SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to design, install and test a pressurized, fully supervised, wet pipe fire protection system for full building protection in accordance with NFPA, IBC, and the Owner's insurance underwriter.

1.2 RELATED DOCUMENTS

A. The drawings and the specifications including SECTION 23 05 00 “Common Work Results for HVAC” are hereby made a part of the work of this section.

1.3 QUALIFICATIONS

A. The Fire Protection Work shall be performed by a qualified Contractor primarily engaged in the design and installation of Fire Protection Systems. The fire protection system design shall be performed under the direction of, and sealed by, a professional engineer registered in the State of Maine or with NICET Level III (minimum) Certification.

B. Welding qualifications of individuals installing welded piping shall be certified by the National Certified Welding Bureau for the type(s) of weld(s) proposed for use in piping assembly.

1.4 SUBMITTALS

A. Items for which the submittal requirements of section 23 05 00 “Common Work Results for HVAC”, apply are as Follows:

1. Hydrant flow test.
2. System components.
3. Hydraulic calculations.
4. Piping layout, details and control diagram.
5. Flushing and testing records.
6. Certificate of installation.
7. Copy of Fire Protection Contractors License.
8. Welding certificates of individual welding technicians.
9. Zone flow switches, piping and valves.
10. Sprinkler heads.
11. Alarm valve(s), part of the “Shell” Contract.
12. Fire department connection(s), part of the “Shell” contract.
13. Firestopping materials and methods.

Submit hydrant flow test, equipment descriptive data, hydraulic calculations and system layout for review by the Owner's Insurance Underwriter. Submit the system layout to the

Architect for review. The Architect's review will be limited to checking for conformance with the design concept of the project and general compliance with the contract documents and will in no way assume liability for review for compliance with codes, standards and laws.

1.5 SPRINKLER COVERAGE

A. Sprinkler head coverage shall conform with NFPA requirements for the use of the building (Light Hazard, 0.10 GPM/SF density for the hydraulically most remote 1500 S.F.). Coverage in other areas shall be increased accordingly where required by the Authority having jurisdiction.

B. If the requirements of the inspection agency or the Owner's insuring agent are more rigorous than those stated herein, then the more rigorous requirements shall govern.

C. The building will be sprinklered by a NFPA13 system under the “Shell” Contract and will require a new sprinkler system layout for full coverage of the tenant space to comply with NFPA13

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS AND HARDWARE

A. Pipe, Fittings, Joints, Hangers, Valves, Fire Department Connections, Alarms: Conform to NFPA-13, Installation of Sprinkler Systems.

B. Sprinkler Heads:

1. Interior Heated Spaces: Conform to NFPA-13, commercial quick response type. Provide semi-recessed type with white finish for acoustical tile ceilings. Sprinkler heads in GWB and corridor / lobby ceilings shall be concealed type. Dry pendent or sidewall heads, where required, may be standard response type.

2. Provide a spare head cabinet with wrenches and six (6) heads of each orifice size, finish, temperature classification, pattern and length furnished in the project.

3. Provide sprinkler head guards where required.

4. Sprinkler heads in unheated / minimally heated areas including all entrance vestibules shall be dry pendent or sidewall type, or served by a separate dry-pipe system.

5. Temperature ratings for sprinkler heads shall be suitable for the space. Heads in locations with concentrated heat sources shall have heads with the appropriate temperature rating.

2.2 WATER SUPPLIES

A. “Shell” contract.

2.3 DEVICES

A. Detection devices and associated wiring both within the fire protection system and connected to the building Fire Alarm System shall be the responsibility of the Sprinkler Contractor.

2.4 BACKFLOW PREVENTER

A. “Shell” contract.

2.5 PIPING SYSTEM IDENTIFICATION

A. Piping system and valve identification and color coding shall be in accordance with ANSI.

2.6 SPRINKLER SYSTEM ZONING

A. Per the City of Portland requirements.

2.7 CEILING CAVITIES

A. Ceiling cavities above all suspended acoustical tile ceilings in corridor areas and certain other areas contain bundled electrical cables and individual wires and shall be sprinklered. Coordinate sprinkler requirements with the Electrical Drawings

PART 3 - EXECUTION

3.1 PIPING LAYOUT AND DESIGN

A. System requirements, installation requirements, design, plans, and calculations: Conform to NFPA-13, Installation of Sprinkler Systems.

B. Sprinkler piping shall be run concealed above ceilings in occupied areas. Piping in other areas may be run exposed. Piping shall not be exposed in occupied spaces unless indicated on the drawings.

C. Pipe penetrations through walls and floors, including pipe sleeves shall be in accordance with Section 23 05 00 – General Mechanical. Traverse points of piping shall be escutcheoned with split chrome floor and ceiling plates and spring anchors, where visible to occupancy.

D. Coordinate design and layout with building structure and building systems. The work shown in the contract documents has precedence for space requirements. Work of other trades may be modified or moved only with permission of the trade involved. Costs associated with modifications or relocations shall be the same as for "Substitutions" Section 23 05 00. Sprinkler system piping may need to be located within the structural system in certain locations.

E. The Architect shall review proposed system layout and reserve the right to relocate heads, substitute head system and in general review final layout for components visible in occupied spaces.

F. Sprinkler heads shall be centered in acoustical ceiling tiles.

3.2 SYSTEM ACCEPTANCE

A. Approval, flushing, hydrostatic testing, instructions, and certificates of installation: Conform to NFPA-13, Installation of Sprinkler Systems.

B. Disinfect the water piping in accordance with AWWA C601. Fill the piping systems with solution containing a minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Repeat disinfection if chlorine residual is less than 10 parts per million after 24 hours. Flush the solution from the systems with clean water until maximum residual chlorine contents is not greater than 0.2 parts per million.

C. Closing in Work:

1. General: Cover up or enclose work after it has been properly and completely reviewed.

2. No additional cost to the Owner will be allowed for uncovering and recovering, work that is covered or enclosed prior to required review and acceptance.

D. Cleanup and Corrosion Prevention:

1. Upon completion of the work thoroughly clean and flush piping systems to the sewer with water.

2. Piping and equipment shall be thoroughly cleaned. Dirt, dust, and debris shall be removed and the premises left in a clean and neat condition.

3. Before uncovered piping is permitted to be concealed, corrosion and rust shall be wire brushed and cleaned and in the case of iron products, a coat of approved protective paint applied to these surfaces. When corrosion is from the effects of hot solder paste, the areas shall be cleaned and polished and a wash of bicarbonate of soda and water used to neutralize the acid condition.

E. Instructions: On completion of the project, provide a technician familiar with the system to thoroughly instruct the Owner's representative in the care and operation of the system. The total period of instruction shall not exceed four (4) hours. The time of instruction shall be arranged with the Owner.

F. Warranty: For a period of one (1) year after completion of the installation repair or replace any defective materials or workmanship. Upon completion of the installation, the system shall be turned over to the Owner fully inspected and tested, and in operational condition.

3.3 FIRESTOPPING

A. Firestopping shall be performed in accordance with Specification Section 07 84 00 “Firestopping”. All penetrations of fire-rated assemblies including walls and floors by mechanical system components (piping, ductwork, conduits, etc.) shall be firestopped as specified.

* END OF SECTION *

SECTION 22 00 00

PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and the specifications including Section 23 05 00 “Common Work Results for HVAC” are hereby made a part of the work of this section.

1.2 DESCRIPTION

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections, and incidentals and the performing of operations required to provide a complete and functional plumbing system.

B. Work shall be in accordance with the current edition of the Maine Internal Plumbing Rules and applicable local ordinances.

1.3 SUBMITTALS

A. Substitutions: Your attention is directed to Section 23 05 00-"Substitutions", relative to competition and the (ONLY) notation. Familiarity with this section shall be achieved before reading the PRODUCTS section of this specification.

B. The items for which the submittals paragraph in Section 23 05 00 “Common Work Results for HVAC”, apply are as follows:

1. Piping materials.
2. Grooved joint couplings and fittings.
3. Valves.
4. Pipe hangers.
5. Fixtures and trim.
6. Miscellaneous equipment.
7. Water heating equipment.
8. Piping, valves and equipment identification.
9. Floor drains and cleanouts.
10. Firestopping materials and methods.
11. Thermostatic mixing valves.
12. Insulation kits for ADA-compliant sinks.
13. Electronic Trap Primers (**ETP**).

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Soil and Waste (Sanitary), Condensate Drains and Vent Piping: Schedule 40 PVC or service weight cast iron with push-on joints below grade. Piping serving Kitchen Areas shall be service weight cast-iron. Above grade, vent piping may be Schedule 40 PVC or

service weight cast iron "no Hub" above grade. Above grade sanitary and waste piping shall be service weight cast-iron, “No-Hub”.

B. Domestic Water Piping and Condensate Drain Piping: Type L hard copper tubing and cast bronze or wrought copper solder fittings, lead-free solder, “Permalynx” push-to-connect fittings by Victaulic, “Installation-Ready” grooved joint couplings by Victaulic, or "Flowguard Gold" by Noveon or Watts "SeaTech" Quick-Connect type, Schedule 40 solvent-welded CPVC pipe and fittings. CPVC pipe and fittings shall be rated at 100 psig at 180^0F. and shall meet or exceed the requirements of ASTM D2846, the IBC, and be certified by the ANSI/NSF for potable water applications. Installation, including supports, shall be per the manufacturers recommendations.

C. Exposed Water and Waste Piping at Fixtures: I.P.S. copper with cast brass fittings chrome plated finish, with deep one piece escutcheon plates at traverse points.

D. Push-to-Connect Fittings: ASME B16.22 wrought copper or ASME B16.18 cast bronze, with stainless steel internal components and EPDM seals, rated to maximum +230 degrees F at 200 psig operating pressure. Victaulic “Permalynx”.

E. Grooved Joint Couplings and Fittings: ASME B16.22 wrought copper or ASME B16.18 cast bronze, copper-tube dimensioned fittings, with Installation-Ready couplings, for direct stab installation without field disassembly or loose parts, cast with offsetting angle-pattern bolt pads for joint rigidity. Gaskets shall be grade EHP, UL classified in accordance with ANSI/NSF-61 for potable water service. Victaulic Style 607.

F. Solder: Lead-free (ONLY), Englehard Silvabrite 100, 440^oF melting point, ASTM B32.

G. Piping located in masonry (CMU) construction: Piping shall be protected from contact with concrete (masonry) by use of pipe sleeves or other methods approved by the local plumbing inspector.

2.2 NO HUB COUPLINGS

A. For abovegrade DWV piping, couplings shall be Clamp-All HI-TORQ125, shall maintain 15 PSI hydrostatic seal, constructed with a 304SS housing and ASTM C-564 neoprene gasket. Couplings shall meet FM 1680, IBC and local codes and requirements.

2.3 VALVES AND ACCESSORIES

A. General Service Ball Valves: Apollo Model 77-100 (threaded) or 77-200 (solder), Victaulic PL-300 (push-to-connect), bronze full port, or Nibco, copper alloy with stationary seat ring and chromium plated or stainless steel floating ball per Federal Specification WW-V-35B. Blowout proof stem, reinforced PTFE seal. Sizes 2" and larger shall have threaded ends. Provide lever or tee handle with stem extension as required to allow operation without interfering with pipe insulation. For CPVC piping systems (ONLY), ball valves shall be Hayward, or approved equal, "True Union Ball Valves", full port design, Corzan PVC construction with Viton or EPDM seals and tee handle.

B. Butterfly Valves: Victaulic Series 608 with copper-tube dimensioned grooved ends, cast bronze body per ASTM B584, with elastomer coated ductile iron disc with integrally cast

stem. Valve rated to 300 psig CWP, with disc coating UL classified in accordance with ANSI/NSF-61 for potable water service.

C. Check Valves: Horizontal Swing, MSS SP-80, Type 3, Class 125.

D. Drain Valves: Provide ball valves with 3/4" hose connection and brass cap and chain.

E. Fixture Service Stop Valves: Angle Loose Key Stop, ASME A112.18M.

1. Each plumbing fixture and item of equipment shall have individual stop valves in the hot and cold supplies.
2. Service stop valves exposed in finished areas shall be chrome-plated brass; in non-finished areas, ball valves shall be used in lieu of chromed supplies.

F. Temperature and Pressure Relief Valves: Bronze body, tested under ANSI Z21.22, AGA and ASME rated, 125 psig/210^{o}F relief settings.

G. Automatic Trap Primers: Zurn Model Z-1022, Josam or Smith,"Sani-Guard" Trap Primer, all-bronze body with integral vacuum breaker, union connection and supply manifold as required to serve floor drain traps. Trap primers shall comply with ANSI/ASSE Standard 1018. Connect to each floor drain trap unless served by an Electronic Trap Primer (ETP).

H. Thermostatic Mixing Valve (**TMV 1**): Shall be Leonard, Symmons, or equal, capacities and performance as scheduled with stainless steel or lead-free bronze tempering valve, stainless steel or lead-free bronze valve, swivel action check-stops, thermometer, shut-offs and strainer. Controller shall consist of a liquid fill thermal motor with bellows mounted out of the water, UL-listed. Installation shall be per the manufacturers recommendations. Thermostatic mixing valves shall comply with ASSE 1070 or CSA B125.3.

I. Indirect Waste Receptor (I.W.): Zurn Model Z-1025, 3" or 4", fixed air gap, Dura-Coated cast-iron. Furnish with trap primer connection and connect to Electronic Trap Primer.

2.4 VALVES (CPVC Piping Systems)

A. Ball Valves: Spears, CEPEX, IPEX, Nibco or Plast-O-Matic, CPVC, 150 psig at 73°F. pressure rating.

B. Gate Valves: Spears, Hayward Industrial or Nibco, CPVC, 150 psig at 73°F. pressure rating.

C. Outside Screw and Yoke (OS&Y) Gate Valves: Spears or Nibco, CPVC, 150 psig at 73°F. pressure rating.

D. Check Valves: Spears, Hayward Industrial or Nibco, CPVC, 150 psig at 73°F. pressure rating.

E. Butterfly Valves: Spears, Hayward Industrial or Nibco, CPVC, 150 psig at 73°F. pressure rating.

F. Valves shall be compatible with up to a 40% solution of propylene glycol and water.

2.5 PIPE HANGERS

A. Adjustable Swivel Hangers:

1. Pipe sizes 2" and less: Carpenter and Paterson Fig. 800, oversize for insulated piping systems.

2. Pipe sizes larger than 2": Carpenter and Paterson Fig. 100, oversize for insulated piping systems.

B. Riser Clamp: Carpenter and Paterson Fig. 126 CT copper plated for copper piping, Fig. 126 for iron and PVC piping.

C. Insulation Shields: 18 ga. galvanized steel, 180^{o} wrap, Carpenter and Paterson Fig. 265P, Type H.

2.6 FIXTURES AND TRIM

A. (**P1**) Water Closet: ADA-compliant, floor-mounted, flush-valve type, TOTO Model CT705ELN (17”H. ADA), American-Standard, Kohler or Zurn, high efficiency elongated bowl, white vitreous china, low consumption (1.28 GPF), and shall flush with 30 psi water pressure at the valve. Where indicated final installation shall meet ADA guidelines and ANSI A117.1. See Architectural Drawings for mounting heights.

1. Flush Valve: TOTO Model TET1LN32#CP “Eco Powered”, Zurn Model ZGEN6200EV “HydroVantage” or Sloan “Solis” Model 8111-1.28, sensor-type, battery-operated and self-powered electronic with manual override button. Furnish with bumper stop, vacuum breaker and stop valve. Furnish with 6VDC lithium batteries and install per the manufacturers recommendations.

2. Seat: Church Model 895SSC, Toto SC534#01, fireproof thermoset, heavy weight solid plastic, open front, external check hinges, for elongated bowl, white color.

B. (**P2**) Lavatory, Wall Hung: Zurn Model Z-5341-PED, 20"x18", Toto LT307#01, American-Standard, Zurn, or approved equal, white vitreous china, with vitreous china shroud / half pedestal, single hole, front edge shall extend a minimum of 17" from rear finished wall, ADA compliant.

1. Drain: perforated grid strainer with bright metal finish.

2. Hanger/Carrier: Concealed arms or as furnished by the manufacturer. Mounting heights shall be as indicated on the Architectural Drawings.

3. Trap: Chrome-plated, cast copper alloy, 1-1/4" P-trap with cleanout plug. Adjustable with connected elbow and nipple to wall.

4. ADA lavatories shall be installed at 34" above finished floor. Final installation of lavatory and accessories shall meet ADA guidelines and ANSI A117.1.

5. (T) indicates a trap primer fitting.

6. Faucet: TOTO TEL105-D10ET#CP “Eco Powered”, Sloan “Optima Solis.” Model EAF-275-ISM, Symmons “Ultra-Sense”, Bradley, Zurn or Chicago-Faucets, chrome-plated brass, automatic electronic or infrared sensing dual temperature mixing type, battery-operated or self-powered and vandal-resistant, low battery indicator, ADA-compliant with a .5 GPM aerator and integral strainer. Supplies shall be chrome-plated with key stop. Furnish with strainer(s), solenoid valve, batteries and hot/cold back checks. Installation shall be in accordance with the manufacturers recommendations.

C. (**P3**) Urinal: Wall-hung, “Ultra Low Consumption, Zurn Model Z5798 “EcoVantage”, TOTO UT445#01, 1/8 GPF (1 pint), ADA-compliant, Sloan, Kohler, or approved equal, white vitreous china, with fastening hardware, 2" brass urinal flange, gasket, urinal lip shall extend a minimum of 14" from the finished wall.

1. Carrier (if required): Zurn, MIFAB, Josam or Jay R. Smith concealed wall carriers.

2. ADA urinals shall be installed with front rim a maximum of 17” above finished floor. Final installation shall meet ADA guidelines and ANSI A117.1.

3. The flush valve shall be Zurn “HydroVantage”, TOTO TEU1UN12#CP, or Sloan Model 8186, sensor-operated, electronic, battery powered and self-powered with manual override. Furnish with batteries and install per the manufacturers recommendations.

E. (**P4**) Washing Machine Supply and Drain: In-wall, concealed type, Watts Model A2C-WB-M1 “Intelliflow” with leak sensor, or equal, for 2" drain, 16 gauge steel, equipped with an electronic device and leak sensor that interlocks the water supplies with washer operation to control hot and cold water. If a leak is detected the water shall be automatically turned off. Provide integral screwdriver stops or ball valves and water hammer arrestors.F. Acceptable fixture / trim / brass manufacturers are as follows: Zurn, Sloan, Toto, American-Standard, Eljer, Just, Elkay, Kohler, and Moen (Commercial). Provide McGuire, or equal, chrome-plated key-operated stops on the hot / cold supplies to each fixture.

2.7 MISCELLANEOUS EQUIPMENT

A. Floor Drains (**FD**): Floor drains (FD) shall be Zurn Z-415S, Josam, or Smith, cast iron body with 2" or 3" bottom or side outlet, as indicated, combination invertible membrane clamp and adjustable collar. Floor drains shall have “deep seal” traps and trap primer connection.

1. Strainer: 7"x7” square Zurn "Type S", polished nickel-bronze.
2. For floor drains receiving indirect wastes, provide a funnel receptor.

B. Floor Cleanout (**FCO**): Zurn Z-1400, Josam, or Smith, adjustable floor cleanout, cast iron body, with gas and watertight ABS tapered thread plug. Provide size equal to piping served with maximum size of 4".

1. Concrete floor finishes: Scoriated round polished bronze top.

2. Sheet tile finishes: Scoriated square polished bronze top recessed to receive tile.

1. Carpeted finishes: Scoriated round polished bronze top and carpet marker.

2. Ceramic tile finishes (Main Street): Square cover, Brushed stainless steel.

C. Wall Cleanout (**WCO**): Sanitary tee with threaded raised nut or countersunk-nut cleanout plug located behind Zurn Z-1468, Josam or Smith, round stainless steel wall access cover.

D. Water Hammer Arrestors (Shock Absorbers): Plumbing and Drainage Institute listed, Zurn or Josam.

Schedule:

"A" - Size #100 PDI - 0-11 Fixture Units
"B" - Size #200 PDI - 12-32 Fixture Units
"C" - Size #300 PDI - 33-60 Fixture Units

E. Vacuum Breaker: Watts Model N36, 3/4" size, 20 CFM capacity.

F. Strainer: Watts Series 777, MIL-S-16293, epoxy-coated or bronze body wye-type, 200 WOG rating, screwed end connections, 20 mesh stainless steel, monel, or bronze screen.

G. Thermometers: Weiss Instruments Model DVU35, solar-operated, Tel-Tru, Trerice or Ashcroft, adjustable angle, plastic or Type 304 stainless steel case. The digital display shall include 3/8" high (minimum) LCD digits. The thermometer display shall be in ^{0}F. Accuracy shall be +/- 1% of the displayed value or 1^{0}, whichever is greater. Furnish with brass thermowells and provide with heat transfer fluid to fill the sealed interstitial space between bulb and well. Evidence of the transfer fluid leaking shall be cause for refilling and sealing the well.

1. Thermowell: Provide with brass thermometer wells projecting a minimum of 2" into the pipe with extension to face of insulation. Provide with heat transfer fluid to fill interstitial space between bulb and well.

2. Range: 30^{o}F to 240^{o}F for domestic hot water systems.

H. Electronic Trap Primer (**ETP**): PPP Inc. PT-series, Mifab or Zurn, 120V., atmospheric vacuum breaker, pre-set 24 hour clock, manual over-ride switch, shut-off valve, water hammer arrestor, calibrated manifold. Individually pipe to floor drain traps. In finished spaces the trap primer shall be enclosed in a flush stainless steel wall box with hinged door and tamper-resistant lock. Run trap primer piping (½" PEX) to each floor drain trap or indirect waste receptor trap as required by Code. Provide a ball shut-off valve on the inlet to the trap primer.

