltage: 115% of line voltage.
12. Provide hardwire connection or add 15-amp receptacle device to hardwired devices to match equipment being protected and maintain UL listing.
13. Provide additional 15 amp in-line fusing as required to comply with UL and the NEC when connected to a 20 amp, 120V circuit.

E. Terminations

1. Provide terminals sized for circuits required on project.
2. Where surge suppression modules are for mounting on 'M' block assembly, provide M block assembly complete with grounding system that mates with surge suppression equipment.

F. Terminal Cabinets

1. Provide terminal cabinets for all terminations and surge suppression equipment including 120VAC power surge suppressor as required in Section Surge Protection Devices. Size

terminal cabinets as required to facilitate installation of terminations and surge suppression in a neat and workmanlike manner.

2. Terminal cabinet to meet specifications in Section Cabinets and Enclosures unless specifically manufactured for use.
3. Manufacturers:
   a. Interior
      1) Schneider Electric
      2) Hoffman.
   b. Exterior
      1) Hoffman
      2) Carlon.

2.19 CABLE

A. Contractor shall provide and install cable as required by the manufacturer, as specified elsewhere in these specifications, and to provide a complete, fully operational, UL Listed Fire Alarm system.

B. Fire alarm system cables installed in interior, exterior and/or underground raceways shall comply with the applicable sections of NEC Articles 760, 770 and 800.

C. Wiring color code shall be as follows:

1.	Horns/Strobes	Black/Red
2.	Door Holders	White
3.	A.H.S.D.	Purple
4.	Gas Shut-Off Pull Stations	Orange
5.	Addressable	Twisted Pair Data Wire
6.	Hard-Wired	Brown/Blue
7.	Speaker	Twisted Pair Audio Wire.

2.20 WATERFLOW DETECTOR

A. Water flow switch to be supplied and installed by the mechanical contractor and wired into Fire Alarm System by systems contractor. Zone as shown on zone schedule.

2.21 SPRINKLER SUPERVISORY SWITCHES

A. Supervisory Switch to be supplied and installed by mechanical contractor and wired into Fire Alarm System by systems contractor. Zone as shown on zone schedule.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Contractor is advised that circuit routing for this system is not necessarily shown on the project drawings. The contractor shall provide and install all raceways, wiring and cabling required for a complete and fully functional system as intended by these specifications and networked to existing facility FACP. All wiring and/or cabling shall be in conduit. Contractor shall provide and install a properly sized, flush mounted outlet box for every device. Contractor shall size and route raceways to accommodate the proper installation of the system cabling. T-Tapped cabling shall not be acceptable. In locations where raceway and/or conduit is not accessible after completion of the project, conduit shall be routed from device to device or fire rated access panels shall be installed to provide access to junction and pull boxes. Routing of raceway from device to device shall only be acceptable where the wiring scheme of the system, as recommended by the manufacturer, requires cable to pass from device to device. Contractor shall properly terminate each device according to the manufacturer's recommendations. Firestopping where penetrations

are made through rated walls and floors shall be required. Firestopping is to be performed under Division 7 Section Firestopping.

B. Locate, install, and test fire alarm and detection systems in accordance with the equipment manufacturer's written instructions, and the latest editions of the National Electrical Code, the National Electrical Contractors Association publication "Standard of Installation" and all applicable codes and standards referenced in this specification.

C. Provide all work required for a complete system including complete system testing and checkout. All components shall be properly mounted and wired. The installation of this system shall comply with the directions and recommendations of authorized factory representatives.

D. Provide wiring, cabling, raceways, and electrical boxes in accordance with manufacturer's written instructions.

E. Components shall be electrically "burned-in" by operating the component at full power for a period as recommended by the manufacturer.

F. Installation shall be done in a neat workmanlike fashion by a firm regularly engaged in Fire Alarm Installation and Service.

G. The installation and inspection of all fire detection and fire alarm devices and systems shall be performed by, or under the direct on-site supervision of, a licensed fire alarm technician or a fire alarm planning superintendent who shall certify the work upon completion of the activity. The certifying licensee shall be present for the final test prior to certification.