I. Floor Sinks (**FS**): Zurn Model Z-1900, Josam, or Smith, “Sani-Flor” receptor, 12"x12"x6" deep cast-iron body and square slotted medium duty grate with acid-resisting porcelain enamel interior and top, 3" outlet, complete with aluminum anti-splash interior bottom dome strainer. Grates shall be half-open. Coordinate with Kitchen Drawings.

2.8 PIPING, VALVE, AND EQUIPMENT IDENTIFICATION

A. Piping identification: Provide plastic "wrap-around" identification markers indicating flow and fluid flowing for the following:

1. Domestic Hot Water
2. Domestic Cold Water
3. Vent Piping
4. Exposed Above Ground Sanitary Drain Piping

B. Markers shall be placed 30-50 ft. apart for piping in accessible areas.

C. Markers shall be placed outside the pipe insulation and in the most obvious location for viewing.

D. Valve Tags:

1. Attach to each valve a 1-1/2" round or octagonal brass tag with 1/2" indented numerals filled with a durable black compound. In addition to the valve numbers, each tag shall identify the system it controls. Service stop valves exposed in finished areas need not be tagged.

2. Tags shall be securely attached to stems of valves with copper or brass "S" hooks, or chains.

3. Valve charts shall be provided for each piping system and shall consist of schematic drawings of piping layouts, showing and identifying each valve and describing its function. Upon completion of the work, one (1) copy of each chart, sealed to rigid backboard with clear lacquer placed under glass and framed, shall be hung where directed. Two (2) additional unmounted copies shall be delivered to the Architect.

4. Tags and charts shall be coordinated with Section 23 00 00 HVAC and when completed this work shall have been done sequentially.

E. Equipment Identification: Provide laminated plastic nameplates for equipment, pumps, mixing valves, backflow preventers, and balancing valves. Nameplates shall be laminated 0.125-inch thick melamine plastic conforming to Fed. Spec. L-P-387, black with white center core. Surface shall be a matte finish, corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be minimum of 0.25-inch high normal block lettering.

2.9 WATER HEATING EQUIPMENT **(GWH)**

A. Gas-Fired Water Heater (**GWH**): AO Smith "Cyclone Mxi", Bradford-White, State Industries Camus TH-series, or approved equal packaged unit of make, model, and performance as scheduled on Drawings; UL 732 and ASHRAE 90.1 compliant, ASME Section IV code construction, designed to burn natural gas, glass-lined or other approved lined tank with replaceable magnesium anode rods and heavy gauge steel jacket with baked enamel finish, or instantaneous type, factory installed ASME rated temperature and pressure relief valve, dial thermometer and pressure gauges and adjustable range thermostat with digital display. Set to provide 140°F water temperature. Hot and cold water connections shall be 1½". The water heater shall be high efficiency, direct vent, sealed combustion.

1. Burner controls: modulating burner, solid state flame safeguard with direct spark ignition, electronic low-water cut-off, and separate high temperature limit control.

2. The water heater shall have a three (3) year free replacement warranty in commercial service for labor and materials. The pressure vessel and combustion chamber shall have a five (5) year warranty for materials and labor. Furnish with concentric sidewall vent kit as indicated. Furnish with condensate neutralization kit.

3. Installation shall be in accordance with the manufacturer's recommendations. Venting shall be Type AL29-4C stainless steel or polypropylene per the installation instructions.

B. Provide firestats, emergency shut-off switches, and service switches as required by NFPA

2.10 THERMOSTATIC MIXING VALVE

A. Thermostatic Mixing Valve (TMV): Shall be Leonard "Eco-Mix", Model as scheduled, or Symmons, capacities and performance as scheduled with swivel action check-stops at the hot and cold inlets, thermometer, shut-off on the discharge piping and removable cartridge with strainer. Controller shall consist of a liquid fill thermal motor with bellows mounted out of the water. Finish shall be rough bronze.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

2. Verify that plumbing may be installed in strict accordance with pertinent codes and regulations and the reviewed Shop Drawings.

3.2 INSTALLATION OF PIPING

A. Provide and erect in accordance with the best practice of the trade piping shown on the drawings and as required to complete the intended installation. Make offsets as shown or required to place piping in proper position to avoid other work and to allow the application of insulation and finish painting to the satisfaction of the Architect.

B. The size and general arrangements, as well as the methods of connecting piping, valves, and equipment, shall be as indicated, or so as to meet the requirements of the Architect.

C. Piping shall be erected so as to provide for the easy and noiseless passage of fluids under working conditions.

D. Install unions to facilitate removal of equipment.

1. Unions are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as unions and disconnect points.)

E. Copper pipe shall be reamed to remove burrs.

F. Connections between copper and steel piping shall be made with brass fittings.

G. Solder joints shall be made with lead free solder. Clean surfaces to be soldered and use a paste flux. Wash joints with sodium bicarbonate and water to remove corrosive effects of heated solder paste. Caution: Lead-bearing solder is not permitted.

H. Grooved joints shall be installed in accordance with the manufacturer’s latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer’s factory trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor’s representative is not considered qualified to conduct the training or jobsite visit(s).)

I. Push-to-Connect Joints: Install Permalynx joints in accordance with the manufacturer’s latest published installation instructions. Prepare and mark tubing ends using a tool supplied by the manufacturer and in accordance with the manufacturer’s instructions.

J. Pipe penetrations through walls, floors and ceilings shall have pipe sleeves and shall be in accordance with Section 23 05 00 "Common Work Results for HVAC". Traverse points of piping shall be escutcheoned with split chrome floor and ceiling plates and spring anchors, where visible to occupancy.

K. Sanitary and vent piping shall be sized and installed at 1/4" per foot slope or as indicated and in no case less than 1/8" per foot.

3.3 PIPE HANGERS

A. Impact driven studs are prohibited.

B. Copper Tubing: supported at intervals with rod sizes as follows, double nuts on hangers and on beam clips.

Copper Size	Hanger Intervals	Rod Sizes
1/2"	5'	3/8"
3/4"	6'	3/8"
1"	6'	3/8"
1-1/4"	8'	3/8"
1-1/2"	8'	3/8"
2"	10'	3/8"
3"	10'	1/2"

C. Cast Iron Pipe: Supported at intervals with rod sizes as follows, double nuts on hangers and on beam clips.

Cast Iron Size	Hanger Intervals	Rod Sizes
1-1/2"	5'	3/8"
2"	5'	3/8"
2-1/2"	5'	1/2"
3"	6'	1/2"
4"	7'	5/8"

D. PVC Pipe: Supported at 4-foot intervals.

E. Verticals: Supported by use of clamp hangers at every story height, and at not more than 6 feet intervals for copper piping 1-1/4" and smaller size.

3.4 CLOSING IN UNINSPECTED WORK

A. General: Cover up or enclose work after it has been properly and completely reviewed.

B. If any of the work is covered or enclosed prior to required inspections and review, uncover the work as required for the test and review. After review, tests and acceptance, repairs and replacements shall be made by the appropriate trades with such materials as necessary for the acceptance by the Architect and at no additional cost to the Owner.

3.5 CLEANUP AND CORROSION PREVENTION

A. Upon completion of the work thoroughly clean and flush piping systems to the sewer with water.

B. Fixtures, piping and equipment shall be thoroughly cleaned. Dirt, dust, and debris shall be removed and the premises left in a clean and neat condition.

C. Caulk around fixtures at floor and wall.

D. Before covering is applied to piping systems, clips, rods, clevises and other hanger attachments, and before uncovered piping is permitted to be concealed, corrosion and rust shall be wire brushed and cleaned and in the case of iron products, a coat of approved protective paint applied to these surfaces. When corrosion is from the effects of hot solder

paste, the areas shall be cleaned and polished and a wash of bicarbonate of soda and water used to neutralize the acid condition.

3.6 DISINFECTING

A. After the entire potable water system is completed, cleaned and tested, and just before the building is ready to be occupied, disinfect the system as follows: After flushing the mains, introduce a water and chlorine solution for a period of not less than three hours before final flushing of the system.

3.7 TESTS

A. Sanitary soil, waste and vent piping: Fill with water to top of vents, and test as required by Code.

B. Water piping shall be tested to a pressure of 100 lbs. per square inch for at least 30 minutes. Pressure drop in this period shall not exceed two pounds per square inch. Leaks shall be repaired and system retested. Notify Architect 24 hours before test is to be performed.

3.8 INSTRUCTIONS

A. On completion of the project, provide a competent technician to thoroughly instruct the Owner's representative in the care and operation of the system. The total period of instruction shall not exceed four (4) hours. The time of instruction shall be arranged with the Owner.

3.9 FIRESTOPPING

A. Firestopping shall be performed in accordance with Specification Section 07 84 00 “Firestopping”. All penetrations of fire-rated assemblies including walls and floors by mechanical system components (piping, ductwork, conduits, etc.) shall be firestopped as specified.

* END OF SECTION *

SECTION 23 00 00

HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to install the heating, ventilating and air conditioning systems indicated.

1.2 RELATED DOCUMENTS

A. The drawings and the specifications including SECTION 23 05 00 “Common Work Results for HVAC” are hereby made a part of the work of this section.

1.3 SUBMITTALS

A. Substitutions: Your attention is directed to Section 23 05 00-"Substitutions", relative to competition and the (ONLY) notation. Familiarity with this section should be achieved before reading the PRODUCTS section of this specification.

B. The items for which the submittals paragraph in Section 23 05 00 “Common Work Results for HVAC”, apply are as follows:

1. Hangers.
2. Piping, valve and equipment identification.
3. Fans.
4. Firestopping materials and methods.

PART 2 PRODUCTS

2.1 FANS

A. Shall be model and performance indicated. Fan manufacturers shall be Panasonic, Greenheck, Cook or equal. The fans shall include housing, fan wheel, shaft, bearings, inlet shroud, motor, mounting support and mounting frame as a factory-assembled unit. An OSHA-approved belt guard for each fan shall be included. The fan drive shall have a 1.5 service factor for the maximum rated horsepower. Provide a disconnect switch for each fan. Roof and sidewall fans shall have a factory-applied epoxy coating with color selection by the Architect. Provide gravity-operated, gasketted automatic gravity backdraft dampers for all exhaust fans.

B. Bearings shall be precision, flange-mounted self-aligning ball bearings at inlet and discharge. Minimum average L50 design life shall be 200,000 hours at maximum catalogued operating conditions. Grease lines shall extend to the exterior of the fan housing.

C. Submit sound power data for inlet and discharge sound.

D. Submit fan curves for each fan with the design operating point clearly marked.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

2. Verify that the heating system may be installed in accordance with pertinent codes and regulations and the reviewed Submittals.

3.2 INSTALLATION OF PIPING

A. Refrigeration Piping:

1. Provide and install refrigeration piping, hangers, and accessories as specified and required. The piping installation shall be performed by a qualified refrigeration mechanic under the direct supervision of the equipment manufacturer. Submit records of tests.

2. Refrigeration piping shall be Type ACR copper tube with brazed joints, nitrogen-charged equal to BCUP-2 Classification of American Welding Society.

3. The refrigeration system shall be tested as follows:

High pressure Side	300 psi
Low Pressure Side	150 psi

4. Support risers, offsets, and equipment, in an acceptable manner.

5. Piping shall be installed to meet Codes and regulations, applicable to the installation and in accordance with the best practice of the trade. Brazing shall be accomplished while sweeping piping with nitrogen.

6. Refrigerant accessories shall include required valves and fittings to provide a complete installation. Refrigerant piping shall be insulated with ¾" thick Armaflex Type AP, or equal, elastomeric unicellular insulation. Exterior insulation shall have 30 mil glossy white UV-resistant PVC jacketing, or approved equal.

7. Parts of the system not factory charged and field installed piping of components shall be evacuated to within .10 MM/Mercury of a perfect vacuum. Break the vacuum to 0 psig with oil-free nitrogen before charging. Hold vacuum overnight for leak test.

8. Provide complete charges of refrigerant and oil to be maintained for the guarantee period.

9. Elbows shall be long radius.

10. The installation shall be in accordance with the above, with equipment manufacturer's instructions, and with established recommended practices.

11. System installation shall include the following:

    a. Pitch lines down in direction of flow a minimum of 1/2 inch per 10 feet.

    b. Trap suction risers as verified with the equipment manufacturer.

    c. Provide service valves on liquid and suction piping at air cooled condensing units.

    d. Maximum filter-dryer pressure drops:

       1 psi for liquid line filter-dryer.

    e. Liquid line solenoid valve on each refrigeration circuit.

    f. Thermal expansion valve on each refrigeration circuit.

3.3 PIPE HANGERS

A. Impact driven studs are not acceptable.

B. Pipes (copper or steel) shall be supported at intervals and rod sizes as follows, double nuts on hangers and on beam clips. PVC and CPVC shall have hanger spacing reduced by 50%.

Pipe Size	Hanger Spacing	Rod Sizes
1/2"	5'	3/8"
3/4"	6'	3/8"
1"	7'	3/8"
1-1/4"	8'	3/8"
1-1/2"	9'	3/8"
2"	10'	3/8"
2-1/2"	10'	1/2"
3"-6”	8'	1/2"

C. Verticals: Supported at the base and at intervals as follows by use of clamp hangers:

Steel Pipe: Not more than 16 ft.

Copper Pipe and Tubing:

1-1/2" and larger - Not more than 12 ft.
1-1/4" and smaller - Not more than 6 ft.

D. Provide welded insulated steel saddles at each hanger on steel piping systems 4" and larger.

E. PVC and CPVC Piping: Supported at 5' maximum intervals.

F. In grooved installations, use Victaulic Style 107 and 07 rigid couplings with offsetting angle-pattern bolt pads and AGS Series W07, or Grinnell, which permit support and hanging in accordance with ANSI B31.1, B31.3, and B31.9.

3.4 CLOSING IN WORK

A. Cover up or enclose work after it has been properly and completely tested and reviewed.

B. No additional cost to the Owner will be allowed for uncovering or recovering any work that is covered or enclosed prior to required test and review.

3.5 TEST AND ADJUST

A. Piping Systems: Test with water to a pressure of 75 psi and hold for a period of two hours. Repair any leaks and retest the piping system; repeat process until systems are leak-free. Test piping before it is insulated.

B. Before operating any system, flush the piping to remove oil and foreign materials.

C. After the installation is complete and ready for operation, test the system under normal operating conditions in the presence of the Architect and demonstrate that the system functions as designed.

D. Demonstrate that the HVAC systems have free and noiseless circulation of water, that all air has been purged and that systems are watertight.

E. Correct defects which develop in operational testing, conduct additional testing until defect free operation is achieved.

3.6 CLEANUP AND CORROSION PREVENTION

A. Piping and equipment shall be thoroughly cleaned. Dirt, dust, and debris shall be removed and the premises left in a clean and neat condition.

B. Before covering is applied to piping systems, clips, rods, clevises and other hanger attachments, and before uncovered piping is permitted to be concealed, corrosion and rust shall be wire brushed and cleaned and in the case of iron products, a coat of approved protective paint applied to these surfaces. When corrosion is from the effects of hot solder paste, the areas shall be cleaned and polished and a wash of bicarbonate of soda and water used to neutralize the acid condition.

3.7 INSTRUCTIONS

A. On completion of the project, instruct the Owner's representative in the care and operation of the system. The total period of instruction shall not be less than eight (8) hours. The time of instruction shall be arranged with the Owner. In addition to the prime Mechanical Contractor, the control system Contractor, Balancing Contractor, and Owner's representative shall be present and participate in the Owner's instruction.

3.8 FIRESTOPPING

A. Firestopping shall be performed in accordance with Specification Section 07 84 00 “Firestopping”. All penetrations of fire-rated assemblies including walls and floors by mechanical system components (piping, ductwork, conduits, etc.) shall be firestopped as specified.

* END OF SECTION *

APPENDIX A
VARIABLE AIR VOLUME BOXES

Price All-In-One
Terminals Performance Schedule

Report Date: Mar 08, 2017 02:27 PM

Job Name: Maine Media
Job Number: QP00000024
Customer:
Entered By: SP Doel
Reps Job No:
Location: 16 Middle Street, Portland, ME
Engineer: Bennett Engineering, Inc.
Sales Person:

Model	Tag ID	Unit Size	Transducer Type	Max (Primary CFM)	Min (Primary CFM)	Differential SP (in.wg)	Min Oper PD (in.wg)	Max Discharge NC	Max Radiated NC	Min Discharge NC	Min Radiated NC	Reheat(CFM)	Capacity kW	Volts	Steps	Current Amps	EAT °F	LAT °F
SDVLP8	1-1	8	VAV	500	250	0.5	0.01	23	--	--	--	250						
SDVLP8	1-2	5		300	150	0.5	0.01	26	--	20	--	150	1.9	480-1	SCRV	3.96	55	95
SDVLP8	1-3	8	VAV	650	325	0.5	0.01	24	--	20	--	325						
SDVLP8	1-4	5	VAV	300	150	0.5	0.01	26	--	20	--	150	1.9	480-1	SCRV	3.96	55	95
SDVLP8	1-5	8	VAV	475	250	0.5	0.01	22	--	--	--	250	3.16	480-1	SCRV	6.67	55	95
SDVLP8	1-6	8	VAV	600	300	0.5	0.01	24	--	20	--	300	3.8	480-1	SCRV	7.92	55	95
SDVLP8	1-7	6	VAV	325	175	0.5	0.09	20	--	--	--	175	2.22	480-1	SCRV	4.58	55	95
SDVLP8	1-8	5	VAV	200	100	0.5	0.01	25	--	20	--	100	1.27	480-1	SCRV	2.71	55	95
SDVLP8	1-9	8	VAV	550	300	0.5	0.01	23	--	20	--	300	3.8	480-1	SCRV	7.92	55	95
SDVLP8	1-10	6	VAV	450	250	0.5	0.18	25	--	--	--	250	3.16	480-1	SCRV	6.67	55	95
SDVLP8	1-11	5	VAV	350	175	0.5	0.01	29	--	21	--	175	2.22	480-1	SCRV	4.58	55	95
SDVLP8	1-12	5	VAV	300	150	0.5	0.01	26	--	20	--	150						
SDVLP8	1-13	5	VAV	250	125	0.5	0.01	27	--	22	--	125						

Job Name:	Maine Media	**Reps Job No:**	
Job Number:	QP00000024	**Location:**	16 Middle Street, Portland, ME
Customer:		**Engineer:**	Bennett Engineering, Inc.
Entered By:	SP Doel	**Sales Person:**	

Model	Tag ID	Unit Size	Transducer Type	Max (Primary CFM)	Min (Primary CFM)	Differential SP (in.wg)	Min Oper PD (in.wg)	Max Discharge NC	Max Radiated NC	Min Discharge NC	Min Radiated NC	Reheat(CFM)	Capacity kW	Volts	Steps	Current Amps	EAT °F	LAT °F

Footnotes Legend:

1) NC's are derived from sound power levels obtained in accordance with ASHRAE Standard 130-2008 and AHRI Standard 880-2011, which include duct end reflection corrections.
2) Sound power performance resulting in dashes (--) are below significance as outlined by the AHRI880-2011 standard.
3) NC values are calculated based on procedures outlined in AHRI Standard 885-2008, "A Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets."
4) Sound power levels are given in decibels (dB).
5) Airflow is given in cubic feet per minute (cfm).
6) Minimum operating pressure is the minimum static pressure required to operate the terminal unit assembly at maximum primary flow with a wide open damper.
7) Air pressure drop is given in inches water gauge (in. w.g.), and water pressure drop is given in feet of water gauge (ft. w.g.).
8) Terminal unit assembly is ETL certified in accordance with UL1995 and CSA 22.2.236.

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Conditions, Supplemental General Conditions and Instructions to Bidders shall apply to this work. Read these to be familiar with conditions related to the installation of the work.

1.2 WORK SHOWN ON DRAWINGS

A. The drawings accompanying this specification, as a part thereof, are working drawings indicating the location and arrangement of the increments of the systems of this section of work. Material deviation from this arrangement, process or means of application, shall bear the Engineer's review stamp before the change is made on the job or materials are ordered. Changes made without such review shall be ordered removed and items installed as specified shall be provided at no additional expense to the Owner.

B. The drawings are not intended to show in minute detail minor items of installation or materials such as specific fittings or findings.

1.3 MATERIALS AND LABOR

A. Furnish materials and labor necessary to deliver to the Owner a complete and operable system installed in accordance with the contract documents.

B. Materials shall be of the best quality. Workmanship shall be of highest grade and construction shall be done according to best practices of the trade.

C. Provide, when required, labeled samples of material or equipment specified herein or proposed to be used in this work.

D. Where words "furnish", "provide", or "install" are mentioned, either singly or in combination, these words are hereby interpreted to mean "furnish and install" or "provide and install", including materials complete with connections, supplemental devices, accessories and appurtenances, unless specifically otherwise noted. These words are likewise hereby interpreted as being prefixed to materials, equipment, and apparatus hereinafter mentioned, either in abbreviated or scheduled information or in the technical sections of the specifications.

1.4 EQUIPMENT INSTALLATION IN HEATING SEASON

A. The system shall be installed provided that the construction area will have sufficient heat to maintain temperature above 40°F throughout the construction period.

1.5 COOPERATION BETWEEN TRADES

A. Provide information sufficiently in advance of this work, so that work by the other trades may be coordinated and installed without delays. Furnish and locate sleeves, supports, anchors and necessary access panels.

B. Where work is concealed, assure it does not project beyond finished lines of floors, ceilings, or walls.

C. Equipment or piping requiring access found to be located above sheetrock ceilings shall be brought immediately to the attention of the Architect for resolution.

1.6 VISITING THE PREMISES

A. Visit the premises and review the existing conditions, as applicable.

1.7 ORDINANCES, AUTHORITIES, PERMITS, AND FEES

A. Obtain necessary permits and licenses, give notices and comply with laws, ordinances, rules, regulations or orders affecting the work, and pay fees and charges in connection therewith.

B. The "authority having jurisdiction" is the organization, office, or individual responsible for "approving" equipment, an installation, or a procedure.

1.8 PROTECTION OF WORK AND MATERIALS

A. Protect and care for materials delivered and work performed until the completion of the work. Defective equipment or equipment damaged in the course of storage, installation or test shall be replaced or repaired to the satisfaction of the Engineer at no additional cost to the Owner.

1.9 INSURANCE

A. Purchase and maintain Public Liability and Property Insurance during the progress of the work and until completion and acceptance of the entire project by the Owner in the amounts as specified in the General Conditions.

1.10 APPLICABLE CODES

A. Work and materials shall conform to the latest rules and regulations listed below and these rules and regulations hereby are made part of this specification. They include, but are not necessarily limited to the following:

2009 International Energy Conservation Code
American Society for Testing and Materials (ASTM)
Underwriters' Laboratories, Inc. (UL)

Air Moving and Conditioning Assoc. (AMCA)
American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
American Society of Mechanical Engineers (ASME)
National Electrical Manufacturers Association (NEMA)
Institute of Electrical and Electronics Engineers (IEEE)
American National Standards Institute (ANSI)
National Fire Protection Association (NFPA)
American Water Works Association (AWWA)
Local Fire Code
Local Plumbing Codes
American Welding Society

1.11 SHOP DRAWINGS

A. Submit shop drawings, manufacturers' data and certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, eight (8) copies, to be submitted to the Architect. Shop drawings will be returned "No Exceptions Taken", "Make Corrections Noted", "Amend and Resubmit", "Submit Specified Item", or "Rejected" less two (2) copies. Work shall progress in accordance with "Reviewed" shop drawings (ONLY).

B. Groups of similar shop drawings shall be submitted as individual bound documents with covers and indexes. Typical similar items would be "Diffusers and Registers", "Valves and Controls". Rejection of individual items shall not be cause for rejection of the entire document.

C. Clearly indicate item(s) to be reviewed on each submission by highlighting or underlining intended item(s). Submissions not clearly marked shall be returned "Amend and Resubmit".

D. Shop drawings must bear the Engineer's review stamp. In the event that the Engineer returns shop drawings "Amend and Resubmit" or "Rejected", the shop drawing must be revised and resubmitted for review.

E. Furnishing of the specified item must still produce the results and performance, dependability and quality reasonably to be expected within the spirit of the specifications, drawings, and the standard of good mechanical performance normal to the trade.

1.12 SUBSTITUTIONS

A. Refer to Specification Section 01 60 00 / 22. Where the specifications allow the substitution of a product, still this product is subject to review by the Engineer in accordance with the paragraph entitled "Shop Drawings". Review of a substitute item is an indication only that the substitute item is compatible with the specified item as a claim of the manufacturer. Insure dimensional propriety, performance, and quality of the substitute item.

B. Reference in the specifications or on the drawings to any product, material, fixture, form or type of construction, by proprietary name, manufacturer, make or catalog number, establishes a standard of quality or design and is not meant to limit competition. Use any equivalent substitute provided favorable written review by the Engineer is first obtained. The (ONLY) notation in the specification is an exception to this and leaves no option.

C. For materials or equipment which are supplied with integral or factory applied finish, the colors will be considered in evaluating substitutions.

D. For the purpose of avoiding conflicts with other trades, contracts, and adjoining work where more than one (1) article, device, material, fixture, form or proprietary name, manufacturer, make or catalog number, the first named shall be used as the basis of design and details. The cost of any changes because of substituted item shall be borne by the Contractor requesting such change.

1.13 COMMISSIONING

A. Mechanical systems in this project will be commissioned by an independent commissioning agent, hired by the Owner. All division 23 contractors and subcontractors will be responsible for carrying out the commissioning requirements specified in Section 019133 - General Commissioning Requirements, and other sections referenced in 019133, at no additional cost to the Owner.

PART 3 - EXECUTION

3.1 GRADES AND ELEVATIONS

A. Establish and maintain grades and elevations in connection with this work.

3.2 EQUIPMENT SUPPORTS

A. Furnish and install equipment supports for mechanical equipment as required. Supports shall be subject to review by the Engineer. All equipment shall be installed level and per the manufacturers recommendations.

3.3 SLEEVES AND PREPARED OPENINGS

A. Coordinate core-drilling, cutting, patching and setting of sleeves, frames, framing and lintels for openings with other trades. Sleeves shall be furnished by the Contractor. Pipe sleeves shall be provided at all floor and wall penetrations. Sleeves shall be Schedule 40 steel pipe for iron pipe, Type “L” copper for copper pipe and Schedule 40 PVC for plastic pipe. Sleeves shall be firestopped, as specified. Piping penetrations thru floors above grade shall have watertight pipe sleeves (LinkSeal, or approved equal).

B. Failure to give timely notice of and to locate openings and furnish sleeves shall cause no additional expense to the Owner.

3.4 CONNECTION TO EQUIPMENT

A. Provide piping connections, supports, brackets, compensators or flexible connections to prevent application of excessive stresses to equipment.

B. Equipment shall be installed with flanges or unions in such a manner as to permit disconnecting for removal of tubes, coils, elements and other equipment for inspection, service and repairs.

3.5 ACCESS TO EQUIPMENT

A. The installation of work performed shall provide reasonable accessibility for operation, inspection, and maintenance of equipment and accessories. The Engineer shall determine the adequacy of such accessibility.

3.6 ACCESS PANELS

A. Access panels shall be provided where indicated on the drawings and as required for access to valves and other serviceable components. Access doors shall be Milcor, Zurn or approved equal hinged with primed finish and with allen wrench operated latch.

B. Access panels installed in fire-rated assemblies shall have the same fire rating as the assembly.

3.7 PAINTING OF EQUIPMENT

A. Exposed ironwork, including steel supports and hangers in unfinished spaces, e.g. boiler rooms, mechanical rooms, pits, and trenches shall be properly cleaned, prepared and painted with two (2) coats of black asphaltum varnish.

3.8 GUARDS

A. Exposed moving and rotating elements of mechanical equipment items shall be protected with suitable guards for personnel protection. Guards shall be of rigid construction, firmly positioned. Holes shall be provided in guards at shaft centers to facilitate tachometer readings.

3.9 LUBRICATION

A. Furnish and install grease fittings for points requiring lubrication. Furnish extension type fittings as required to provide easy access for maintenance lubrication.

B. Furnish initial charges of lubricants for equipment. Lubricants shall be in conformance with the manufacturer's requirements and recommendations.

3.10 ELECTRIC MOTORS AND MOTOR CONTROLS

A. Unless otherwise noted, motors, motor starters and other electrical accessories which are specified under Mechanical specifications shall be selected with characteristics as follows:

1/2 Horsepower and less - 120 volt, 1 phase, 60 Hz.
3/4 Horsepower and larger – 460 or 208 volt, 3 phase, 60 Hz., as indicated.

B. Motors shall be built in accordance with the latest applicable NEMA, IEEE and ANSI Standards. Motors shall be manufactured by Baldor, Magnetek or Toshiba, of the latest type and quality specified under individual items of equipment. Motor efficiencies shall be premium high efficiency type per the Consortium for Energy Efficiency Standard and/or be “Energy Star” compliant.

C. Magnetic motor starters for mechanical items of equipment shall be furnished under Division 26 unless the starter is an integral part of a factory packaged item of equipment. Each starter furnished as an integral item of equipment shall be provided with overload heater elements. Starters shall be combination type with “Hand-Off-Auto” switches and shall have single phase protection or shall have relays installed to provide this feature. Starters shall be equipped with suitable step-down transformers to provide required control voltage.

D. Motors shall have a minimum continuous duty service factor of 1.15. Minimum motor efficiency shall be:

MOTOR HORSEPOWER	PERCENTAGE EFFICIENCY		
	(1200RPM)	(1800 RPM)	(3600 RPM)
1-3	----	86.5	85.5
5	89.5	89.5	86.5
7.5	90.2	91.0	88.5
10	91.7	91.7	89.5
15	91.7	93.0	90.2

3.11 CLEANING OF SYSTEMS

A. Piping and duct systems shall be thoroughly cleaned and flushed prior to initial operation.

B. Thoroughly clean exposed portions of the mechanical installation, removing labels and foreign substance.

C. Furnish detergents, solvents, cleaning compounds, and tools required for cleaning operations.

D. Keep the premises free from accumulation of waste material or rubbish and at the completion of the work, remove from the job site tools, scaffolding, surplus materials, and rubbish, leaving the work areas "broom" clean.

3.12 STARTING OF EQUIPMENT

A. Testing or starting of equipment shall be done in collaboration with trades concerned to insure safe and proper operation of the equipment.

B. Prior to starting equipment, provide lubrication at required points. Before starting any electrical or electric motor driven equipment, a check must be made to insure that proper heater coils are installed in the starters and that the equipment is rotating in the proper direction.

3.13 OPERATIONAL TESTING

A. Operate systems until successful operation is demonstrated to the Engineer. This initial operation shall be in addition to the testing of the system and shall be done after the system is cleaned and finished.

3.14 RECORD DRAWINGS

A. During construction, keep an accurate record of deviations to the installation of the work as indicated on the drawings. Upon completion of the work, furnish a copy of this record to the Engineer. **Submit record drawings before requesting final payment**.

3.15 MANUFACTURER'S REPRESENTATIVE

A. As indicated in the Technical Sections of this specification or as directed by the Engineer, provide the services of a factory trained Engineer or Technician to inspect, adjust, and place in proper operating condition the equipment or item involved. No additional compensation will be allowed for such service.

3.16 MANUFACTURER'S INSTRUCTIONS, OPERATION AND MAINTENANCE DATA

A. Provide for each item of equipment or apparatus furnished, a complete set of printed instructions obtained from the manufacturer covering proper operation, maintenance, lubrication, cleaning, servicing, adjustment, and safety instructions.

B. Manufacturer's data shall include performance data (curves are preferred where applicable) complete parts lists, recommended spare parts lists, piping, and wiring diagrams.

C. Arrange data in complete sets, properly indexed and marked.

D. Data shall include a complete set of shop drawings.

E. Material shall first be submitted in preliminary form for review by the Engineer. After review, submit two (2) copies in bound volumes to the Engineer for distribution.

3.17 GUARANTEES

A. An item becomes "defective" when it ceases to conform to the Contract Documents. Guarantees begin on the date of issuance of a certificate authorizing final payment or certificate of substantial completion with the Owner taking occupancy or beneficial use thereafter.

B. Upon completion of the work and before applying for final payment, furnish a written guarantee, stating that the work complies with the provisions of codes listed herein and the local enforcing authorities, and that it will be free from defects of material and workmanship for not less than one (1) year. Guarantee shall further state that the Contractor will, at his own expense, repair or replace any of his material and work which may become defective during the time of guarantee, together with other work damaged as a consequence of such defects.

C. Where special guarantees, covering installation, operation or performance of any systems, or equipment furnished under are indicated, the full responsibility for the fulfillment of such guarantees must be assumed by the Contractor who shall obtain written guarantees in triplicate, two (2) copies of which shall be filed with the Engineer before final acceptance.

D. Repeated malfunctioning or failure in service of any item or work of the system is sufficient cause for the Engineer to order the removal of the item, and its replacement with new item at the expense of the Contractor.

3.18 EXISTING UTILITIES AND EQUIPMENT

A. The Contractor shall be responsible for correcting any damage to existing systems, components or utilities that are to remain in service.

B. The Contractor shall visit the premises to become familiar with the existing conditions prior to submitting a bid. No additional compensation will be allowed for existing conditions that are readily apparent during a site visit.

3.19 FIRESTOPPING

A. Firestopping shall be performed in accordance with Specification Section 07 84 00 “Firestopping”. All penetrations of fire-rated assemblies including walls and floors by mechanical system components (piping, ductwork, conduits, etc.) shall be firestopped as specified. Coordinate size, location and type of pipe and duct sleeves as required by firestopping systems.

3.20 HAZARDOUS MATERIALS

A. Recognized hazardous materials such as lead, mercury or asbestos shall be prohibited from the project. Submit MSDS sheets to the Owner for review.

* END OF SECTION *

SECTION 23 0 593

TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION: The work covered by this section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required for testing and balancing the air systems.

1.2 RELATED DOCUMENTS

A. The General Conditions, Supplemental General Conditions and Instructions to Bidders shall apply to this work. Read these to be familiar with conditions related to the installation of the work.

1.3 DEFINITIONS

A. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment, (e.g., reduce fan speed, throttling).

B. Balance: To proportion flows within the distribution system (submains, branches and terminals) in accordance with specified design quantities.

C. Procedure: Standardize approach and execution of sequence of work operations to yield reproducible results.

D. Report Forms: Test data sheets arranged for collection of test data in logical order to submission and review. This data should also form the permanent record which shall be used as the basis for any future testing, adjusting, and balancing required.

E. Test: To determine quantitative performance of equipment.

1.4 SUBMITTALS: Submit the following:

A. Standards Compliance:

Testing Agency
Testing Agency Personnel
Professional Engineers
Instrument Calibration

1.5 TESTING AND BALANCING AGENCY

A. Air and Water Systems Testing and Balancing: Upon completion of the installation and field testing, performance test and adjust the supply, return, make-up, and exhaust air systems, and heating water systems to provide the air volume and water flow quantities indicated. Accomplish work in accordance with the agenda and procedures specified and AABC 71679 and standards of the NEBB. Correct air and water system performance deficiencies disclosed by the test before balancing the systems.

B. Agency Qualifications: Obtain the services of a qualified testing organization to perform the testing and balancing work as herein specified. Prior to commencing work under this section of the specifications, the testing organization shall have been reviewed by the Architect. The criteria for determining qualifications shall be membership in the AABC, or certification by the NEBB, or the testing organization shall have submitted proof to satisfy the Architect that the organization meets or exceeds the technical standards for membership of the AABC as published in the AABC 71679. The testing organization shall be independent of both the installing contractors and equipment suppliers for this project.

1.6 AGENDA

A. Preliminary Report: Review drawings and specifications prior to installation of any of the affected system. Submit a written report to the Architect indicating any deficiencies in the system that would preclude the proper adjusting, balancing, and testing of the systems.

1.7 PROCEDURES, GENERAL

A. Requirements: Adjust systems and components thereof that perform as required by drawings and specifications.

B. Test Duration: Operating tests of heating and cooling coils, fans and other equipment shall be of not less than 4 hours duration, after stabilized operating conditions have been established. Capacities shall be based on temperatures and air and water quantities measured during such tests.

C. Instrumentation: Method of application of instrumentation shall be in accordance with the manufacturer's instructions. Furnish personnel, instruments, and equipment for tests specified herein.

D. Accuracy of Instruments: Instruments used for measurements shall be accurate. Provide calibration histories for each instrument for examination. Calibrate each test instrument by an reviewed laboratory or by the manufacturer. The Architect has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.

E. Accuracy of Thermometers: Plus or minus one graduation at the temperatures to be measured. Graduations shall conform with the following schedule:

Medium	Design Temperature Differential (°F)	Maximum Graduation (°F)
Air	10 or less	1/2
Air	over 10	1

F. Flow Rate Tolerance: Values are based on discussion in ASHRAE "HVAC Applications", Chapter 34. Air filter resistance during tests, artificially imposed if necessary, shall be 80 percent of final values.

1. Air Handling Unit CFM: Minus 0 percent to plus 10 percent.

2. Other Fans: Minus 0 percent to plus 10 percent.

3. Air Terminal Units (VAV Boxes): Minus 5 percent to plus 10 percent.

4. Minimum Outside Air (for manually set dampers): Minus 0 percent to plus 10 percent.

5. Individual Room Air Outlets and Inlets, and Air Flow Rates Not mentioned Above: Minus 10 percent to plus 10 percent.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 AIR SYSTEM PROCEDURES

A. Adjustments: Adjust air handling systems to provide the required design air quantity to, or through, each component. Conduct adjusting and balancing of systems during periods of the year approximating maximum seasonal operation.

B. Balance: Use flow adjusting (volume control) devices to balance air quantities only; i.e., proportion flow between various terminals comprising system, and only to the extent that their adjustments do not create objectionable air motion or sound, i.e., in excess of specified limits.

C. Balancing Between Runs (submains, branch mains, and branches): Use flow regulating devices at, or in, the divided - flow fitting. Minimize restriction imposed by flow regulating devices in or at terminals.

D. Final Measurements of Air Quantity: Make final measurements of air quantity, after the air terminal has been adjusted to provide the optimum air patterns of diffusion.

E. Fan Adjustment: Total air system quantities, generally, shall be varied by adjustment of fan speeds, or axial-flow fan wheel blade pitch. For systems with direct-connected fans (without adjustable pitch blades), damper restrictions of a system's total flow or variable speed rheostats shall be adjusted as appropriate.

F. Air Measurement:

1. Pitot Tube: Except as specifically indicated herein, make pitot tube traverses of each duct to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform with the ASHRAE Handbook Fundamentals.

2. Pitot Tube Traverse: Pitot-tube traverse may be omitted if the duct serves only a single room or space and its design volume is less than 2000 cfm. In lieu of Pitot-tube traverse, determine air flow in the duct by totalling volume of individual terminals served, measured as described herein.

3. Measurements of Air Quantity: Where duct's design velocity and air quantity are both less than 1000 (fpm/cfm), air quantity may be determined by measurements at terminals served.

G. Air Terminal Balancing: Measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, shall be used only for balancing.

3.2 WATER SYSTEM PROCEDURES

A. Adjustment: Adjust heating, water systems to provide required quantity to, or through each component.

B. Metering: Measure water quantities and pressures with calibrated meters.

C. Water Measurements and Balancing: Use venturi tubes, orifices, or other metering fittings and pressure gages. Adjust systems to provide the design flow rates through the heat transfer equipment prior to the capacity testing. Perform measurement of temperature differential with the air system, adjusted as described herein, in operation.

D. Automatic Controls: Position automatic control valves for full flow through the heat transfer equipment of the system during tests.

E. Flow: Flow through by-pass circuits at three-way valves shall be adjusted to balance that through the supply circuit.

F. Distribution: Adjust distribution by means of balancing devices (cocks, valves, and fittings) and automatic flow control valves. Do not use service valves for adjustment. Where automatic flow control valves are utilized in lieu of venturi tubes, record only the pressure drop across the valve if within the pressure drop rating on the valve tag.

G. Special Procedures: Where available, pump capacity (as designed) is less than total flow requirements of individual heat transfer units of system served, full flow may be simulated by the temporary restriction of flow to portions of the system.

3.3 CERTIFIED REPORTS

A. Submittal: Submit three copies of the reports described herein, covering air and water system performance, air motion (fpm), to the Architect prior to final tests and inspection.

B. Instrument Records: Include types, serial numbers, and dates calibration of instruments.

C. Reports: Reports shall identify conspicuously items not conforming to contract requirements, or obvious maloperation and deficiencies.

D. Certification: The reports shall be certified by an independent Registered Professional Engineer who is versed in the field of air and water balancing and who is not affiliated with any firm involved in the design or construction phases of the project.

3.4 AIR SYSTEM DATA

A. Report: The certified report shall include for each air-handling system the data listed below:

1. Equipment (fan or factory fabricated station unit):

a. Installation Data:

1) Manufacturer and Model
2) Size
3) Arrangement, Discharge, and Class
4) Motor H.P., Voltage, Phase, Cycles, and Full Load Amps.
5) Location and Local Identification Data

b. Design Data: Data listed in schedules on drawings and specifications.

c. Fan Recorded (Test) Data

1) C.F.M.
2) Static Pressure
3) R.P.M.
4) Motor Operating Amps.
5) Motor Operating B.H.P.

2. Duct Systems:

a. Duct Air Quantities (Maximum and Minimum) - Main, Submains, Branches, Outdoor (Outside) Air, Total-Air, and Exhaust

1) Duct size(s)
2) Number of Pitot-tube (Pressure) Measurements
3) Sum of Velocity Measurement, excluding pressure measurements
4) Average Velocity
5) Recorded (Test) C.F.M.
6) Design C.F.M.

b. Individual Air Terminals:

1) Terminal Identification (Supply or Exhaust, Location and Number Designation)
2) Type Size, Manufacturer, and Catalog Identification
3) Design and Recorded Quantities - C.F.M.
4) Deflector Vane or Diffusion Cone Settings
5) Applicable Factor for Application, Velocity, Area
6) Design and Recorded Velocities - F.P.M. (State "core" "inlet," as applicable)

3.5 WATER SYSTEM DATA

A. Report: Include data listed below:

1. Pumps:

a. Installation Data:

1) Manufacturer and Model
2) Size
3) Type Drive
4) Motor H.P., Voltage, Phase, and Full Load Amps.

b. Design Data:

1) G.P.M.
2) Head
3) R.P.M.
4) B.H.P. and Amps.

c. Recorded Data:

1) Discharge Pressures (Full-Flow and No-Flow)
2) Suction Pressures (Full-Flow and No-Flow)
3) Operating Head
4) Operating G.P.M. (from pump curves if metering is not provided)
5) No-Load Amps. (where possible)
6) Full-Flow Amps
7) No-Flow Amps

2. Air Heating and Cooling Equipment:

a. Design Data:

1) Load in Btu per hr
2) G.P.M.
3) Entering and Leaving Water Temperature
4) Entering and Leaving Air Conditions (D.B. and W.B.)
5) C.F.M.
6) Water Pressure Drop

b. Recorded Data:

1) Type of Equipment and Identification (location or number designation)
2) Entering and Leaving Air Conditions (D.B. and W.B.)
3) Entering and Leaving Water Temperatures
4) G.P.M. (if metered)
5) Temperature Rise or Drop

3. Converters and Heat Exchangers:

a. Installation Data:

1) Manufacturer, Model, and Type
2) G.P.M.
3) Inlet (entering) and Outlet (leaving) Temperatures
4) Water Pressure Drop

b. Recorded Data:

1) G.P.M. (if metered)
2) Entering and Leaving Water Temperature - System
3) Water pressure drop
4) Heating (or Cooling) Media Steam Pressure and Temperature and Condensate Temperature, or Entering and Leaving Water Temperature
5) Heating (or Cooling) Media - Flow (G.P.M. or lbs. per hour)

3.6 FINAL TESTS, REVIEW, AND ACCEPTANCE

A. Capacity and Performance Tests: Make tests to demonstrate that capacities and general performance of air and water systems comply with contract requirements.