H. As-built plans and wiring diagrams shall bear the signature and license number of the licensed fire alarm planning superintendent, the date of installation and the name, address, and certificate-of-registration number of the registered firm.

I. All components shall be completely wired. System shall be fully operable when main power service has failed.

J. Installation of detectors:

1. All ceiling mounted detectors shall be installed in accordance with the requirements of NFPA 72.
2. All concealed detectors shall be provided with a remote indicating lamp and test switch installed in an occupied space (corridor, etc.) on wall or on the ceiling grid indicating the type of detector and the zone to which it is connected. Label shall be red with white lettering.
3. Duct detectors shall be installed in accordance with NFPA 90A. All brackets and hardware shall be provided as required to install detector housing in correct position. All detector housings shall be sealed as required to prevent air leakage between duct and housing. Sampling tubes of proper length shall be provided and installed to match duct width at the installed location.

3.2 RACEWAYS AND BOXES

A. Provide dedicated raceway with applicable boxes for all fire alarm wiring in accordance with applicable sections of these specifications.

B. All initiating, indicating and auxiliary control devices shall be mounted on UL listed outlet boxes.

C. Provide supporting devices per Section Raceways.

D. Identify raceways and boxes per Section 26 05 53, Electrical Systems Identification.

3.3 WIRE/CABLE

A. Conductor: 98% conductivity, stranded copper with maximum of 19 strands. Stranded conductors shall have a compression lug installed at every end. Wrapping twisted strands at terminal block screw is not acceptable. As an acceptable equivalent, stranded conductors without crimp-on lugs may be terminated into terminal strips of box-lug connectors. SLC loops may utilize solid conductors.

B. Insulation: A type accepted by NEC for the application. All cable shall be UL listed for fire-protective signaling applications. Communication, Class 3 or Multi-Purpose cables shall not be substituted for FP cable types. All multi-conductor cables shall have individually insulated conductors with an overall outer jacket.

C. Size: All conductors shall be sized as prescribed by the system manufacturer, with following minimums:

1. Multiplex Signaling Line Circuit: AWG #14, solid twisted pair.
2. Notification Circuits, Devices: AWG #14 THHN/THWN stranded conductors.
3. Initiating Circuits, Hard-Wired Devices: AWG #14 THHN/THWN stranded conductors.
4. Initiating Circuits, Addressable Devices: AWG #16 twisted pair.
5. Speaker Notification Circuits: AWG #16 twisted pair.
6. Provide larger conductors where required to maintain voltage drop or signal strength within acceptable limits.
7. Multiplex signal line circuits and addressable circuits shall be either shielded or unshielded based on equipment manufacturer’s recommendations for specific application.

D. The above wire sizes shall be increased to size as required to comply with Authority Having Jurisdiction or as required for voltage drop, load, etc.

E. Color Coded:

1. Permanent wire materials shall be used to identify all splices and terminations for each circuit at all junction boxes, outlet boxes, and terminations.

F. UL:

1. General: Fire-protective signaling cable shall be UL listed as non-power limited or power limited as needed to match the output of the fire alarm equipment.
2. Non-Power Limited: Fire protective signaling circuits classified as non-power limited shall use cable listed under UL Electrical Construction Materials Directory. Category HNHT, "NON-POWER LIMITED FIRE-PROTECTIVE SIGNALING CABLE". All such cable shall have fire resistance, listing and markings as described in NEC 760.176. Minimum cable marking shall be NPLF.
3. Power Limited: Fire protective signaling circuits classified as power limited shall use cable listed under UL Category HNIR, "POWER LIMITED FIRE-PROTECTIVE SIGNALING CABLE". All such circuits shall be durably marked where plainly visible at terminations to indicate that it is a power-limited fire protective signaling circuit. Refer to paragraph titled "Fire Resistance of Cables" for additional requirements.
4. Fire Resistance of Cables: Power-limited fire-protective signaling circuit cables shall be UL listed as described in NEC 760.179. All such cable shall bear a cable marking that includes a Type designation as given in NEC 760.179(I). Provide Type FPL.

G. Connections of Installation Wiring:

1. Connections to Equipment: In accordance with NFPA for monitoring integrity and with the equipment manufacturer's instructions.