B. Final Inspection: At the time of final review, recheck, in the presence of the Engineer, random selections of data water and air quantities and air motion recorded in the certified report.

C. Points and Areas for Recheck: As selected by the Architect.

D. Measurement and Test Procedures: As reviewed for work forming basis of certified report.

E. Selections for Recheck (specific plus random): In general, selections for recheck will not exceed 25 percent of the total number tabulated in the report.

F. Retests: If random tests elicit a measured flow deviation of ten percent or more from, at ten percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, systems shall be readjusted and tested, new data recorded, new certified reports submitted, and new inspection tests made.

G. Marking of Settings: Following final acceptance of certified reports by the Architect, the settings of valves, dampers, and other adjustment devices shall be permanently marked, so that adjustment can be restored if disturbed at any time. Do not mark devices until after final review.

3.7 DUCT LEAK TESTING

A. Medium pressure ductwork systems shall be leak-tested in accordance with SMACNA and as follows:

1. Medium pressure ductwork and associated components shall be tested at a minimum static pressure of 3.0" w.g. or 1.5 times the actual operating pressure (whichever pressure is greater) and maximum allowable leakage shall not exceed SMACNA Class 3 or 3.0 CFM/100 sf (@ a static pressure of 1.0" w.g.) of duct surface area. Total maximum leakage shall not exceed 2% of total system design airflow. Leak testing equipment shall be United-McGill "Leak Detective", or approved equal.

B. The leakage testing shall be witnessed by a representative of the Owner and the results shall be submitted to the Engineer for review.

* END OF SECTION *

SECTION 23 07 00

HVAC INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and the specifications including the project manual are hereby made a part of the work of this section.

1.2 DESCRIPTION

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to insulate the heating, ventilating, air conditioning, and plumbing systems.

1.3 SUBMITTALS

A. Substitutions: Your attention is directed to Section 23 05 00-"Substitutions", relative to competition and the (ONLY) notation. Familiarity with this section shall be achieved before reading the PRODUCTS section of this specification.

B. The items for which the submittals paragraph in Section 23 05 00, Common Work Results for HVAC, apply are as follows:

1. Piping insulation.
2. Duct insulation.
3. Equipment and component insulation.
4. Insulation application schedule.

1.4 DEFINITIONS

A. Finished Spaces: Spaces other than furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels, unless specifically listed below as an unfinished space.

B. Unfinished Spaces: Mechanical rooms and Elevator machine rooms.

C. Unconditioned Spaces: Spaces exposed to near outside ambient temperatures, such as unheated attic spaces or non-air conditioned areas.

D. Outside: Areas beyond the exterior side of walls or above the roof, unexcavated spaces, and crawl spaces.

E. Concealed: Not visible in finished or unfinished spaces. For example, above ceilings, below floors, between double walls, furred-in areas, pipe and duct shafts, and similar spaces.

F. Exposed: Visible from a finished or unfinished space.

1.5 MANUFACTURER'S STAMP OR LABEL

A. Packages or standard containers of insulation, jackets, cements, adhesives, and coatings delivered to the project site for use must have the manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material. Insulation shall be asbestos-free.

1.6 FLAME SPREAD AND SMOKE DEVELOPED RATINGS

A. Materials shall have a flame-spread rating of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with NFPA 255, ASTM E84, or UL 723.

B. Provide materials with flame resistant treatments not subject to deterioration due to aging, moisture, high humidity, oxygen, ozone, or heat.

C. Materials Exempt From Fire-Resistant Rating: Nylon anchors for securing insulation to ducts or equipment.

PART 2 PRODUCTS

2.1 PIPING INSULATION

A. Fiberglass: Heavy density preformed fiberglass with thermal conductivity of 0.29 Btu-in/hr-ft^2-^{o}F at 150^{o}F mean temperature, Johns Manville Micro-Lok HP, or approved equal. Insulation shall conform to ASTM C547 Class I and shall be suitable for 850^{o}F service. Fitting insulation shall be of same material used for pipe. The flame spread / smoke developed rating shall be 25 / 50.

1. Insulation Jacket: All service (ASJ) type conforming to Fed. Spec. HH-B-100B Type I. Jacket permeability shall not exceed 0.02 perms (ASTM E96). Pipe fitting jacket shall be factory premolded, one-piece, PVC covers with pressure sensitive taped joints. Jackets in exposed locations shall have a white surface suitable for field painting. Provide vapor barrier as required by service.

2. Aluminum Jackets: ASTM B 209M (ASTM B 209), Temper H14, minimum thickness of 27 gage (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside diameters less than 8 inches. Provide corrugated surface jackets for jacket outside diameters 8 inches and larger. Provide 1/2" wide stainless steel bands. Provide factory prefabricated aluminum covers for insulation on fittings, valves, and flanges.

3. PVC Jacket: Glossy white finish, ASTM 1784, minimum thickness 0.030", over insulation and vapor barrier with solvent-welded joints. Jacket shall be overlapped 2" minimum on down side.
Provide jacketing over insulation in finished areas where exposed to view. See the Reflected Ceiling Plans for additional information. Provide jacketing on insulated exterior piping.

B. Flexible Unicellular: Flexible unicellular with thermal conductivity of 0.27 Btu-in/hr-ft^2-^{o}F at 75^{o}F mean temperature. Insulation shall conform to ASTM C534, Type I, Tubular and shall be suitable for 200^{o}F service. Fitting insulation shall be of same material used for pipe. Permeability shall not exceed 0.10 perms (ASTM E96). Insulation adhesive shall conform to Mil. Spec. MIL-A-24179A, Type II, Class 1.

C. Fittings, Flanges, Hydronic Components and Accessories, Pump Casings and Valves: Provide insulation for fittings, flanges, and valves premolded, precut, or job fabricated of the same thickness and conductivity as used on adjacent piping.

D. Insulation Kit: Insulate exposed supply and waste piping at handicapped accessible sinks with fully molded insulation kit. McGuire Products ProWrap, 3/16" thick closed vinyl with anti-microbial additive, 1.02 Btu-in/hr-F^2-^{o}F thermal conductivity, white color.

2.2 DUCT INSULATION

A. Fiberglass (Ductwrap): Fiberglass duct wrap with foil-scrim-kraft facing/vapor barrier, 1.0 lb/cu.ft. density (0.75 lb/cu.ft. for 3" thickness only), 0.29 Btu-in/hr-ft^2-^{o}F conductivity at 75^{o}F mean temperature, 0.05 permeance rating. Insulation shall meet the requirements of NFPA 90A & B and shall be UL rated. Provide foil-scrim-kraft (FSK) tape.

B. Fiberglass (Ductboard): Fiberglass insulation board with foil-scrim-kraft facing/vapor barrier, 3.0 lb./CF density, 0.25 Btu-in/hr-ft^2-^{o}F conductivity at 75^{o}F mean temperature, 0.05 permeance rating. Insulation shall meet the requirements of NFPA 90A and B and shall be UL rated. Provide foil-scrim-kraft (FSK) tape.

2.3 EQUIPMENT INSULATION

A. Fiberglass (Hot Equipment): Semi-rigid fiberglass board conforming to Fed. Spec. HH-I-558B, Form B, Type I. Thermal conductivity shall be 0.32 Btu-in/hr-ft^2-^{o}F at 150^{o}F mean temperature (ASTM C177), insulation shall be suitable for 650^{o}F service. Insulation jacket shall be "all service" type conforming to Fed. Spec. HH-I-100B Type I or II. Jacket permeability shall not exceed 0.02 perms (ASTM E96).

B. Flexible Unicellular (Cold Equipment and Piping): Flexible unicellular with thermal conductivity of 0.27 Btu-in/hr-ft^2-^{o}F at 75^{o}F mean temperature. Insulation shall conform to ASTM C534, Type II, sheet and shall be suitable for 200^{o}F service. Permeability shall not exceed 0.10 perms (ASTM E96). Insulation adhesive shall conform to Mil. Spec. MIL-A-24179A, Type II, Class 1.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

2. Verify that the insulation systems may be installed in accordance with pertinent codes and regulations and the reviewed Submittals.

3.2 GENERAL

A. Insulate after system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust, and scale and are dry.

B. Install insulation with jackets drawn tight and cement down longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Insulation shall be continuous through sleeves, wall and ceiling openings, except at fire dampers in duct systems and pipe penetrations through fire rated assemblies. Extend surface finishes to protect ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer's recommended coverage per gallon. Individually insulate piping and ductwork. Keep insulation and piping dry during the application of the finish. Bevel and seal the edges of exposed insulation.

C. Unless otherwise indicated, do not insulate the following:

1. Factory preinsulated flexible ductwork.
2. Factory pre-insulated ductwork, plenums, casings, mixing boxes, and filter boxes.
3. Chrome plated pipes and fire protection pipes.
4. Vibration isolating connections.
5. Adjacent insulation.
6. ASME stamps, nameplates, access plates.
7. Ductwork exposed to view in a normally occupied space.

3.3 PIPING INSULATION

A. Pipe Insulation (Fiberglass): Place sections of insulation around the pipe and joints, tightly butt into place. Draw jacket laps tight and smooth. Secure jacket with fire resistant adhesive, or factory applied self sealing lap. Cover circumferential joints with butt strips, not less than 3-inches wide, of material identical to the jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inches. Adhesive used to secure the butt strip shall be the same as used to secure the jacket laps.

B. Flanges, Flexible Connectors, Pump Connectors, Unions, Valves and Fittings Insulation (Fiberglass): Factory fabricated removable and reusable insulation covers. Place factory premolded, precut or field-fabricated segmented insulation of the same thickness and conductivity as the adjoining pipe insulation around the flange, union, valve, and fitting abutting the adjoining pipe insulation. Install factory premolded one-piece PVC fitting covers over the insulation and secure by stapling or with metal or plastic tacks made for securing PVC fitting covers and secure with PVC vapor barrier tape.

C. Pipe Insulation (Flexible Unicellular): Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Insulate flanges, flexible connectors, pump connectors, unions, valves, pump casings, hydronic accessories and components and fittings.

D. Where penetrating roofs and exterior walls, insulate piping to a point flush with the underside of the deck or wall and seal with a vapor barrier coating.

E. Hangers and Anchors: Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by the insulation, provide MSS SP-58, Type 40 galvanized steel shields (16 gage minimum). For fiberglass insulation systems on pipe sizes 2 inches through 3", provide insulation inserts at points of hangers and supports. Insulation inserts shall be of molded glass fiber (minimum 12 pcf). Insulation inserts shall cover the bottom half of the pipe circumference, 180 degrees, and be not less than 12" long and shall not compress the insulation. Vapor-barrier facing of the insert shall be of the same material as the facing on the adjacent insulation. Seal inserts into the insulation. Insulation inserts for pipe sizes 4" and larger shall be welded pipe saddles. Install insulation in void area of saddle of same material used on adjacent insulation. **For pipe sizes 2" and smaller, insulation inserts for flexible unicellular insulation systems shall be wooden doweling set on end of length equal to insulation thickness. Seal dowel to insulation with adhesive.**

F. PVC or Metal Jackets: Provide over exterior insulation exposed to the weather. Machine cut jacket to smooth edge of circumferential joints. Overlap metal jacket not less than 2 inches at longitudinal and circumferential joints and secure with metal bands at not more than 9 inch centers. Overlap longitudinal joints down to shed water. Seal circumferential joints with a coating recommended by insulation manufacturer for weatherproofing. Solvent weld PVC jacket system to provide continuous watertight seal.

3.4 DUCT INSULATION

A. Rigid Insulation: Secure rigid insulation by impaling over pins or anchors located not more than 3 inches from joint edges of boards, spaced not more than 12 inches on centers and secure with washers and clips. Spot weld anchor pins or attach with a waterproof adhesive especially designed for use on metal surfaces. Each pin or anchor shall be capable of supporting a 20-pound load. Cut off protruding ends of pins. After installing washers, provide foil-scrim-kraft (FSK) tape to seal break in vapor barrier, tape shall extend 1" minimum around pin. Apply insulation with joints tightly butted. Bevel insulation around name plates and access plates and doors. Seal joints with FSK tape. Provide additional adhesive or staples to assist tape adhesion in difficult applications.

B. Flexible Blanket Insulation: Apply insulation with joints tightly butted. Staple laps of jacket with outward clinching staples and seal with foil scrim kraft (FSK) tape. Sagging of flexible duct insulation shall not be permitted. For ductwork over 24-inches wide on horizontal duct runs, provide pins, washers and clips. Install speed washers with pins and pin trimmed to washer. Cut off protruding ends of pins after clips are secured. Seal with FSK tape, extend tape 1" minimum around pin. Use pins on sides of vertical ductwork being insulated. Space pins and clips on 18 inch centers and not more than 18 inches from duct corners. Carry insulation over standing seams and trapeze-type hangers.

3.5 EQUIPMENT INSULATION

A. General Procedures: Apply equipment insulation suitable for temperature and service to fit as closely as possible to equipment. Join sections of insulation with adhesive. Bevel insulation around nameplates, ASME Stamp, and access plates. For insulation on equipment that must be opened periodically for inspection, cleaning, or repair, construct insulation to be removable and replaceable without damage. Provide vapor barrier seal at joints and seams for "cold" equipment.

B. Heating Equipment: Provide semi-rigid mineral fiberboard insulation. Seal longitudinal and lateral seams with FSK tape. Bond cuts, ends, and mitered sections with adhesive. Provide a vinyl-acrylic mastic coating on exposed fiberglass ends.

C. Cold Equipment, Valves, Pump Casings, Flexible Connections and Accessories: Provide flexible unicellular sheet insulation, bond cuts, butt joints, longitudinal joints and ends with vapor barrier adhesive. Vapor seal exposed edges to equipment.

3.7 INSULATION APPLICATION SCHEDULE

SERVICE	THICKNESS	MATERIAL/JACKET
PIPING:		
Domestic Cold Water Piping		
1" and smaller	1/2"	Fiberglass w/ASJ or Flexible Unicellular
1¼" and larger	1"	Fiberglass w/ASJ or Flexible Unicellular
Domestic Hot Water Piping		
2" and smaller	1½"	Fiberglass w/ASJ or Flexible Unicellular
Water and Drain Piping Under Handicap Accessible Fixtures		Insulation Kit
Domestic Water Branch Piping Less than 10 ft in Stud Walls	1/2"	Fiberglass w/ASJ or Flexible Unicellular
Condensate Drain Piping	½"	Flexible Unicellular
DUCTWORK:		
Acoustically Lined Ductwork: Unless indicated otherwise, acoustical duct liner shall be 1" thick. Acoustically lined ductwork in unconditioned spaces (such as mechanical rooms) shall have 1½" thick fiberglass ductwrap. Exposed ductwork in finished spaces shall be double-wall insulated construction.		
Concealed Supply Ductwork from the AC Unit(s) / to Spaces Served	2"	Ductwrap, FSK
Return Ductwork from the Spaces Served to the Air Handling Units (in conditioned spaces) and all ductwork exposed in finished spaces	N.A.	N.A.
Supply and Return Ductwork In unconditioned spaces	2"	Ductwrap, FSK

(Such as mechanical rooms)		
Exhaust Ductwork from a point three (3) feet interior of the motorized control damper or backdraft damper to the exterior wall, roof, or louver.	2"	Ductboard, FSK

3.8 FIELD INSPECTION

A. Visually inspect to ensure that materials used conform to specifications. Inspect installations progressively for compliance with requirements.

* END OF SECTION *

SECTION 23 09 00

INSTRUMENTATION AND CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to install the automatic temperature control system indicated. The system shall be a direct digital control (DDC) system with dynamic color graphics software to provide the sequences as described in these specifications. The ATC system shall be complete with required components including, low voltage and line voltage wiring and conduit. Control wiring shall include all control-related components and devices and associated interlock wiring, including that furnished or required by the HVAC equipment manufacturers, including sensors, controllers, valves, etc. Coordinate with the respective equipment manufacturers. Wiring shall be in accordance with Division 26, "Electrical" of the specifications and NFPA 70, National Electrical Code. See “System Input-Output Summary” for additional requirements and information.

B. Recognized hazardous materials such as lead, mercury or asbestos shall be prohibited from the project. Submit MSDS sheets to the Owner for review.

1.2 ACCEPTABLE MANUFACTURERS

A. Maine Controls, Presumpscot Street, Portland, ME.
B. Siemens.
C. IB Controls.
D. Basix.
E. Trident.

1.3 RELATED DOCUMENTS

A. The drawings and the specifications including SECTION 23 05 00 “Common Work Results for HVAC” are hereby made a part of the work of this section.

B. Section 23 00 00 – HVAC.

1.4 SUBMITTALS

A. Substitutions: Your attention is directed to Section 23 05 00 relative to competition and the (ONLY) notation. Familiarity with this section shall be achieved before reading the PRODUCTS section of this specification.

B. The items for which the shop drawings paragraph in Section 23 05 00 “Common Work Results for HVAC”, apply are as follows:

1. Temperature control system schematic including variables, flow diagrams, ladder diagrams, and point to point wiring diagrams, indicating set points, reset ranges,

throttling ranges, controller gains, differentials, operating ranges, normal positions, controller action, dial ranges, voltages, currents, mounting locations, indicators, and terminal strip points.

2. Sequence of operation for each system and function.

3. Generic, functional description of each control component indicated.

4. Equipment interlocks required by sequence of operation.

5. Automatic valve schedule showing flow, Cv, and pressure drop.

6. Manufacturer's Data:

   a. Dampers, valves and operators.
   b. Controllers, including wiring and connection diagrams.
   c. Thermostats, temperature sensors, including wiring and connection diagrams.
   d. Temperature and pressure indicators.
   e. Pressure sensors, including wiring and connection diagrams.
   f. Switches, relays, transmitters, transformers, including wiring and connection diagrams.

7. Dynamic color graphics software data.

8. Airflow measuring stations.

9. Flowmeters.

1.5 WARRANTY

A. The automatic temperature control system shall have a **two (2) year parts and labor** warranty.

PART 2 – PRODUCTS AND FEATURES

2.1 CONTROL PANELS

A. In general, relays, transformers, or other control devices (not including room thermostats or duct-mounted instruments) shall be grouped and mounted in a factory-built cabinet enclosure.

2.2 AUTOMATIC CONTROL DAMPERS

A. Automatic dampers not furnished with equipment shall be furnished under this paragraph. Automatic dampers shall be constructed and installed in accordance with the following specifications:

1. Damper Blades: All automatic dampers, including dampers for static pressure control, shall be of the balanced type, factory-fabricated, with fully gasketed galvanized steel airfoil blades, mounted in welded frames. Damper blades shall be not more than 8

inches wide, shall have interlocking edges, edge and jamb seals and be capable of operation against 4" static pressure differential. Dampers shall be Arrow "Arrow-Foil" Model PBDAF-206, OBDAF-207, Ruskin Model CD-60 or Tamco Series 1000.

2. Modulating Dampers: All modulating dampers shall be of the opposed blade type.

3. Damper Size and Bearings: Damper blades shall have steel trunnions mounted in oil-impregnated bearings. Dampers shall be not more than 48 inches in length between bearings.

4. Frames: Damper frames shall be of welded channel or angle-iron, with heavy steel corner gussets and braces or stiffened with steel tie-rods where necessary. Frames shall be painted with aluminum paint to prevent rusting.

5. Dampers shall be guaranteed to close tightly, and shall provide substantially the full area of the opening when open. All outdoor air intakes and all exhaust ducts to outside and all fresh air, return air and exhaust air dampers in systems shall have damper blades with inflatable seals or other devices to guarantee low leakage, not to exceed 6 CFM/SF at 1 in. WG pressure differential.

6. Damper Linkages: Damper-operating links shall be cadmium plated steel or brass rods, adjustable in length with ball and socket joints and of such proportions that they will withstand, without appreciable deflection, a load equal to not less than twice the maximum operating force of the damper motor. Linkages shall be concealed in the frame.

B. Damper Actuators: For each automatically controlled damper, a suitable damper actuator or actuators shall be provided in accordance with the following specifications:

1. Actuator: Damper actuators shall be electronic, direct-coupled, spring-return type and have a rating of not less than twice the torque needed for actual operation of the damper.

2. Adjustments: Provide adjustable stops for the open and closed positions.

3. Mounting: Damper actuators shall be direct-coupled over the shaft. The damper actuators and mounting base shall not be mounted directly on cold or insulated ducts and casings, but shall be mounted outside the insulated covering in such a manner as to prevent sweating and interference with the insulation.

4. Where indicated, damper actuators shall be provided with an auxiliary switch rated at 120 V AC, and accept a 0 to 20 ma input.

2.3 TEMPERATURE SENSORS

A. Temperature Sensors: RTD Elements, accuracy of $\pm$0.1% at 70^{o}F, sensors shall be securely attached to a single gang electrical box or other suitable base, securely mounted on the wall or other building surface. Each sensor shall be located where shown or, if not shown, where it will respond to the average temperature in the room. Sensors, generally, shall be mounted

48 inches above the floor, and shall not be mounted on outside walls if other locations are possible. If located on an outside wall, it shall have an insulated base. Sensors shall have locked or concealed adjustment devices, by means of which the operating points can be adjusted through a range of not less than 10 degrees above and below the operating points specified.

B. Room temperature sensors shall be equal to Vaisala, Kele or Honeywell, with blank covers. Provide an override button with LED indicator light. Provide tamperproof cast aluminum guards, where indicated. Temperature sensors / thermostats with guards shall have a blank, lockable cover (tamperproof).

2.4 CO_2 and IAQ SENSORS

A. Duct mounted: CO_2 sensors shall be Vaisala Carbocap Series, Model GMD20, Kele, Telaire or TSI and utilize Non-Dispersive Infrared Detection (NDIR) or Photo-Acoustic Sensing and be capable of daily self-calibration during "unoccupied" periods.

B. Wall-mounted room sensors: CO2 sensors shall be equal to Vaisala Carbocap Series, Model GMW20, Kele, Telaire or TSI combination temperature and CO_2 without CO_2 display. IAQ sensors shall be BAPI "AQS", or equal. Sensors shall be mounted at 48" A.F.F.

2.5 SEQUENCE OF CONTROL

A. Provide and install electronic/electric components to enable the mechanical system to operate in the following sequences:

1. Combination Fire / Smoke Dampers:

a. The dampers shall open prior to their respective air handling systems operating. If smoke is detected, the damper(s) shall close and the respective air handling system(s) shut down. The fire alarm system shall be notified if smoke is detected.

2. Rooftop Air Conditioning Unit (**AC-***): The units shall operate on an "occupied-unoccupied" cycle. During scheduled "occupied" periods, the gas heating and DX cooling and economizer shall be enabled as required to maintain the room temperature setpoint, and the unit shall operate continuously with the outside air damper open to the minimum outside air position. A return air CO2 sensor shall open the outside air damper as required to maintain the setpoint subject to a mixed air low limit sensor (setpoint 55F.). The enthalpy economizer shall operate to provide free cooling when available. A manual reset freeze-protection thermostat shall shut down the unit and if the discharge temperature drops below 50F.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

2. Verify that the automatic temperature control system may be installed in strict accordance with pertinent codes and regulations and the reviewed Shop Drawings.

3.2 INSTALLATION

A. Provide wiring, and conduit to connect the ATC components for an operational ATC system. Wiring and installation shall conform to NFPA 70.

B. Identification: Label or code each field wire at each end. Permanently label or code each point of field terminal strips to show the instrument or item served. Color-coded cable with annotated cable diagrams may be used to accomplish cable identification.

C. Temperature Sensors: Stabilize sensors to permit on-the-job installation that will require minimum field adjustment or calibration. Temperature sensor assemblies shall be readily accessible and adaptable to each type of application to allow quick, easy replacement and servicing without special tools or skills. Strap-on sensor mountings, using helical screw stainless steel clamps, shall be permitted on new piping for unit heater or other on-off operation only, after pipe is cleaned to bright metal. Strap-on bulb and pipe shall be insulated after installation. Strap-on sensor mountings are also permitted for hot water piping sizes up to 2 inches. Other liquid temperature sensors shall be provided with wells.

D. Duct Sensors: Provide sensors in ductwork; specific location within duct shall be selected to accurately sense air properties. Do not locate sensors in dead air spaces or positions obstructed by ducts or equipment. Installation shall be within the vibration and velocity limits of the sensing element. Where an extended surface element is required to sense the average or lowest air temperature, position and securely mount sensor within duct in accordance with sensor manufacturer's recommendations. Temperature sensing elements shall be thermally isolated from brackets and supports. Provide separate duct flange for each sensing element; securely seal ducts where elements or connections penetrate duct. Seal penetrations of duct insulation vapor barrier with vapor barrier coating compound to provide a vapor-tight covering. Mount sensor enclosures to allow easy removal and servicing without disturbance or removal of duct insulation or vapor barrier. On downstream side of each sensor, provide access doors.

E. Pipe Sensors: Provide wells for sensors measuring temperatures in pressure vessels or in pipes. Wells shall be noncorrosive to the medium being measured and shall have sufficient physical strength to withstand the working and test pressures and velocities. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in the piping at elbows to effect proper flow across the entire area of the well. Wells may either look upstream or downstream. Provide thermal transmission material within the well to speed the response of temperature measurement. Provide wells with sealing nuts to contain the thermal transmission material and allow for easy removal. Wells shall not restrict flow area to less than 70 percent of line-size-pipe normal flow area. Increase piping size as required to avoid restriction.

3.3 ADJUSTMENTS

A. Adjust controls and equipment to maintain the conditions indicated, to perform the functions indicated, and to operate in the sequence specified.

3.4 DUCT SMOKE DETECTORS

A. The Fire Alarm Contractor shall furnish and wire duct smoke detectors. Installation shall be accomplished by the sheetmetal contractor and be wired by the Fire Alarm Contractor.

3.5 INSTRUCTING OPERATING PERSONNEL

A. Upon completion of the work and when designated by the Architect, furnish the services of a competent technician regularly employed by the temperature control manufacturer for the instruction of Owner in the operation and maintenance of each automatic space temperature control system. The period of instruction shall be for not less than three (3) 8-hour non-concurrent working days (twenty-four (24) hours total) and shall include video tape demonstration of controllers.

3.6 FIELD INSPECTION AND TESTS

A. Tests shall be performed or supervised by employees of the ATC system or manufacturer of the ATC system, or by an authorized representative of the ATC manufacturer. Give Architect 14 calendar days advance written notice prior to the date of the field acceptance testing. If the Architect witnesses tests, such tests shall be subject to approval. If the Architect does not witness tests, provide performance certification.

B. Plan for Inspections and Tests: Furnish a written inspections and tests plan at least 60 days prior to the field acceptance test date. This plan shall be developed by the manufacturer of the ATC system. The plan shall delineate the inspections and testing procedures required for the ATC system to demonstrate compliance with the requirements specified. Additionally, the test plan shall indicate how ATC system is to be tested, what variables will be monitored during test, names of individuals performing tests, and what criteria for acceptance should be used. Indicate how operation of H&V system and ATC system in each seasonal condition will be simulated.

C. Field Acceptance Testing: Upon completion of 72 hours of continuous H&V and ATC systems operation and before final acceptance of work, test the automatic temperature control systems in service with the heating, ventilating and air conditioning systems to demonstrate compliance with contract requirements. Test controls through each cycle of operation, including simulation of each season insofar as possible. Test safety controls to demonstrate performance of required function. Adjust or repair defective or malfunctioning automatic space temperature control equipment or replace with new equipment. Repeat tests to demonstrate compliance with contract requirements.

SECTION 23 30 00

HVAC FOR DISTRIBUTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and the specifications including SECTION 23 05 00 “Common Work Results for HVAC” are hereby made a part of the work of this section.

1.2 DESCRIPTION OF WORK

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to install the ductwork systems indicated.

1.3 SUBMITTALS

A. Substitutions: Your attention is directed to Section 23 05 00-"Substitutions", relative to competition and the (ONLY) notation. Familiarity with this section should be achieved before reading the PRODUCTS section of this specification.

B. The items for which the submittals paragraph in Section 23 05 00 “Common Work Results for HVAC”, apply are as follows:

1. Ductwork.
2. Ductwork accessories.
3. Air devices.
4. Acoustical duct liner.
5. Firestopping materials and methods.
6. Louvers and dampers.
7. Ductwork sealing products.

PART 2 PRODUCTS

2.1 DUCTWORK

A. Classification of Ductwork: Low pressure ductwork: up to 2" W.G. static pressure. Medium pressure ductwork: 2" to 6" W.G. static pressure. The duct pressure class shall be determined by multiplying the total static pressure scheduled in the fan schedules by 1.2.

B. Materials: Unless otherwise indicated low pressure ductwork shall be galvanized steel. Galvanized sheet metal shall be new galvanized steel sheets of lock forming quality with zinc coating that will not flake or peel under forming operation.

C. Construction for Low Pressure Round and Rectangular Ductwork:

1. Material: Galvanized steel conforming to ASTM A527, weight of galvanized coating shall be not less than 1-1/4 ounces total for both sides of one sq.ft. of a sheet.

Construction, metal gage, and reinforcements shall conform with SMACNA "Duct Construction Standards" and NFPA 90A for 2" W.G. pressure class.

2. Fittings: Shall be constructed in accordance with SMACNA Standards and shall be of the types indicated (ONLY).

3. Longitudinal seams shall be Pittsburgh lockseam (ONLY). Button punch snap locks are not acceptable.

4. Joints and seams shall be sealed to SMACNA seal class B (Leakage Class 12 for rectangular ducts and Leakage Class 6 for round and flat oval ducts).

5. Unless indicated otherwise, exhaust ductwork above the roof shall be Type 304 stainless steel construction.

D. Construction for Spiral Seam Round and Flat Oval Ductwork:

1. Ductwork and fittings shall be United McGill Uni-seal or Uni-rib, Eastern Sheetmetal, Lindab, Semco or Monroe Sheetmetal, galvanized steel, factory fabricated, spiral lockseam or welded longitudinal seam, round or flat oval type, as indicated. Seams shall be solid welded or spot-welded and factory sealed airtight. Ducts and fittings shall be specifically designed for medium pressure application. Round or flat oval ductwork indicated as acoustically lined or double-wall (DW) shall be United-McGill Acousti-K27, double wall medium pressure construction with solid 26 gauge sheetmetal inner liner and 1" thick fiberglass insulation. Fittings shall be furnished with solid liners. Insulation shall be provided with thermal conductivity of 0.27 BTU/HR-^{o}F-FT^{2}-IN. Exposed ductwork in finished spaces specified to be painted shall be “Paint-Grip” galvanized material. Interior ductwork shall be constructed of galvanized sheetmetal. Exposed supply ductwork shall be double-wall construction with “Paint-Grip” galvanized outer shell.

a. Sheetmetal Gauges: Per SMACNA for listed pressure class.

b. Fittings: Fittings shall be machine formed type or welded multi-segment type. All seams shall be factory sealed or welded airtight. Tap offs shall be 90^{o} conical type or 45^{o} standard type, with smooth, machine formed entrance, designed for low pressure drop and low noise generation. 90^{o} elbows shall be 5 piece construction (where space permits) or vaned type mitered elbow where space is restricted. Unless specifically indicated (and field-verified) as 5 piece construction, use vaned 90^{o} elbows. Vanes shall be single thickness, solid-welded in place.

c. Joints on round spiral ductwork shall be slip type, coupling type, Van Stone flanges, or factory fabricated flange system type connectors, as standard with the manufacturer. Flat oval joints shall be Van Stone flanges (gasketed) or factory fabricated flange system type connectors. Joints shall be made up with joint sealer applied in strict accordance with the manufacturer's recommendations. Joint sealer shall be as recommended by the manufacturer.

d. Duct and fittings shall have been tested for air friction loss and leakage in an independent testing laboratory. Test results shall be submitted with the Shop Drawings for review.

e. External reinforcing angles shall be provided in accordance with the manufacturer's recommendations. External reinforcing angles shall be galvanized or painted with a rust inhibiting aluminum paint. Include reinforcing data with Shop Drawing submittal. Duct and reinforcing shall be designed for a positive static pressure of 6 inches of water gage.

f. No internal tie rod reinforcing will be allowed.

g. Hangers shall be of the clamp-on or trapeze type. Exposed ductwork shall use clamp-on hangers only. Holes shall not be drilled through the ducts.

E. Acoustical duct liner for rectangular ductwork shall be Type AP Armaflex SA duct liner. The liner shall be elastomeric unicellular (closed cell) and have a thermal conductivity of 0.27 Btuh/^{0}F.-sf-in. and be cleanable and suitable for duct velocities of 4000 FPM. Duct liner thickness shall be 1" unless indicated otherwise. The installation shall include 100% coverage of the manufacturer’s recommended adhesive and protective Z-strips at all exposed upstream edges. Mechanical fasteners shall be used in addition to adhesive. Insulation shall comply with NFPA 90A and NFPA 90B and be approved by Factory Mutual.

F. Exposed Ductwork: Interior exposed ductwork shall be “Paint-Grip” galvanized, suitable for field-painting without dents or other visible cosmetic damage.

2.2 DUCTWORK ACCESSORIES

A. Access Doors:

1. Medium Pressure Duct Systems: Ruskin Model ADHP-3, 12"x12" size, 16 gauge galvanized steel, foam gasket, insulated door, spring latches.

2. Low Pressure Duct Systems: Ruskin Model ADC2, 12"x12" size, 24 gauge galvanized steel, steel on both sides of door, foam gasket seals, 1" insulation, 2 cam locks, no hinge.

B. Counter Balanced Dampers (CBD): Aluminum frame and blades, extruded vinyl edge seals, 2-1/4" deep, set 0.06" WG.

C. Backdraft Dampers (BDD): Ruskin Model CBD2 or American Warming and Ventilating aluminum frame and blades, extruded vinyl edge seals, field set at 0.10" W.G. pressure differential for full open operation.

D. Fire Dampers: Greenheck DFD-series, Ruskin Model IBD2, or Cesco, curtain type, 100% free area (ONLY), Style C for round duct installations, and Style B or ODFD type for rectangular duct applications. Fire dampers located immediately behind transfer grilles may be Style A dampers. The dampers shall be UL rated for 1-1/2 hours and have a 165^{o}F fusible link. Fire dampers shall be “dynamic” rated and shall comply with UL “Standard for Safety” 555.

E. Drawbands for Flexible Ducts: Clinch type stainless steel with screwdriver adjustment, or nylon with lever action tightening tool provided by the drawband manufacturer.

F. Turning Vanes: (Low Pressure):

1. Solid blade, mounted with the long edge down stream in accordance with duct construction details indicated. Submit a 12"x12" sample elbow for review prior to fabrication.

G. Volume Dampers:

1. Factory fabricated as specified, or shop fabricated in accordance with SMACNA "HVAC Duct Construction Standards".

2. Rectangular: Ruskin Model MD-35, or American Warming and Ventilating, 12 gauge galvanized steel, locking quadrant, opposed blade over 11", single blade 11" and under.

3. Round: Ruskin Model MDRS25, or American Warming and Ventilating, 20 gauge galvanized steel with locking quadrant(ONLY). Dampers may be provided integral with spin-in fittings.

H. Flexible Ductwork:

1. Not allowed.

I. Joint Sealer:

1. Duro-Dyne DDS181, Design Polymerics DP 1010 water-based polymeric duct sealant, Hardcast DT tape and FTA-50 activator or Airseal #33 fiber-reinforced water-based brush-on sealer by Polymer Adhesive Sealant Systems, Inc. (UL181A-M or 181B-M labeled).

2. Provide waterproof sealer where watertight seal is specified.

2.3 AIR DEVICES (Krueger, Price, Metal Aire, Titus) ONLY

A. Material and Finishes: Construct diffusers, registers, and grilles of aluminum. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Steel parts shall be factory zinc-phosphate treated prior to priming and painting or have a baked-on enamel finish. Aluminum parts shall be finish painted. Provide frame style compatible with ceiling or wall type. Colors shall be selected by Architect. Devices to be installed on exposed duct installations shall be furnished in primer suitable for field application of color coat.

B. **Sound Level**: Manufacturer certified sound level rating of inlets and outlets in accordance with ADC 1062 R4. Conform with the maximum permissible room / diffuser noise criteria (NC) level for each device as scheduled. Provide submittal data accordingly.

C. Throw: Defined as distance from the diffuser, register, or grille to the point which the resultant room air velocity is 50 to 35 feet per minute.

D. Ceiling Diffusers: Equip with core styles required to provide air distribution pattern indicated. Internal parts shall be removable through the diffuser-neck for access to the duct and without the use of special tools. Construct each diffuser of four or more concentric elements designed to deliver air in a generally horizontal direction. The interior elements of square and rectangular ceiling diffusers may be square or rectangular as manufacturer's standard. Screws or bolts in exposed face of frames or core elements are not acceptable. Diffusers shall have an opposed blade volume damper in the diffuser neck if no damper is indicated in the branch duct (see Drawings). Diffusers shall have a 24"x24" lay-in panel for areas with acoustical ceilings and surface-mount frame for GWB ceilings. Ceiling diffusers shall be Price AMX series, high induction type with induction vanes.

E. Grilles and Registers: Construction and finish as indicated, 1/2" louver spacing, 45^{o} curved blade. Registers shall have opposed-blade volume dampers with screwdriver adjuster. Unless otherwise indicated, registers shall be provided.

F. Linear Diffusers and Bar Grilles: Linear bar grilles/registers and linear slot diffusers shall be as scheduled and indicated. Provide opposed blade volume dampers for each diffuser (unless a volume damper is provided in the branch duct) and adjustable pattern controllers. Return air slots shall be without pattern controllers. “Revers-A-Core” diffusers shall have deflection vanes. Construction shall be extruded aluminum with an anodized finish.

G. General: The interior of all sheetmetal connections to grilles, registers and diffusers shall be painted with a non-specular flat black paint so that no sheetmetal surfaces are visible from the finished space.

2.4 COMBINATION FIRE / SMOKE DAMPERS

A. Combination fire / smoke dampers shall be Greenheck Model FSD-33, 1½ hour fire rating, with dynamic rating, UL-listed.

B. Furnish with an integral 16 gauge sleeve with break-away connections, and smoke detector.

C. Damper shall be constructed of galvanized steel with airfoil blades. Sleeve type shall accommodate rectangular, round or flat oval ductwork, as required, with **Class I** leakage construction.

D. Provide suitable access doors, as required.

E. Installation shall be per the manufacturer’s recommendations and the performance listing.

F. Actuator: Belimo, Internally-mounted electric actuator, with end switch interlocked with the smoke detector and associated air handling system. Provide access, as required.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

2. Verify that the duct systems may be installed in accordance with pertinent codes and regulations and the reviewed Submittals.

3.2 INSTALLATION OF DUCTWORK AND AIR DEVICES

A. Provide and erect in accordance with the best practice of the trade ductwork shown on the drawings and as required to complete the intended installation. Make offsets as shown or required to place ductwork in proper position to avoid conflicts with other work and to allow the application of insulation and finish painting to the satisfaction of the Architect. Sizes given are "inside - clear" dimensions and not necessarily that of sheet metal. Ducts shall be arranged to adjust to "field conditions". The Sheet Metal trades shall coordinate his work with other trades. Work shall conform to ASHRAE duct construction recommendations, SMACNA "Duct Construction Standards", NFPA, and the requirements of the IBC code.

B. Joint Sealing: See PRODUCTS section.

C. Longitudinal joints: See PRODUCTS section.

D. Turns shall be made with long radius elbows or, if physically impossible to use long radius elbows, shall be square turns with specified turning vanes. CAUTION: Turns not conforming to this requirement shall be ordered removed and replaced with properly built turns.

E. Access Doors: Provide access doors for concealed apparatus requiring service and inspection in the duct system including but not limited to dampers, sensors and motors, and upstream and downstream from duct coils.

F. Duct Sleeves and Prepared Openings: Install duct sleeves and prepared openings for duct mains, duct branches, and ducts passing through walls, roofs, and ceilings. Insure the proper size and location of sleeves and prepared openings. Allow one-inch clearance between duct and sleeve or one-inch clearance between insulation and sleeve for insulated ducts, except at grilles, registers, and diffusers.

G. Duct Supports: Unless otherwise indicated, provide one-inch wide by 16 gage galvanized steel sheet metal strips on each side of ducts. Anchor risers in the center of the vertical run to allow ends or riser free vertical movements. Attach supports only to structural framing members. Do not anchor supports to metal decking unless a means is provided (architectural review required) for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C clamps are used, use retainer clips.

H. Flexible Collars and Connections: Provide flexible collars between fans and ducts or casings and where ducts are of dissimilar metals, except where fans are internally connected to the casing with flexible connectors. For round ducts, securely fasten flexible connections using stainless steel clinch-type draw-band. Nylon drawbands may be used if installed using the drawband manufacturer's lever-action tightening tool. For rectangular ducts, lock flexible

connections to metal collars. All air handling equipment fan connections to the duct systems shall have flexible connections, factory or field-installed.

I. Flexible Ducts: Provide where indicated. No fiberglass shall be exposed or in contact with air flow. Flexible duct length shall not be more than 4'-0". Install with metal band hangers and without excess length, provide maximum extension of flex duct. Securely fasten flexible ducts to metal collars using a stainless steel or tool-tightened nylon drawband on the duct core and a second drawband on the insulation vapor barrier. If the duct exceeds 12 inches diameter, position the drawband behind a bead on the metal collar. Taping in lieu of drawbands is not allowed.

J. Any deviation in the duct system must be submitted as a shop drawing and stamped. CAUTION: Any deviation not submitted and favorably reviewed will be ordered removed from the system and replaced with that which is shown on the Drawings.

K. Discrepancies between actual field conditions and the Contract Documents shall be brought to the attention of the Architect prior to fabrication.

L. Field Changes to Ductwork: Field changes of ducts such as those required to suit the sizes of factory-fabricated equipment actually furnished shall be designed to minimize expansion and contraction. Use 4:1 transitions in field changes as well as modifications to connecting ducts.

M. Transitions with a slope greater than 4 to 1 shall be ordered removed from the system and replaced with a transition which meets this criteria.

N. Joints and seams at intake and exhaust plenums and joints on intake and exhaust ductwork for a distance of 3 feet from the plenum shall be sealed watertight on the bottom and side joints and seams.

O. Isolation dampers at intake and exhaust louvers and vent hoods shall be sealed to the ductwork to provide an airtight assembly with similar performance characteristics to the isolation damper.

P. The inside of sheetmetal connections to grilles, registers and diffusers shall be painted flat black so that no sheetmetal is visible from the finished space.

Q. All sharp edges and corners on ductwork, hangers or equipment located within 7'-0" of the finished floor shall be protected with a suitable padding material and identified with fluorescent orange paint.

3.3 CLOSING IN WORK

A. Cover up or enclose work after it has been properly and completely tested and reviewed.

B. No additional cost to the Owner will be allowed for uncovering or recovering any work that is covered or enclosed prior to required test and review.

3.4 TEST AND ADJUST

A. Ductwork shall be leak tested in accordance with Section 23 05 93 "Testing and Balancing for HVAC". Provide end cap and closure pieces. Close off and seal openings in ductwork to be tested. Ductwork shall be tested before it is insulated.

B. Before operating any system, the system shall be cleaned out to remove dust and foreign materials.

C. After the installation is complete and ready for operation, test the system under normal operating conditions in the presence of the Architect and demonstrate that the system functions as designed.

D. Correct defects which develop during the test period, conduct additional testing until defect free operation is achieved.