2. Connections of installation wiring to alarm initiating devices and alarm indicating appliances shall be monitored for integrity.
3. Interconnecting means shall be arranged so that a single break or single ground fault will not cause an alarm signal.
4. Apply a compression lug, similar to T&B Sta-Kon Terminal, to all stranded conductors at terminations or use box-lug terminal strips.
5. There shall be no wire splices. All wiring shall be continuous, uncut between devices and terminal blocks.

H. Rated Enclosures:

1. All vertical fire alarm wiring traversing more than one level shall be routed in rated enclosures. In addition, all horizontal wiring serving devices located on floors other than where wiring originates shall be routed in 2-inch concrete encasement, suitable rated building construction, or 2-hour wrap application enclosure accepted by local Authority Having Jurisdiction.

3.4 MANUAL PULL STATIONS

A. Install at 48 inches to top above finished floor.

B. All manual stations shall be in unobstructed locations.

C. Install to comply with NFPA, ADA, and all handicap/accessibility code requirements.

D. Provide, install, and connect additional pull stations (from that shown on drawings) as required to comply with above requirements.

3.5 AUDIBLE SIGNAL DEVICES, VISUAL SIGNAL DEVICES, COMBINATION AUDIBLE/VISUAL SIGNAL DEVICES

A. Shall comply with NFPA, the Americans with Disabilities Act and other applicable handicap/accessibility codes including but not limited to the following:

1. Wall mounted devices shall have their bottom edge at heights above the finished floor of not less than 80 inches and no greater than 96 inches.
2. In general, no place in any room or space required to have a visual signal appliance shall be more than 50 ft. (15 m) from the signal (in the horizontal plane). In large rooms and spaces exceeding 100 ft. (30 m) across, without obstructions 6 ft. (2 m) above the finished floor, such as auditoriums, devices may be placed around the perimeter, spaced a maximum 100 ft. (30 m) apart, in lieu of suspending appliances from the ceiling. Placement of visual devices shall not be less than the requirements as specified by NFPA 72.
3. No place in common corridors or hallways in which visual alarm signaling appliances are required shall be more than 50 ft. (15 m) from the signal. Placement of visual devices shall not be less than the requirements as specified by NFPA 72.

3.6 END-OF-LINE DEVICE

A. Mount end-of-line device box with last device or separate box adjacent to last device in circuit.

3.7 AUXILIARY CONTROL RELAYS

A. An auxiliary fire alarm relay used to control an emergency control device, e.g. motor controller for HVAC system fan controller shall be located within 3 ft. of the emergency control device.

B. The installation wiring between the system panel and the auxiliary fire alarm relay shall be monitored for integrity.

C. Auxiliary control relays shall be listed for use with fire alarm systems.

3.8 SPRINKLER FLOW SWITCHES

A. Coordinate the electrical and operating characteristics of the flow switches with the fire alarm panel.

B. Run conduit and wiring to the flow switches and connect them so as to provide an operable supervised sprinkler alarm system per NFPA standards, and state and local codes.

C. Provide all electrical including zones as required by Authority Having Jurisdiction and codes.

3.9 SPRINKLER VALVE SUPERVISORY SWITCHES

A. Coordinate the electrical and operating characteristics of the supervisory switches with the fire alarm panel.

B. Run conduit and wiring to the supervisory switches and connect them so as to provide an operable supervised sprinkler alarm system per NFPA standards, and state and local codes.

C. Provide all electrical including zones as required by Authority Having Jurisdiction and codes.

3.10 DOOR ELECTRIC LOCK AND HOLD-OPEN POWER SYSTEMS

A. General: Provide 24V-dc low voltage power to all building doors with openers, hold-open devices, closers, or electric locks. Refer to Architectural door hardware schedule for doors that may have electric holders or locks. Low voltage power supplies for door hardware shall be furnished separately from the fire alarm system. The fire alarm system shall only provide the unlocking or release control signals and auxiliary control relays at power supplies, in order to reduce power draw on fire alarm system power supplies and batteries.