3.5 CLEANUP AND CORROSION PREVENTION

A. Ductwork and equipment shall be thoroughly cleaned. Dirt, dust, and debris shall be removed and the premises left in a clean and neat condition.

B. Before covering is applied to duct systems, clips, rods, clevises and other hanger attachments, and before uncovered piping is permitted to be concealed, corrosion and rust shall be wire brushed and cleaned and in the case of iron products, a coat of approved protective paint applied to these surfaces.

3.6 INSTRUCTIONS

A. On completion of the project, instruct the Owner's representative in the care and operation of the system. The total period of instruction shall not exceed four (4) hours. The time of instruction shall be arranged with the Owner. In addition to the prime Mechanical Contractor, the control system Contractor, Balancing Contractor, and Owner's representative shall be present and participate in the Owner's instruction.

3.7 FIRESTOPPING

A. Firestopping shall be performed in accordance with Specification Section 078400 “Firestopping”. All penetrations of fire-rated assemblies including walls and floors by mechanical system components (piping, ductwork, conduits, etc.) shall be firestopped as specified.

* END OF SECTION *

SECTION 260000

GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to Divisions 26, 27 and 28 Sections.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. ANSI C2 - National Electrical Safety Code.

C. ANSI/NFPA 101 - Life Safety Code.

1.03 RELATED REQUIREMENTS

A. Conditions of the Contract and Division 1 - General Requirements, apply to all work, including work of this Division. Examine all contract documents for requirements affecting this work.

1.04 SUBMITTALS

A. Submit under provisions of Division 01.

B. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

C. Mark dimensions and values in units to match those specified.

D. Provide fixture schedule, lighting drawings, panelboard schedules and single line or risers diagram(s) to supplier for assistance in pricing as applicable. Contractor shall receive one set of black line drawings for reproduction from the engineer for this purpose.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable local, State and Federal Building Code for the State of Maine.

B. Electrical: Conform to NFPA 70, NFPA72, NFPA 99, NFPA 101, ANSI C2, 2 FM, UL, and applicable ASTM and ANSI Standards.

C. Contractor shall visit the site to become familiar with all existing conditions affecting this work. No claim shall be recognized for extra compensation due to failure of contractor to familiarize himself/herself with the conditions and extent of proposed work.

D. Obtain permits and request inspections by local authority having jurisdiction.

1.06 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Engineer before proceeding.

1.08 TEMPORARY LIGHT AND POWER

A. Temporary light and power shall be installed and maintained by the Electrical Contractor for use by all trades for the duration of construction complete with all wiring, switches, protective devices and similar equipment as may be required. Arrangement for the temporary service with the Power Company is the responsibility of the Electrical Contractor. Power bills will be paid by the General Contractor. Provide 120/208 volt or 120/240 volt 100 ampere, drop box similar to standard CMP detail 980-31.1.4. Provide 15-20 watt self ballasted compact fluorescent, lamps with plastic “cages” as needed. or 4 foot twin lamp (T8) fluorescent tamper-proof, gasketted and water-tight as required.

1.09 CONTRACT DRAWINGS AND SPECIFICATIONS

A. It is to be understood that drawings accompanying these specifications are intended to show general arrangement and extent of work to be done, but exact location and arrangement of all components shall be determined as work progresses. Anything shown on the drawings and not specifically mentioned in specifications or vice versa shall be considered as required in both.

B. Locations of equipment, and materials, etc., as given on drawings are approximate unless dimensioned. It shall be understood they are subject to such modifications as may be found necessary or desirable at time of installation in order to meet any structural conditions. Such changes shall be made by the contractor without extra charges.

C. Because of small scale drawings, all required offsets, etc., as may be required to clear work of other Contractors, may not be shown. Contractor, however, shall provide all necessary offsets, etc., as required to complete the installation of their work and not conflict with that of others.

D. It is the intention that wiring systems shall be complete and fully operational. The contractor shall identify system components during the bid process that clearly constitute conditions that would cause the system to be incomplete. Clarification: The remedy to these discrepancies shall be communicated by the engineer to all bidders or included as an addenda.

1.10 MATERIALS AND LABOR

A. Bidders for this work shall carefully examine the Plans and Specifications, as the Contractor shall be required to furnish all materials and labor necessary to deliver to the Owner a complete system installed in full accordance with Local State and Federal laws. The system shall be furnished as specified, tested, and turned over to the Owner in perfect operating

condition.

B. All materials shall be new and of best quality of their respective kinds. Workmanship in all respects shall be of highest grade and all construction shall be done according to best practices of the trade. Materials shall be warrantied directly by the manufacturer.

C. Contractor shall provide, when required for review of Engineer, labeled samples of any material or equipment specified herein or proposed to be used on this project.

D. Where words "furnish", "provide" or "install" are mentioned, either singly or in combination, these words are hereby interpreted to mean "furnish and install" or "provide and install," including all materials complete with all connections, supplemental devices, accessories and appurtenances, unless specifically otherwise noted. These words are likewise hereby interpreted as being prefixed to all materials, equipment, and apparatus hereinafter mentioned, either in abbreviated or schedule information.

1.11 PROTECTION OF WORK AND MATERIALS

A. Contractors shall be responsible for the care and protection of all materials delivered and labor performed until the completion of the work.

B. Cap all uncompleted lines, raceways, and ducts until ready for final connections, or future work as indicated.

C. All portions of the work liable to damage by weather or by those engaged on the project, must be securely protected by temporary, but substantial covering which must be maintained in position until Engineer authorizes removal.

1.12 REPLACEMENTS

A. In the event of damage to any equipment or materials, immediately make all repairs and replacements necessary to the approval of the Engineer at no additional cost to the Owner.

1.13 SAFETY REGULATIONS

A. All work to be performed and/or installed shall conform to all requirements of the Occupational Safety and Health Act (OSHA) of 1970 and all Amendments thereto.

1.14 INSURANCE

A. The Contractor shall purchase and maintain all Workmen's Compensation Insurance, Public Liability and Property Damage Insurance during the progress of the work and until completion and acceptance of the entire project by the Owner.

1.15 QUALITY ASSURANCE/CONTROL OF INSTALLATION

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

B. Comply fully with manufacturers' instructions, including each step-in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

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

E. Perform work using persons qualified to produce workmanship of specified quality.

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

1.16 UNDERWRITER'S APPROVALS

A. All electrical materials and equipment shall bear label of Underwriter's Laboratories, shall be listed by them in their list of electrical fittings and shall be approved by them for purpose for which they are to be used, unless materials and equipment are of a type for which Underwriter's Laboratories does not list or provide label service.

1.17 SUBSTITUTIONS

A. Where the specifications allow the substitution of a product for that which has been specified, said substitution must be reviewed by the Engineer and shall be equivalent in all respects to that which is specified. The Engineer's decision shall be obtained on all questions as follows, and his/her judgment shall be final and binding on all parties.

B. Reference in the specifications or on the drawings to any product, material, fixture, form or type of construction, etc., by proprietary name, manufacturer, make or catalog number, shall be interpreted as establishing a standard of quality or design and shall not be construed as limiting competition. The Contractor may, at his/her option, use any fully equivalent substitute provided written review by the Engineer is first obtained indicating acceptance of the equality of the substitute preferred.

C. For materials or equipment which are supplied with integral or factory applied finish, the colors of same shall be considered in evaluating substitutions.

D. For the purpose of avoiding conflicts with other trades, contracts, and adjoining work where more than one (1) article, device, material, fixture, form or type of construction, etc., is referred to by proprietary name, manufacturer, make or catalog number, the first named shall be used as the basis of design and details. The cost of any changes of approved equivalent item shall be borne by the Contractor requesting such change.

1.18 RECORD DRAWINGS

A. During construction, the Contractor shall keep an accurate record of all deviations to the installation of the work as indicated on the drawings. Upon completion of the work, the Contractor shall furnish a copy of this record to the Engineer, on a black line of the original

which will be available from the Engineer. Submit record drawings before requesting final payment.

1.19 MANUFACTURER'S REPRESENTATIVE

A. At appropriate times, or as directed by the Engineer, provide the services of a competent factory trained Engineer or Technician of the manufacturer of equipment or item involved, to inspect, adjust, and place in proper operating condition any and all such items of manufacture. No additional compensation shall be allowed Contractors for such service.

1.20 MANUFACTURERS' INSTRUCTIONS, AND OPERATION AND MAINTENANCE DATA

A. Provide for each item of equipment or apparatus furnished, a complete set of printed instructions obtained from the manufacturer covering proper operation, care, lubrication, cleaning, servicing, adjustment, etc., together with any special safety instructions.

B. Manufacturers' data shall further include performance data (time current curves, where applicable), complete parts lists, recommended spare parts lists, and wiring diagrams.

C. Data shall be arranged in complete sets, properly indexed and marked.

D. Data shall include complete set of shop drawings.

E. Material shall first be submitted in preliminary fashion for review by Engineer. After approval, Contractor shall submit two (2) copies in bound volumes to the Engineer for distribution.

F. Provide contacts for service agencies for all major system components.

1.21 GUARANTEES

A. An item becomes "defective" when it ceases to conform to this Contract Document. Guarantees beginning on the date of issuance of the Owner's final payment, or certificate of substantial completion, with Owner taking occupancy or beneficial use thereafter.

B. Upon completion of the work and before applying for final payment, furnish a written guarantee, stating that the work complies with the provisions of codes listed herein and the local enforcing authorities, and that it will be free from defects of material and workmanship for the required guarantee period. Guarantee shall further state that the Contractor will, at his own expense, repair and/or replace any of his material and work which may become defective during the time of guarantee, together with other work damaged as a consequence of such defects. All manufacturers written warranties shall apply to materials. Warranties other than that of the manufacturer are not acceptable.

C. The guarantee period shall be one (1) year except when longer periods are indicated for specific equipment.

D. All materials in Division 26 where a written warranty is published shall require the warranty to

be offered by the product manufacturer.

1.22 EXISTING UTILITIES AND EQUIPMENT

A. Extreme care shall be taken to protect existing utilities and equipment above and below grade and in all other locations. Information contained on drawings is not guaranteed as to location, invert, etc. but represent the best information available as to the location of underground and concealed utilities and equipment. The Contractor shall be responsible for the replacement of all damaged or broken utilities or equipment due to their work or operations.

1.23 ENERGIZING EQUIPMENT

A. Obtain Owner’s written approval before energizing any equipment.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 CONNECTION TO EQUIPMENT

A The Contractor shall be responsible for proper wiring and raceway connections to equipment, make sure of alignment, both initially and under operating conditions, and provide proper supports, brackets, means of expansion, etc., to make sure that no excessive stresses are applied to equipment. Raceways shall be run to the equipment and alignment checked before final bolting and fastening.

B At the request of the Engineer, dismantle equipment connections to demonstrate proper installation and make such corrections necessary without additional compensation for disassembly, re-connection, or the required corrective work.

C Equipment shall be installed in such a manner as to permit disconnecting for service and repairs without the necessity of rigging.

3.02 CLOSING IN UNINSPECTED WORK

A General: Do not cover up or enclose work until it has been properly and completely inspected and approved. Engineer may waive this requirement by written permission.

B Noncompliance: Should any of the work be covered up or enclosed prior to all required inspections and approvals, uncover the work as required, and after it has been completely inspected and approved, make all repairs and replacements with such materials as are necessary to the approval of the Engineer and at no additional cost to the Owner.

3.03 CLEANING OF SYSTEMS

A All wiring systems shall be thoroughly cleaned prior to initial operation and in accordance with manufacturer's instructions for equipment to be furnished and/or installed.

B Furnish all detergents, solvents, cleaning compounds, tools, etc., required in connection with cleaning operations.

C Thoroughly clean all exposed portions of all equipment, remove all labels, and wipe clean with a damp rag.

3.04 TESTING, BALANCING, AND ADJUSTING

A Electrical loads shall be balanced on all phase legs to a tolerance of plus or minus 10 percent. Include testing circuits for shorts to ground. Measure grounding system resistance. Correct all deficiencies. Provide all test equipment.

3.05 INSTRUCTIONS

A On completion of the job, Contractor shall provide competent technicians to thoroughly instruct the Owner's representative in the care and operation of the system. The total period of instruction shall not exceed 2 hours and be performed in a minimum of one interval. The time of instruction shall be arranged with the Owner. The Electrical subcontractor shall be present and participate in the Owner’s instruction.

3.06 FIRESTOPPING

A Firestopping shall be performed in accordance with Specification Section “Firestopping”. All penetrations of fire-rated assemblies including walls and floors by electrical system components (conduits, cables, trays, etc.) shall be firestopped as specified. Coordinate size, location and type of sleeves as required by firestopping systems.

*** END OF SECTION ***

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. General Cable Technologies Corporation.
2. Southwire Incorporated.
3. The Okonite Company.

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for Metal Clad cable, Type MC or SO cable.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.
6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.
9. Tyco Electronics.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.

B. Feeders: Type THHN-2-THWN-2, single conductors in raceway.

C. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal Clad Cable, Type MC.

E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

B. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Grounding systems and equipment.

B. Section includes grounding systems and equipment, plus the following special applications:

1. Underground distribution grounding.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
2. Backfill Material: Electrode manufacturers recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.5 LABELING

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and less: 10 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. EMT: Comply with ANSI C80.3 and UL 797.

D. FMC: Comply with UL 1; zinc-coated steel or aluminum.

E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Fittings for EMT:

a. Material: Steel or die cast.
b. Type: Setscrew.

G. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Metal Floor Boxes:

1. Material: Cast metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

J. Gangable boxes are allowed.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed: EMT.
2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
4. Damp or Wet Locations: GRC.
5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12 inches (300 mm) of enclosures to which attached.

H. Stub-ups to Above Recessed Ceilings:

1. Use EMT for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

K. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

L. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

M. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

N. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

P. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

Q. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

R. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

S. Locate boxes so that cover or plate will not span different building finishes.

T. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

U. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

V. Set metal floor boxes level and flush with finished floor surface.

3.3 INSTALLATION OF ELECTRICAL BOXES IN FIRE RATED WALLS

A. Outlet boxes on opposite sides of the wall shall be separated as follows:

1. By a horizontal distance of not less than 24 inches (610 mm);

2. By a horizontal distance of not less than the depth of the wall cavity where the wall cavity is filled with cellulose loose fill, rockwool or slag mineral wool insulation.

3. By protecting both outlet boxes by listed putty pads, 3M Catalog # MPP+ or equal.

B. Boxes exceeding 16 sq. in. (103 sq. cm) must be protected by listed putty pads, 3M Catalog # MPP+ or equal.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an white field.
2. Legend: Indicate voltage.

C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers diagonally over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stop stripes at legends.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Colors for Cables Carrying Circuits at 600 V and Less:

1. Black letters on an white field.
2. Legend: Indicate voltage.

C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- (0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.4 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE.

2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

C. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot (10-m) maximum intervals.

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded feeder and service conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.

C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

E. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring.

1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.

I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-)

high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Enclosed switches.
e. Enclosed circuit breakers.
f. Enclosed controllers.
g. Variable-speed controllers.
h. Push-button stations.
i. Contactors.
j. Remote-controlled switches, dimmer modules, and control devices.

END OF SECTION 260553

SECTION 260924
LIGHTING CONTROL DEVICES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wall box mounted, wall/corner mounted, and ceiling mounted occupancy sensors including dual technology, ultrasonic, and passive infrared technologies. This includes self contained PIR sensors as well as low voltage sensors that work with Switchpacks.

B. Related Sections:
   1. Section 265100 – Interior Lighting.

1.2 REFERENCES

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
   1. C62.41-1991 – Recommended Practice for Surge Voltages in Low Voltage AC Power Circuits.

B. ASTM International (ASTM)
   1. D4674 -02a Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight.

C. National Electrical Manufacturers Association (NEMA)
   1. WD1 (R2005) - General Color Requirements for Wiring Devices.

D. Underwriters Laboratories, Inc. (UL):
   1. 94 – Flammability Rating
   2. 916 – Energy Management Equipment.
   3. 508 (2005) - Standard for Industrial Control Equipment.
   4. 244A – Appliance Controls

1.3 SYSTEM DESCRIPTION

A. Permanently installed
   1. Wall switch occupancy sensors
   2. Ceiling mounted occupancy sensors

1.4 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Specification Conformance Document: Indicate whether the submitted equipment:
   1. Meets specification exactly as stated.
   2. Meets specification via an alternate means and indicate the specific methodology used.

C. Shop Drawings; include:
   1. Load schedule indicating actual connected load, load type, and voltage per circuit, circuits and their respective control zones, circuits that are on emergency, and capacity, phase, and corresponding circuit numbers.
   2. Schematic of system.
   3. Lighting plan clearly marking product type, location and orientation of each sensor.

D. Product Data: Catalog specification sheets with performance specifications demonstrating

compliance with specified requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer: Minimum 20 years' experience in manufacture of occupancy sensor lighting controls.
B. Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standards, including in-house engineering for product design activities.
C. Occupancy Sensing Lighting Controls:
   1. Listed by UL specifically for the required loads. Provide evidence of compliance upon request.
D. Installer Qualifications: Installer shall be one who is experienced in performing the work of this section, and who has specialized in installation of work similar to that required for this project.
E. Source Limitations: To assure compatibility, obtain occupancy sensors from a single source with complete responsibility over all lighting controls, including accessory products. The use of subcontracted component assemblers is not acceptable.

1.6 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
   1. Ambient temperature: 0° to 40° C (32° to 104° F).
   2. Relative humidity: Maximum 90 percent, non-condensing.
   3. Occupancy Sensors must be protected from dust during installation.

1.7 WARRANTY

A. Provide manufacturer's 5-year parts warranty.

1.8 MAINTENANCE

A. Make ordering of new equipment for expansions, replacements, and spare parts available to end user.
B. Make new replacement parts available for minimum of ten years from date of manufacture.
C. Provide factory direct technical support.

PART 2- PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Eaton Lighting Systems (formerly Cooper Controls)
B. Substitutions: Allowed under provisions of Division 1.

2.2 SENSOR PERFORMANCE REQUIREMENTS

A. Sensing mechanism:
   1. Infrared: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   2. Dual technology:
      a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.

b. Utilize an operating frequency of 32 kHz or 40 kHz that shall be crystal controlled to operate within plus or minus 0.005% tolerance.
c. Incorporate Doppler shift ultrasonic and passive infrared motion detection technologies. Products that react to noise or ambient sound shall not be considered.

B. Power failure memory:
1. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.

C. Designed and tested to withstand discharges without impairment of performance when subjected to discharges of 15,000 volts per IEC 801-2.

D. Products tested in identical manner, complaint to NEMA WD 7 -2011 Occupancy Motion Sensors Standards.

E. Sensor shall have time delays from 10 to 30 min.

F. When specified, sensors shall automatically adjust time delay and sensitivity settings.

G. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

H. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

I. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed, and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

2.3 LINE VOLTAGE CEILING MOUNTED OCCUPANCY SENSORS

A. Product: OAC-DT-2000-MV, OAC-DT-2000-DMV

B. Provide all necessary mounting hardware and instructions.

C. Capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet

D. Shall accommodate loads from 0-800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180 degree coverage capability.

E. Shall be able to have their visible plastic parts replaced, for color changes in the field, without removing the body of the control from the wall and without requiring special tools.

F. Shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor’s longevity.

G. Shall have no leakage current to load, in manual or in Auto/Off Mode for safety purposes and shall have voltage drop protection.

H. Where specified, dual relay sensors shall offer daylighting foot-candle adjustment control for either or both relays.

2.4 OCCUPANCY WALL SWITCHES

A. Product: OSW-P-0451-MV-*, ONW-P-1001-MV-*, ONW-P-1001-347-*, ONW-P-1001-DMV-*, ONW-P-1001-D347-*, ONW-P-1001-SP-*, ONW-P-1001-RR7-*

B. Capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet

C. Shall accommodate loads from 0-800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have

180 degree coverage capability.

D. Shall be able to have their visible plastic parts replaced, for color changes in the field, without removing the body of the control from the wall and without requiring special tools.

E. Shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.

F. Shall have no leakage current to load, in manual or in Auto/Off Mode for safety purposes and shall have voltage drop protection.

G. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from Automatic On to Manual On.

H. Where specified, dual relay sensors shall offer daylighting footcandle adjustment control for either or both relays.

2.5 0-10V DIMMER SENSOR

A. Product: OSW-P-010-*

2.6 SOURCE QUALITY CONTROL

A. Perform full-function testing on 100% of all system components and panel assemblies at the factory.

PART 3- EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's installation instructions.

B. Provide complete installation of system in accordance with Contract Documents.

C. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.

3.2 TESTING

A. Upon completion of all wiring and after all fixtures are installed and lamped, a representative shall check the installation prior to energizing the system. Each installed occupancy sensor shall be tested in the Test Mode to see that lights turn OFF and on based on occupancy.

B. At the time testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

END OF SECTION

SECTION 261900
SUPPORTING DEVICES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Conduit and equipment supports.

B. Fastening hardware.

1.02 RELATED WORK

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

PART 2 PRODUCTS

2.01 MATERIAL

A. Support Channel: Galvanized or painted steel.

B. Hardware: Corrosion resistant.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using pre-cast insert system, expansion anchors, beam clamps.

C. Anchors and Fasteners

1) Concrete Structural Elements: Use pre-cast insert system, expansion anchors, powder actuated anchors and preset inserts.
2) Steel Structural Elements: Use beam clamps, steel ramset fasteners, and welded fasteners.
3) Concrete Surfaces: Use self-drilling anchors and expansion anchors.
4) Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
5) Solid Masonry Walls: Use expansion anchors and preset inserts.
6) Sheet Metal: Use sheet metal screws.
7) Wood Elements: Use wood screws.

D. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

E. Do not use power-actuated anchors.

F. Do not drill structural steel members.

G. Fabricate supports or trapeze hangers 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.

H. In wet locations install free-standing electrical equipment on concrete pads.

I. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch off wall.

*** END OF SECTION ***

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.
3. Snap switches and wall-box dimmers.
4. Cord and plug sets.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

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

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

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

2.5 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.6 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

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

2.7 WALL-BOX DIMMERS

A. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

2.8 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant**,** die-cast aluminum with lockable cover.

2.9 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Round, die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for UTP cable complying with requirements in Section 271500 "Communications Horizontal Cabling."

2.10 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

B. Wiring device will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 264700

PANELBOARDS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Branch Circuit panelboards.

1.02 RELATED WORK

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

1.03 REFERENCES

A. NECA (National Electrical Contractors Assoc.) “Standard of Installation”.

B. FS W-C-375 - Circuit Breakers, Molded Case, Branch Circuit and Service.

C. NEMA AB 1 - Molded Case Circuit Breakers.

D. NEMA PB 1 - Panelboards.

E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

F. NEMA PB 1.2 - Application Guide for Ground-Fault Protective Devices for Equipment.

G. NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

A. Submit shop drawings for equipment and component devices.

B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

1.05 SPARE PARTS

A. Keys: Furnish 4 each to Owner.

PART 2 PRODUCTS

2.01 PANELBOARDS

Branch Circuit Panelboards

1. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type. FS W-P-115; Type I, Class 1.
2. Enclosure: NEMA PB 1; Type 1.
3. Cabinet Size: 6 inches deep; 20 inches wide for 240 volt and less panelboards.
4. Provide surface cabinet front with concealed trip clamps, concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
5. Provide panelboards with aluminum bus, ratings as scheduled on Drawings. Provide copper ground bus in all panelboards.
6. Minimum Integrated Short Circuit Rating: as shown on Drawings.
7. Molded Case Circuit Breakers: NEMA AB 1 FS W-C- 375; bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on Drawings.
8. Current Limiting Molded Case Circuit Breakers: NEMA AB 1 FS W-C-375; provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
9. Provide circuit breaker accessory trip units and auxiliary contacts as indicated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards plumb and flush with wall finishes, in conformance with NEMA PB 1.1.

B. Height: 6 feet to top of panelboard maximum.

C. Provide filler plates for unused spaces in panelboards.

D. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads. Label Panels per Section 261950.

E. Provide 6 – 1" EMT conduits from recessed panelboards to accessible point above the ceiling wherever possible.

3.02 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

*** END OF SECTION ***

SECTION 265100

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, LEDs and drivers.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LER: Luminaire efficacy rating.

D. Lumen: Measured output of lamp and luminaire, or both.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Energy-efficiency data.
4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
5. Lamp data including dimensions, color temperature and power consumption
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Installation instructions.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1. Lamps: 10 of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: One of each type and rating installed. Furnish at least one of each type.
3. Ballasts: 2 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: 1 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

    a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
    b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

2.3 LEDs:

1. The light source of the luminaires shall consist of LED arrays or bars. If required, the LED arrays or bars shall be removable.
2. The LEDs shall be either white or RGB, according to the light fixture schedule and Drawings. For luminaires specified with white light, it is not acceptable to provide RGB LEDs mixed to produce white light.
3. Refer to the light fixture schedule and Drawings for the specified correlated color temperature (CCT) of each luminaire.
4. Individual LEDs shall be binned by manufacturer to comply with ANSI C78.377.
5. The LEDs shall be manufactured by Cree, Philips, Toshiba, Osram, Samsung, or Nichia, unless otherwise noted.

2.4 DRIVERS:

1. The driver or power supply for the luminaire shall be modular and replaceable.
2. The rated life of the driver shall match the rated life of the LEDs and luminaire.
3. In general, the drive current rating of the driver shall be minimized, while still maintaining the required lumen output, to improve luminaire efficiency and life.
4. The driver shall meet the emission standards of IEC EN-61000-6-3 at a minimum. For healthcare or other applications with EMI sensitive equipment, provide drivers that meet more stringent standards as required.

2.5 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

    a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.6 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION 265100

SECTION 271100

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Telecommunications equipment racks.
3. Grounding.

B. Related Requirements:

1. Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. LAN: Local area network.

C. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

PART 2 - PRODUCTS

2.1 EQUIPMENT FRAMES

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

1. Belden Inc.
2. Cooper B-Line.
3. Emerson Network Power Connectivity Solutions.
4. Hubbell Premise Wiring.
5. Leviton Commercial Networks Division.
6. Middle Atlantic Products, Inc.
7. Ortronics, Inc.
8. Panduit Corp.
9. Siemon Co. (The).
10. Tyco Electronics Corporation; AMP Products.

B. General Frame Requirements:

1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch (480-mm) panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.

C. Floor-Mounted Racks: Modular-type, steel construction.

1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug**,** and a power strip.
2. Baked-polyester powder coat finish.

D. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.

4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.2 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting.
3. Six 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.
6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
8. Close-coupled, direct plug-in line cord.
9. Rocker-type on-off switch, illuminated when in on position.
10. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.3 GROUNDING

A. Comply with requirements in Section "Grounding and Bonding" for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with J-STD-607-A.

2.4 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 FIRESTOPPING

A. Comply with TIA-569-B, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.3 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.4 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Section "Identification for Electrical Systems."

B. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

SECTION 271500

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Coaxial Cable
3. Cable connecting hardware, patch panels, and cross-connects.
4. Telecommunications outlet/connectors.
5. Cabling system identification products.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. LAN: Local area network.

F. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

G. RCDD: Registered Communications Distribution Designer.

H. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer**,** qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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

1. Patch-Panel Units: One of each type.
2. Connecting Blocks: One of each type.
3. Device Plates: One of each type.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
1. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Grounding: Comply with J-STD-607-A.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ADC.
2. Belden Inc.
3. Berk-Tek; a Nexans company.
4. CommScope, Inc.
5. Draka Cableteq USA.
6. Genesis Cable Products; Honeywell International, Inc.
7. Mohawk; a division of Belden Networking, Inc.
8. Superior Essex Inc.

9. SYSTIMAX Solutions; a CommScope, Inc. brand.
10. 3M Communication Markets Division.
11. Tyco Electronics Corporation; AMP Products.

B. Description: 100-ohm, four-pair UTP, covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, **Category 6**.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

    a. Communications, General Purpose: Type CM or CMG.
    b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
    c. Communications, Riser Rated: Type CMR, complying with UL 1666.
    d. Communications, Limited Purpose: Type CMX.
    e. Multipurpose: Type MP or MPG.
    f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
    g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ADC.
2. American Technology Systems Industries, Inc.
3. Belden Inc.
4. Dynacom Inc.
5. Hubbell Premise Wiring.
6. Leviton Commercial Networks Division.
7. Molex Premise Networks; a division of Molex, Inc.
8. Panduit Corp.
9. Siemon Co. (The).
10. Tyco Electronics Corporation; AMP Products.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for **Category 6**. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure **Category 6** performance. Patch cords shall have latch guards to protect against snagging.

2.5 COAXIAL CABLE

A. The drop cable shall be plenum rated RG-6U with 100% shielding. The cable shall be West Penn Wire 25841, or approved equal.

2.6 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Port-connector assemblies, with quantities shown on drawings, mounted in single faceplate.

1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
2. For use with snap-in jacks accommodating any combination of UTP.
3. Legend: Machine printed, in the field, using adhesive-tape label.
4. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.7 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with J-STD-607-A.

2.8 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where

unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.4 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section "Identification for Electrical Systems."

B. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

C. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

D. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm **Category 6**, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

B. End-to-end cabling will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 271500

SECTION 283111

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manual fire-alarm boxes.
2. System smoke detectors.
3. Heat detectors.
4. Notification appliances.
5. Addressable interface device.

1.2 SYSTEM DESCRIPTION

A. Extend existing addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified fire-alarm technician, Level III minimum.

D. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

    a. Frequency of testing of installed components.
    b. Frequency of inspection of installed components.
    c. Requirements and recommendations related to results of maintenance.
    d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.

2.2 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.

b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions were applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.3 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.4 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level

of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

2.5 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

D. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

E. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

F. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

G. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to elevator recall system and components.
2. Supervisory connections at valve supervisory switches.
3. Supervisory connections at elevator shunt trip breaker.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

   a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
   b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm

Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

B. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

C. Fire-alarm system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

F. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

END OF SECTION 283111

SECTION 21 13 13

WET-PIPE SPRINKLER SYSTEMS

PART 1 - GENERAL

1.1 DESCRIPTION OF WORK

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to design, install and test a pressurized, fully supervised, wet pipe fire protection system for full building protection in accordance with NFPA, IBC, and the Owner's insurance underwriter.

1.2 RELATED DOCUMENTS

A. The drawings and the specifications including SECTION 23 05 00 “Common Work Results for HVAC” are hereby made a part of the work of this section.

1.3 QUALIFICATIONS

A. The Fire Protection Work shall be performed by a qualified Contractor primarily engaged in the design and installation of Fire Protection Systems. The fire protection system design shall be performed under the direction of, and sealed by, a professional engineer registered in the State of Maine or with NICET Level III (minimum) Certification.

B. Welding qualifications of individuals installing welded piping shall be certified by the National Certified Welding Bureau for the type(s) of weld(s) proposed for use in piping assembly.

1.4 SUBMITTALS

A. Items for which the submittal requirements of section 23 05 00 “Common Work Results for HVAC”, apply are as Follows:

1. Hydrant flow test.
2. System components.
3. Hydraulic calculations.
4. Piping layout, details and control diagram.
5. Flushing and testing records.
6. Certificate of installation.
7. Copy of Fire Protection Contractors License.
8. Welding certificates of individual welding technicians.
9. Zone flow switches, piping and valves.
10. Sprinkler heads.
11. Alarm valve(s), part of the “Shell” Contract.
12. Fire department connection(s), part of the “Shell” contract.
13. Firestopping materials and methods.

Submit hydrant flow test, equipment descriptive data, hydraulic calculations and system layout for review by the Owner's Insurance Underwriter. Submit the system layout to the

Architect for review. The Architect's review will be limited to checking for conformance with the design concept of the project and general compliance with the contract documents and will in no way assume liability for review for compliance with codes, standards and laws.

1.5 SPRINKLER COVERAGE

A. Sprinkler head coverage shall conform with NFPA requirements for the use of the building (Light Hazard, 0.10 GPM/SF density for the hydraulically most remote 1500 S.F.). Coverage in other areas shall be increased accordingly where required by the Authority having jurisdiction.

B. If the requirements of the inspection agency or the Owner's insuring agent are more rigorous than those stated herein, then the more rigorous requirements shall govern.

C. The building will be sprinklered by a NFPA13 system under the “Shell” Contract and will require a new sprinkler system layout for full coverage of the tenant space to comply with NFPA13

PART 2 - PRODUCTS

2.1 SYSTEM COMPONENTS AND HARDWARE

A. Pipe, Fittings, Joints, Hangers, Valves, Fire Department Connections, Alarms: Conform to NFPA-13, Installation of Sprinkler Systems.

B. Sprinkler Heads:

1. Interior Heated Spaces: Conform to NFPA-13, commercial quick response type. Provide semi-recessed type with white finish for acoustical tile ceilings. Sprinkler heads in GWB and corridor / lobby ceilings shall be concealed type. Dry pendent or sidewall heads, where required, may be standard response type.

2. Provide a spare head cabinet with wrenches and six (6) heads of each orifice size, finish, temperature classification, pattern and length furnished in the project.

3. Provide sprinkler head guards where required.

4. Sprinkler heads in unheated / minimally heated areas including all entrance vestibules shall be dry pendent or sidewall type, or served by a separate dry-pipe system.

5. Temperature ratings for sprinkler heads shall be suitable for the space. Heads in locations with concentrated heat sources shall have heads with the appropriate temperature rating.

2.2 WATER SUPPLIES

A. “Shell” contract.

2.3 DEVICES

A. Detection devices and associated wiring both within the fire protection system and connected to the building Fire Alarm System shall be the responsibility of the Sprinkler Contractor.

2.4 BACKFLOW PREVENTER

A. “Shell” contract.

2.5 PIPING SYSTEM IDENTIFICATION

A. Piping system and valve identification and color coding shall be in accordance with ANSI.

2.6 SPRINKLER SYSTEM ZONING

A. Per the City of Portland requirements.

2.7 CEILING CAVITIES

A. Ceiling cavities above all suspended acoustical tile ceilings in corridor areas and certain other areas contain bundled electrical cables and individual wires and shall be sprinklered. Coordinate sprinkler requirements with the Electrical Drawings

PART 3 - EXECUTION

3.1 PIPING LAYOUT AND DESIGN

A. System requirements, installation requirements, design, plans, and calculations: Conform to NFPA-13, Installation of Sprinkler Systems.

B. Sprinkler piping shall be run concealed above ceilings in occupied areas. Piping in other areas may be run exposed. Piping shall not be exposed in occupied spaces unless indicated on the drawings.

C. Pipe penetrations through walls and floors, including pipe sleeves shall be in accordance with Section 23 05 00 – General Mechanical. Traverse points of piping shall be escutcheoned with split chrome floor and ceiling plates and spring anchors, where visible to occupancy.

D. Coordinate design and layout with building structure and building systems. The work shown in the contract documents has precedence for space requirements. Work of other trades may be modified or moved only with permission of the trade involved. Costs associated with modifications or relocations shall be the same as for "Substitutions" Section 23 05 00. Sprinkler system piping may need to be located within the structural system in certain locations.

E. The Architect shall review proposed system layout and reserve the right to relocate heads, substitute head system and in general review final layout for components visible in occupied spaces.

F. Sprinkler heads shall be centered in acoustical ceiling tiles.

3.2 SYSTEM ACCEPTANCE

A. Approval, flushing, hydrostatic testing, instructions, and certificates of installation: Conform to NFPA-13, Installation of Sprinkler Systems.

B. Disinfect the water piping in accordance with AWWA C601. Fill the piping systems with solution containing a minimum of 50 parts per million of available chlorine and allow solution to stand for minimum of 24 hours. Repeat disinfection if chlorine residual is less than 10 parts per million after 24 hours. Flush the solution from the systems with clean water until maximum residual chlorine contents is not greater than 0.2 parts per million.

C. Closing in Work:

1. General: Cover up or enclose work after it has been properly and completely reviewed.

2. No additional cost to the Owner will be allowed for uncovering and recovering, work that is covered or enclosed prior to required review and acceptance.

D. Cleanup and Corrosion Prevention:

1. Upon completion of the work thoroughly clean and flush piping systems to the sewer with water.

2. Piping and equipment shall be thoroughly cleaned. Dirt, dust, and debris shall be removed and the premises left in a clean and neat condition.

3. Before uncovered piping is permitted to be concealed, corrosion and rust shall be wire brushed and cleaned and in the case of iron products, a coat of approved protective paint applied to these surfaces. When corrosion is from the effects of hot solder paste, the areas shall be cleaned and polished and a wash of bicarbonate of soda and water used to neutralize the acid condition.

E. Instructions: On completion of the project, provide a technician familiar with the system to thoroughly instruct the Owner's representative in the care and operation of the system. The total period of instruction shall not exceed four (4) hours. The time of instruction shall be arranged with the Owner.

F. Warranty: For a period of one (1) year after completion of the installation repair or replace any defective materials or workmanship. Upon completion of the installation, the system shall be turned over to the Owner fully inspected and tested, and in operational condition.

3.3 FIRESTOPPING

A. Firestopping shall be performed in accordance with Specification Section 07 84 00 “Firestopping”. All penetrations of fire-rated assemblies including walls and floors by mechanical system components (piping, ductwork, conduits, etc.) shall be firestopped as specified.

* END OF SECTION *

SECTION 22 00 00

PLUMBING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and the specifications including Section 23 05 00 “Common Work Results for HVAC” are hereby made a part of the work of this section.

1.2 DESCRIPTION

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections, and incidentals and the performing of operations required to provide a complete and functional plumbing system.

B. Work shall be in accordance with the current edition of the Maine Internal Plumbing Rules and applicable local ordinances.

1.3 SUBMITTALS

A. Substitutions: Your attention is directed to Section 23 05 00-"Substitutions", relative to competition and the (ONLY) notation. Familiarity with this section shall be achieved before reading the PRODUCTS section of this specification.

B. The items for which the submittals paragraph in Section 23 05 00 “Common Work Results for HVAC”, apply are as follows:

1. Piping materials.
2. Grooved joint couplings and fittings.
3. Valves.
4. Pipe hangers.
5. Fixtures and trim.
6. Miscellaneous equipment.
7. Water heating equipment.
8. Piping, valves and equipment identification.
9. Floor drains and cleanouts.
10. Firestopping materials and methods.
11. Thermostatic mixing valves.
12. Insulation kits for ADA-compliant sinks.
13. Electronic Trap Primers (**ETP**).

PART 2 - PRODUCTS

2.1 PIPING MATERIALS

A. Soil and Waste (Sanitary), Condensate Drains and Vent Piping: Schedule 40 PVC or service weight cast iron with push-on joints below grade. Piping serving Kitchen Areas shall be service weight cast-iron. Above grade, vent piping may be Schedule 40 PVC or

service weight cast iron "no Hub" above grade. Above grade sanitary and waste piping shall be service weight cast-iron, “No-Hub”.

B. Domestic Water Piping and Condensate Drain Piping: Type L hard copper tubing and cast bronze or wrought copper solder fittings, lead-free solder, “Permalynx” push-to-connect fittings by Victaulic, “Installation-Ready” grooved joint couplings by Victaulic, or "Flowguard Gold" by Noveon or Watts "SeaTech" Quick-Connect type, Schedule 40 solvent-welded CPVC pipe and fittings. CPVC pipe and fittings shall be rated at 100 psig at 180^0F. and shall meet or exceed the requirements of ASTM D2846, the IBC, and be certified by the ANSI/NSF for potable water applications. Installation, including supports, shall be per the manufacturers recommendations.

C. Exposed Water and Waste Piping at Fixtures: I.P.S. copper with cast brass fittings chrome plated finish, with deep one piece escutcheon plates at traverse points.

D. Push-to-Connect Fittings: ASME B16.22 wrought copper or ASME B16.18 cast bronze, with stainless steel internal components and EPDM seals, rated to maximum +230 degrees F at 200 psig operating pressure. Victaulic “Permalynx”.

E. Grooved Joint Couplings and Fittings: ASME B16.22 wrought copper or ASME B16.18 cast bronze, copper-tube dimensioned fittings, with Installation-Ready couplings, for direct stab installation without field disassembly or loose parts, cast with offsetting angle-pattern bolt pads for joint rigidity. Gaskets shall be grade EHP, UL classified in accordance with ANSI/NSF-61 for potable water service. Victaulic Style 607.

F. Solder: Lead-free (ONLY), Englehard Silvabrite 100, 440^oF melting point, ASTM B32.

G. Piping located in masonry (CMU) construction: Piping shall be protected from contact with concrete (masonry) by use of pipe sleeves or other methods approved by the local plumbing inspector.

2.2 NO HUB COUPLINGS

A. For abovegrade DWV piping, couplings shall be Clamp-All HI-TORQ125, shall maintain 15 PSI hydrostatic seal, constructed with a 304SS housing and ASTM C-564 neoprene gasket. Couplings shall meet FM 1680, IBC and local codes and requirements.

2.3 VALVES AND ACCESSORIES

A. General Service Ball Valves: Apollo Model 77-100 (threaded) or 77-200 (solder), Victaulic PL-300 (push-to-connect), bronze full port, or Nibco, copper alloy with stationary seat ring and chromium plated or stainless steel floating ball per Federal Specification WW-V-35B. Blowout proof stem, reinforced PTFE seal. Sizes 2" and larger shall have threaded ends. Provide lever or tee handle with stem extension as required to allow operation without interfering with pipe insulation. For CPVC piping systems (ONLY), ball valves shall be Hayward, or approved equal, "True Union Ball Valves", full port design, Corzan PVC construction with Viton or EPDM seals and tee handle.

B. Butterfly Valves: Victaulic Series 608 with copper-tube dimensioned grooved ends, cast bronze body per ASTM B584, with elastomer coated ductile iron disc with integrally cast

stem. Valve rated to 300 psig CWP, with disc coating UL classified in accordance with ANSI/NSF-61 for potable water service.

C. Check Valves: Horizontal Swing, MSS SP-80, Type 3, Class 125.

D. Drain Valves: Provide ball valves with 3/4" hose connection and brass cap and chain.

E. Fixture Service Stop Valves: Angle Loose Key Stop, ASME A112.18M.

1. Each plumbing fixture and item of equipment shall have individual stop valves in the hot and cold supplies.
2. Service stop valves exposed in finished areas shall be chrome-plated brass; in non-finished areas, ball valves shall be used in lieu of chromed supplies.

F. Temperature and Pressure Relief Valves: Bronze body, tested under ANSI Z21.22, AGA and ASME rated, 125 psig/210^{o}F relief settings.

G. Automatic Trap Primers: Zurn Model Z-1022, Josam or Smith,"Sani-Guard" Trap Primer, all-bronze body with integral vacuum breaker, union connection and supply manifold as required to serve floor drain traps. Trap primers shall comply with ANSI/ASSE Standard 1018. Connect to each floor drain trap unless served by an Electronic Trap Primer (ETP).

H. Thermostatic Mixing Valve (**TMV 1**): Shall be Leonard, Symmons, or equal, capacities and performance as scheduled with stainless steel or lead-free bronze tempering valve, stainless steel or lead-free bronze valve, swivel action check-stops, thermometer, shut-offs and strainer. Controller shall consist of a liquid fill thermal motor with bellows mounted out of the water, UL-listed. Installation shall be per the manufacturers recommendations. Thermostatic mixing valves shall comply with ASSE 1070 or CSA B125.3.

I. Indirect Waste Receptor (I.W.): Zurn Model Z-1025, 3" or 4", fixed air gap, Dura-Coated cast-iron. Furnish with trap primer connection and connect to Electronic Trap Primer.