B. Low Voltage Power: Provide a low voltage transformer on each floor having doors with electric hardware. Transformer shall be 120-24V ac, sized as required to handle load served. Mount in a NEMA 1 enclosure above accessible corridor ceiling outside the first door closest to fire alarm riser. Provide transformer primary fusing to comply with N.E.C. Provide a 24V ac-24V dc rectifier on the secondary side of the transformer. Provide dedicated branch circuit from closest 120V normal power panel. Provide necessary interposing auxiliary control relay(s) to accept unlocking/release and restore signals from the fire alarm system.

C. Wiring: Electric hardware shall be connected for fail-safe operation. Upon loss of normal power hardware shall unlock without unlatching. Hold-open doors shall release for closure. Restoration of hardware power shall be automatic after the fire alarm system unlock control is reset. Provide all wiring necessary to connect transformer. Provide all low voltage wiring to connect electric locks. Extend wiring down hinge side of stair door jamb through hinge plate into door and through door to electric lock mechanism.

D. Fire Alarm Unlocking Control: All door hardware circuits shall be controlled by fire alarm system. Upon receipt of signal from fire alarm system all door holders shall release, and stair/egress door electric locks power system shall be disabled allowing all locks to unlock (without unlatching). Signal to activate shall be automatic fire alarm signal or manual command initiated in the building Fire Control Room. Manual unlock override command shall be through override system. Provide pilot light and 3-position keyed override switch. ON position (illuminated red pilot light) shall

initiate fail-safe operation. OFF position shall restore low voltage power. Locate switch at reception desk.

E. Mount outlet box for electric door holder to withstand 80 pounds (36.4 kg) pulling force.

3.11 CABLE IDENTIFICATION

A. Provide and install permanent cable markers on all cables/wire lines, telephone lines, etc. at terminal strips, terminal cabinets and at main equipment.

3.13 SURGE PROTECTION

A. General

1. Provide, install, and connect new surge suppression equipment as specified herein, including protection of equipment power source, cable/wire entering or leaving building housing, main fire alarm system equipment, ground lugs, #6 copper ground wire in 3/4"c. to main building service ground.
2. Extreme care shall be taken by contractor to assure a properly surge protected system.
3. Surge protection equipment must be selected by contractor to match the equipment being protected including wire sizes, operating volts, amps, and circuit impedance.
4. Installation of surge protection equipment and its grounding must be per manufacturer's recommendations to assure short and proper ground paths.

B. Equipment Selection

1. Contractor to coordinate with suppliers and installers of all equipment being protected and provide surge suppression equipment which meets these specifications on respective equipment, wires, etc.

C. Equipment Installation

1. Install surge suppression equipment per manufacturer’s recommendation at each wire terminal as noted under Part 1.
2. Install surge suppression equipment terminal cabinets, etc. as required to facilitate installation of surge protection equipment and terminal points. Increase size of terminal cabinets (from that shown on drawings) to size required to facilitate installation of surge suppression equipment and terminal blocks.
3. Locate surge suppression equipment in terminal cabinet nearest main equipment cabinet (FACP).
4. Coordinate with Section Surge Suppression Equipment Contractor to assure that surge suppression for 120VAC power circuit and surge suppression required by this section are all installed in same terminal cabinet and bonded together.

D. Ground Installation

1. Ground Bus Connections
   a. Provide "local" ground bus in each terminal cabinet housing surge protection equipment (with lugs, etc. as required).
   b. Bond "local" ground bus to terminal cabinet with minimum #6 copper wire.
   c. Connect terminal cabinet "local" ground bus to "systems" ground bus installed per Section Grounding and Bonding with minimum #6 copper insulated wire (unless otherwise noted) in conduit.
   d. Note that "systems" ground bar is also to be used for power transformation ground (480V to 208V) where applicable.

2. Surge suppression equipment grounding
   a. Connect each surge suppressor to local ground bus in terminal cabinet with wire sized as recommended by manufacturer. Where "M" block type terminations/surge suppressors are used, bond ground rail to local ground bar with wire as recommended by manufacturer.
   b. Coordinate with Section Surge Protection Devices Contractor to assure that 120VAC power source/supply surge suppressor is also grounded to same local ground bus as surge suppressors provided in this section for same system (i.e. fire alarm, intercom, television, etc.).
3. Conductors
   a. Conductors shall meet requirements of Section Building Wire and Cable. Minimum size to be #12 THWN.
   b. Bends in excess of 90 degrees in any grounding conductor shall not be permitted. A radius of 6 inches or greater shall be maintained on all bends.
   c. Do not bundle unprotected conductors with protected conductors.
   d. Conductors shall be kept as short as possible.
   e. Conductors shall be secured at 12" intervals with an accepted copper clamp.
   f. Grounding conductors shall be properly connected to the building service ground by accepted clamps.
4. Grounding Connectors
   a. Connectors, splices, and other fittings used to interconnect grounding conductors, bond to equipment or grounding bars, shall be accepted by NEC or UL for the purpose.
   b. All connectors and fittings shall be of the Nicopress crimp or compression set screw type.
   c. Special treatment to fittings, lugs, or other connectors of dissimilar material shall be applied to prevent electro-galvanic action.

3.14 CONDUIT/BOX IDENTIFICATION

A. Contractor shall identify fire alarm conduit and boxes with red paint in exposed locations. Identify conduit in concealed locations with 4" mark of red paint every 4'-0" OC.

3.15 DEMONSTRATION

A. When system is complete it shall be demonstrated to Owner's Representative who shall be given complete instructions, spare parts, manuals, and maintenance information.

3.16 SYSTEM TESTING

A. Prior to certification of the fire alarm system the contractor shall accomplish a complete test of the fire alarm system in accordance with NFPA 72, Test Methods.

B. Perform a complete, functional, component by component test of the entire fire alarm and detection system. Provide a detailed step by step testing procedure which is unique to this project, reflecting the type of system and the number and location of all components.

C. Perform a sensitivity test of all smoke detectors and duct detectors. Perform a calibration/test of heat sensors.

D. Demonstrate the proper operation of each component as follows:

   1. Photoelectric, and duct smoke detectors: activate the detector with a "false smoke" product which has been specifically formulated for testing smoke detection systems.
   2. Heat detectors: activate the detector by utilizing the detector check button.
   3. Pull Stations: activate the station by operating the station in its normal mode.

4. Audible, Speaker, and Visual Alarms: verify proper operation when the system is put into the alarm mode.
5. Sprinkler Flow Switches: open the sprinkler system's inspection test valve. Verify that the flow switch sends an alarm signal within the allowed time corresponding to the switch's time delay setting.
6. Fire Alarm Panels: functionally check-out and test the panel per the manufacturer's written instructions. Demonstrate the proper operation of each modular component. Demonstrate automatic power change to batteries and back to building power upon a drop in voltage below the voltage threshold as specified by the panel manufacturer.

E. Demonstrate the supervisory function at each device loop circuit, and at all single component wiring runs such as for the sprinkler valve supervisory switches.

3.17 CERTIFICATION

A. After completion of the installation of the system, the licensee shall complete an NFPA Inspection and Testing form. The Inspection and Testing form format shall be as indicated in NFPA 72, Inspection and Testing Form. When an Inspection and Testing form has been completed, legible copies shall be distributed as directed by the Authority Having Jurisdiction.

B. After completion of the installation and testing provide NFPA 72, Record of Completion Form to the Owner.

C. After an installation has been complete, affix a Fire Alarm Tag to the control panel. The Fire Alarm Tag is in addition to the Inspection and Testing form. Protect the Fire Alarm Tag from vandalism by applying pressure sensitive label; do not use a "tie-on" tag. It shall be as required in the Fire Safety Rules.

3.18 FINAL DRAWINGS

A. As-built drawings shall be given to the Owner’s representative, at time of instruction, in addition to those to be supplied as general requirements of the job.

3.19 AUTHORITY HAVING JURISDICTION

A. The drawings and specifications herein comply to the best of the Engineer's knowledge with all applicable codes at time of design. However, it is this Contractor's responsibility to coordinate/verify (prior to bid) the requirements of the Authority Having Jurisdiction over this project and bring any discrepancies to the Engineer's attention at least 7 days prior to bid. No changes in contract cost will be acceptable after the bid for work/equipment required to comply with the Authority Having Jurisdiction.

END OF SECTION