2.4 VALVES (CPVC Piping Systems)

A. Ball Valves: Spears, CEPEX, IPEX, Nibco or Plast-O-Matic, CPVC, 150 psig at 73°F. pressure rating.

B. Gate Valves: Spears, Hayward Industrial or Nibco, CPVC, 150 psig at 73°F. pressure rating.

C. Outside Screw and Yoke (OS&Y) Gate Valves: Spears or Nibco, CPVC, 150 psig at 73°F. pressure rating.

D. Check Valves: Spears, Hayward Industrial or Nibco, CPVC, 150 psig at 73°F. pressure rating.

E. Butterfly Valves: Spears, Hayward Industrial or Nibco, CPVC, 150 psig at 73°F. pressure rating.

F. Valves shall be compatible with up to a 40% solution of propylene glycol and water.

2.5 PIPE HANGERS

A. Adjustable Swivel Hangers:

1. Pipe sizes 2" and less: Carpenter and Paterson Fig. 800, oversize for insulated piping systems.

2. Pipe sizes larger than 2": Carpenter and Paterson Fig. 100, oversize for insulated piping systems.

B. Riser Clamp: Carpenter and Paterson Fig. 126 CT copper plated for copper piping, Fig. 126 for iron and PVC piping.

C. Insulation Shields: 18 ga. galvanized steel, 180^{o} wrap, Carpenter and Paterson Fig. 265P, Type H.

2.6 FIXTURES AND TRIM

A. (**P1**) Water Closet: ADA-compliant, floor-mounted, flush-valve type, TOTO Model CT705ELN (17”H. ADA), American-Standard, Kohler or Zurn, high efficiency elongated bowl, white vitreous china, low consumption (1.28 GPF), and shall flush with 30 psi water pressure at the valve. Where indicated final installation shall meet ADA guidelines and ANSI A117.1. See Architectural Drawings for mounting heights.

1. Flush Valve: TOTO Model TET1LN32#CP “Eco Powered”, Zurn Model ZGEN6200EV “HydroVantage” or Sloan “Solis” Model 8111-1.28, sensor-type, battery-operated and self-powered electronic with manual override button. Furnish with bumper stop, vacuum breaker and stop valve. Furnish with 6VDC lithium batteries and install per the manufacturers recommendations.

2. Seat: Church Model 895SSC, Toto SC534#01, fireproof thermoset, heavy weight solid plastic, open front, external check hinges, for elongated bowl, white color.

B. (**P2**) Lavatory, Wall Hung: Zurn Model Z-5341-PED, 20"x18", Toto LT307#01, American-Standard, Zurn, or approved equal, white vitreous china, with vitreous china shroud / half pedestal, single hole, front edge shall extend a minimum of 17" from rear finished wall, ADA compliant.

1. Drain: perforated grid strainer with bright metal finish.

2. Hanger/Carrier: Concealed arms or as furnished by the manufacturer. Mounting heights shall be as indicated on the Architectural Drawings.

3. Trap: Chrome-plated, cast copper alloy, 1-1/4" P-trap with cleanout plug. Adjustable with connected elbow and nipple to wall.

4. ADA lavatories shall be installed at 34" above finished floor. Final installation of lavatory and accessories shall meet ADA guidelines and ANSI A117.1.

5. (T) indicates a trap primer fitting.

6. Faucet: TOTO TEL105-D10ET#CP “Eco Powered”, Sloan “Optima Solis.” Model EAF-275-ISM, Symmons “Ultra-Sense”, Bradley, Zurn or Chicago-Faucets, chrome-plated brass, automatic electronic or infrared sensing dual temperature mixing type, battery-operated or self-powered and vandal-resistant, low battery indicator, ADA-compliant with a .5 GPM aerator and integral strainer. Supplies shall be chrome-plated with key stop. Furnish with strainer(s), solenoid valve, batteries and hot/cold back checks. Installation shall be in accordance with the manufacturers recommendations.

C. (**P3**) Urinal: Wall-hung, “Ultra Low Consumption, Zurn Model Z5798 “EcoVantage”, TOTO UT445#01, 1/8 GPF (1 pint), ADA-compliant, Sloan, Kohler, or approved equal, white vitreous china, with fastening hardware, 2" brass urinal flange, gasket, urinal lip shall extend a minimum of 14" from the finished wall.

1. Carrier (if required): Zurn, MIFAB, Josam or Jay R. Smith concealed wall carriers.

2. ADA urinals shall be installed with front rim a maximum of 17” above finished floor. Final installation shall meet ADA guidelines and ANSI A117.1.

3. The flush valve shall be Zurn “HydroVantage”, TOTO TEU1UN12#CP, or Sloan Model 8186, sensor-operated, electronic, battery powered and self-powered with manual override. Furnish with batteries and install per the manufacturers recommendations.

E. (**P4**) Washing Machine Supply and Drain: In-wall, concealed type, Watts Model A2C-WB-M1 “Intelliflow” with leak sensor, or equal, for 2" drain, 16 gauge steel, equipped with an electronic device and leak sensor that interlocks the water supplies with washer operation to control hot and cold water. If a leak is detected the water shall be automatically turned off. Provide integral screwdriver stops or ball valves and water hammer arrestors.F. Acceptable fixture / trim / brass manufacturers are as follows: Zurn, Sloan, Toto, American-Standard, Eljer, Just, Elkay, Kohler, and Moen (Commercial). Provide McGuire, or equal, chrome-plated key-operated stops on the hot / cold supplies to each fixture.

2.7 MISCELLANEOUS EQUIPMENT

A. Floor Drains (**FD**): Floor drains (FD) shall be Zurn Z-415S, Josam, or Smith, cast iron body with 2" or 3" bottom or side outlet, as indicated, combination invertible membrane clamp and adjustable collar. Floor drains shall have “deep seal” traps and trap primer connection.

1. Strainer: 7"x7” square Zurn "Type S", polished nickel-bronze.
2. For floor drains receiving indirect wastes, provide a funnel receptor.

B. Floor Cleanout (**FCO**): Zurn Z-1400, Josam, or Smith, adjustable floor cleanout, cast iron body, with gas and watertight ABS tapered thread plug. Provide size equal to piping served with maximum size of 4".

1. Concrete floor finishes: Scoriated round polished bronze top.

2. Sheet tile finishes: Scoriated square polished bronze top recessed to receive tile.

1. Carpeted finishes: Scoriated round polished bronze top and carpet marker.

2. Ceramic tile finishes (Main Street): Square cover, Brushed stainless steel.

C. Wall Cleanout (**WCO**): Sanitary tee with threaded raised nut or countersunk-nut cleanout plug located behind Zurn Z-1468, Josam or Smith, round stainless steel wall access cover.

D. Water Hammer Arrestors (Shock Absorbers): Plumbing and Drainage Institute listed, Zurn or Josam.

Schedule:

"A" - Size #100 PDI - 0-11 Fixture Units
"B" - Size #200 PDI - 12-32 Fixture Units
"C" - Size #300 PDI - 33-60 Fixture Units

E. Vacuum Breaker: Watts Model N36, 3/4" size, 20 CFM capacity.

F. Strainer: Watts Series 777, MIL-S-16293, epoxy-coated or bronze body wye-type, 200 WOG rating, screwed end connections, 20 mesh stainless steel, monel, or bronze screen.

G. Thermometers: Weiss Instruments Model DVU35, solar-operated, Tel-Tru, Trerice or Ashcroft, adjustable angle, plastic or Type 304 stainless steel case. The digital display shall include 3/8" high (minimum) LCD digits. The thermometer display shall be in ^{0}F. Accuracy shall be +/- 1% of the displayed value or 1^{0}, whichever is greater. Furnish with brass thermowells and provide with heat transfer fluid to fill the sealed interstitial space between bulb and well. Evidence of the transfer fluid leaking shall be cause for refilling and sealing the well.

1. Thermowell: Provide with brass thermometer wells projecting a minimum of 2" into the pipe with extension to face of insulation. Provide with heat transfer fluid to fill interstitial space between bulb and well.

2. Range: 30^{o}F to 240^{o}F for domestic hot water systems.

H. Electronic Trap Primer (**ETP**): PPP Inc. PT-series, Mifab or Zurn, 120V., atmospheric vacuum breaker, pre-set 24 hour clock, manual over-ride switch, shut-off valve, water hammer arrestor, calibrated manifold. Individually pipe to floor drain traps. In finished spaces the trap primer shall be enclosed in a flush stainless steel wall box with hinged door and tamper-resistant lock. Run trap primer piping (½" PEX) to each floor drain trap or indirect waste receptor trap as required by Code. Provide a ball shut-off valve on the inlet to the trap primer.

I. Floor Sinks (**FS**): Zurn Model Z-1900, Josam, or Smith, “Sani-Flor” receptor, 12"x12"x6" deep cast-iron body and square slotted medium duty grate with acid-resisting porcelain enamel interior and top, 3" outlet, complete with aluminum anti-splash interior bottom dome strainer. Grates shall be half-open. Coordinate with Kitchen Drawings.

2.8 PIPING, VALVE, AND EQUIPMENT IDENTIFICATION

A. Piping identification: Provide plastic "wrap-around" identification markers indicating flow and fluid flowing for the following:

1. Domestic Hot Water
2. Domestic Cold Water
3. Vent Piping
4. Exposed Above Ground Sanitary Drain Piping

B. Markers shall be placed 30-50 ft. apart for piping in accessible areas.

C. Markers shall be placed outside the pipe insulation and in the most obvious location for viewing.

D. Valve Tags:

1. Attach to each valve a 1-1/2" round or octagonal brass tag with 1/2" indented numerals filled with a durable black compound. In addition to the valve numbers, each tag shall identify the system it controls. Service stop valves exposed in finished areas need not be tagged.

2. Tags shall be securely attached to stems of valves with copper or brass "S" hooks, or chains.

3. Valve charts shall be provided for each piping system and shall consist of schematic drawings of piping layouts, showing and identifying each valve and describing its function. Upon completion of the work, one (1) copy of each chart, sealed to rigid backboard with clear lacquer placed under glass and framed, shall be hung where directed. Two (2) additional unmounted copies shall be delivered to the Architect.

4. Tags and charts shall be coordinated with Section 23 00 00 HVAC and when completed this work shall have been done sequentially.

E. Equipment Identification: Provide laminated plastic nameplates for equipment, pumps, mixing valves, backflow preventers, and balancing valves. Nameplates shall be laminated 0.125-inch thick melamine plastic conforming to Fed. Spec. L-P-387, black with white center core. Surface shall be a matte finish, corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be minimum of 0.25-inch high normal block lettering.

2.9 WATER HEATING EQUIPMENT **(GWH)**

A. Gas-Fired Water Heater (**GWH**): AO Smith "Cyclone Mxi", Bradford-White, State Industries Camus TH-series, or approved equal packaged unit of make, model, and performance as scheduled on Drawings; UL 732 and ASHRAE 90.1 compliant, ASME Section IV code construction, designed to burn natural gas, glass-lined or other approved lined tank with replaceable magnesium anode rods and heavy gauge steel jacket with baked enamel finish, or instantaneous type, factory installed ASME rated temperature and pressure relief valve, dial thermometer and pressure gauges and adjustable range thermostat with digital display. Set to provide 140°F water temperature. Hot and cold water connections shall be 1½". The water heater shall be high efficiency, direct vent, sealed combustion.

1. Burner controls: modulating burner, solid state flame safeguard with direct spark ignition, electronic low-water cut-off, and separate high temperature limit control.

2. The water heater shall have a three (3) year free replacement warranty in commercial service for labor and materials. The pressure vessel and combustion chamber shall have a five (5) year warranty for materials and labor. Furnish with concentric sidewall vent kit as indicated. Furnish with condensate neutralization kit.

3. Installation shall be in accordance with the manufacturer's recommendations. Venting shall be Type AL29-4C stainless steel or polypropylene per the installation instructions.

B. Provide firestats, emergency shut-off switches, and service switches as required by NFPA

2.10 THERMOSTATIC MIXING VALVE

A. Thermostatic Mixing Valve (TMV): Shall be Leonard "Eco-Mix", Model as scheduled, or Symmons, capacities and performance as scheduled with swivel action check-stops at the hot and cold inlets, thermometer, shut-off on the discharge piping and removable cartridge with strainer. Controller shall consist of a liquid fill thermal motor with bellows mounted out of the water. Finish shall be rough bronze.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

2. Verify that plumbing may be installed in strict accordance with pertinent codes and regulations and the reviewed Shop Drawings.

3.2 INSTALLATION OF PIPING

A. Provide and erect in accordance with the best practice of the trade piping shown on the drawings and as required to complete the intended installation. Make offsets as shown or required to place piping in proper position to avoid other work and to allow the application of insulation and finish painting to the satisfaction of the Architect.

B. The size and general arrangements, as well as the methods of connecting piping, valves, and equipment, shall be as indicated, or so as to meet the requirements of the Architect.

C. Piping shall be erected so as to provide for the easy and noiseless passage of fluids under working conditions.

D. Install unions to facilitate removal of equipment.

1. Unions are not required in installations using grooved mechanical joint couplings. (The couplings shall serve as unions and disconnect points.)

E. Copper pipe shall be reamed to remove burrs.

F. Connections between copper and steel piping shall be made with brass fittings.

G. Solder joints shall be made with lead free solder. Clean surfaces to be soldered and use a paste flux. Wash joints with sodium bicarbonate and water to remove corrosive effects of heated solder paste. Caution: Lead-bearing solder is not permitted.

H. Grooved joints shall be installed in accordance with the manufacturer’s latest published installation instructions. Grooved ends shall be clean and free from indentations, projections, and roll marks in the area from pipe end to groove. Gaskets shall be of an elastomer grade suitable for the intended service, and shall be molded and produced by the coupling manufacturer. The grooved coupling manufacturer’s factory trained representative shall provide on-site training for contractor’s field personnel in the use of grooving tools and installation of grooved joint products. The representative shall periodically visit the jobsite and review contractor is following best recommended practices in grooved product installation. (A distributor’s representative is not considered qualified to conduct the training or jobsite visit(s).)

I. Push-to-Connect Joints: Install Permalynx joints in accordance with the manufacturer’s latest published installation instructions. Prepare and mark tubing ends using a tool supplied by the manufacturer and in accordance with the manufacturer’s instructions.

J. Pipe penetrations through walls, floors and ceilings shall have pipe sleeves and shall be in accordance with Section 23 05 00 "Common Work Results for HVAC". Traverse points of piping shall be escutcheoned with split chrome floor and ceiling plates and spring anchors, where visible to occupancy.

K. Sanitary and vent piping shall be sized and installed at 1/4" per foot slope or as indicated and in no case less than 1/8" per foot.

3.3 PIPE HANGERS

A. Impact driven studs are prohibited.

B. Copper Tubing: supported at intervals with rod sizes as follows, double nuts on hangers and on beam clips.

Copper Size	Hanger Intervals	Rod Sizes
1/2"	5'	3/8"
3/4"	6'	3/8"
1"	6'	3/8"
1-1/4"	8'	3/8"
1-1/2"	8'	3/8"
2"	10'	3/8"
3"	10'	1/2"

C. Cast Iron Pipe: Supported at intervals with rod sizes as follows, double nuts on hangers and on beam clips.

Cast Iron Size	Hanger Intervals	Rod Sizes
1-1/2"	5'	3/8"
2"	5'	3/8"
2-1/2"	5'	1/2"
3"	6'	1/2"
4"	7'	5/8"

D. PVC Pipe: Supported at 4-foot intervals.

E. Verticals: Supported by use of clamp hangers at every story height, and at not more than 6 feet intervals for copper piping 1-1/4" and smaller size.

3.4 CLOSING IN UNINSPECTED WORK

A. General: Cover up or enclose work after it has been properly and completely reviewed.

B. If any of the work is covered or enclosed prior to required inspections and review, uncover the work as required for the test and review. After review, tests and acceptance, repairs and replacements shall be made by the appropriate trades with such materials as necessary for the acceptance by the Architect and at no additional cost to the Owner.

3.5 CLEANUP AND CORROSION PREVENTION

A. Upon completion of the work thoroughly clean and flush piping systems to the sewer with water.

B. Fixtures, piping and equipment shall be thoroughly cleaned. Dirt, dust, and debris shall be removed and the premises left in a clean and neat condition.

C. Caulk around fixtures at floor and wall.

D. Before covering is applied to piping systems, clips, rods, clevises and other hanger attachments, and before uncovered piping is permitted to be concealed, corrosion and rust shall be wire brushed and cleaned and in the case of iron products, a coat of approved protective paint applied to these surfaces. When corrosion is from the effects of hot solder

paste, the areas shall be cleaned and polished and a wash of bicarbonate of soda and water used to neutralize the acid condition.

3.6 DISINFECTING

A. After the entire potable water system is completed, cleaned and tested, and just before the building is ready to be occupied, disinfect the system as follows: After flushing the mains, introduce a water and chlorine solution for a period of not less than three hours before final flushing of the system.

3.7 TESTS

A. Sanitary soil, waste and vent piping: Fill with water to top of vents, and test as required by Code.

B. Water piping shall be tested to a pressure of 100 lbs. per square inch for at least 30 minutes. Pressure drop in this period shall not exceed two pounds per square inch. Leaks shall be repaired and system retested. Notify Architect 24 hours before test is to be performed.

3.8 INSTRUCTIONS

A. On completion of the project, provide a competent technician to thoroughly instruct the Owner's representative in the care and operation of the system. The total period of instruction shall not exceed four (4) hours. The time of instruction shall be arranged with the Owner.

3.9 FIRESTOPPING

A. Firestopping shall be performed in accordance with Specification Section 07 84 00 “Firestopping”. All penetrations of fire-rated assemblies including walls and floors by mechanical system components (piping, ductwork, conduits, etc.) shall be firestopped as specified.

* END OF SECTION *

SECTION 23 00 00

HEATING, VENTILATING AND AIR CONDITIONING

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to install the heating, ventilating and air conditioning systems indicated.

1.2 RELATED DOCUMENTS

A. The drawings and the specifications including SECTION 23 05 00 “Common Work Results for HVAC” are hereby made a part of the work of this section.

1.3 SUBMITTALS

A. Substitutions: Your attention is directed to Section 23 05 00-"Substitutions", relative to competition and the (ONLY) notation. Familiarity with this section should be achieved before reading the PRODUCTS section of this specification.

B. The items for which the submittals paragraph in Section 23 05 00 “Common Work Results for HVAC”, apply are as follows:

1. Hangers.
2. Piping, valve and equipment identification.
3. Fans.
4. Firestopping materials and methods.

PART 2 PRODUCTS

2.1 FANS

A. Shall be model and performance indicated. Fan manufacturers shall be Panasonic, Greenheck, Cook or equal. The fans shall include housing, fan wheel, shaft, bearings, inlet shroud, motor, mounting support and mounting frame as a factory-assembled unit. An OSHA-approved belt guard for each fan shall be included. The fan drive shall have a 1.5 service factor for the maximum rated horsepower. Provide a disconnect switch for each fan. Roof and sidewall fans shall have a factory-applied epoxy coating with color selection by the Architect. Provide gravity-operated, gasketted automatic gravity backdraft dampers for all exhaust fans.

B. Bearings shall be precision, flange-mounted self-aligning ball bearings at inlet and discharge. Minimum average L50 design life shall be 200,000 hours at maximum catalogued operating conditions. Grease lines shall extend to the exterior of the fan housing.

C. Submit sound power data for inlet and discharge sound.

D. Submit fan curves for each fan with the design operating point clearly marked.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

2. Verify that the heating system may be installed in accordance with pertinent codes and regulations and the reviewed Submittals.

3.2 INSTALLATION OF PIPING

A. Refrigeration Piping:

1. Provide and install refrigeration piping, hangers, and accessories as specified and required. The piping installation shall be performed by a qualified refrigeration mechanic under the direct supervision of the equipment manufacturer. Submit records of tests.

2. Refrigeration piping shall be Type ACR copper tube with brazed joints, nitrogen-charged equal to BCUP-2 Classification of American Welding Society.

3. The refrigeration system shall be tested as follows:

High pressure Side	300 psi
Low Pressure Side	150 psi

4. Support risers, offsets, and equipment, in an acceptable manner.

5. Piping shall be installed to meet Codes and regulations, applicable to the installation and in accordance with the best practice of the trade. Brazing shall be accomplished while sweeping piping with nitrogen.

6. Refrigerant accessories shall include required valves and fittings to provide a complete installation. Refrigerant piping shall be insulated with ¾" thick Armaflex Type AP, or equal, elastomeric unicellular insulation. Exterior insulation shall have 30 mil glossy white UV-resistant PVC jacketing, or approved equal.

7. Parts of the system not factory charged and field installed piping of components shall be evacuated to within .10 MM/Mercury of a perfect vacuum. Break the vacuum to 0 psig with oil-free nitrogen before charging. Hold vacuum overnight for leak test.

8. Provide complete charges of refrigerant and oil to be maintained for the guarantee period.

9. Elbows shall be long radius.

10. The installation shall be in accordance with the above, with equipment manufacturer's instructions, and with established recommended practices.

11. System installation shall include the following:

    a. Pitch lines down in direction of flow a minimum of 1/2 inch per 10 feet.

    b. Trap suction risers as verified with the equipment manufacturer.

    c. Provide service valves on liquid and suction piping at air cooled condensing units.

    d. Maximum filter-dryer pressure drops:

       1 psi for liquid line filter-dryer.

    e. Liquid line solenoid valve on each refrigeration circuit.

    f. Thermal expansion valve on each refrigeration circuit.

3.3 PIPE HANGERS

A. Impact driven studs are not acceptable.

B. Pipes (copper or steel) shall be supported at intervals and rod sizes as follows, double nuts on hangers and on beam clips. PVC and CPVC shall have hanger spacing reduced by 50%.

Pipe Size	Hanger Spacing	Rod Sizes
1/2"	5'	3/8"
3/4"	6'	3/8"
1"	7'	3/8"
1-1/4"	8'	3/8"
1-1/2"	9'	3/8"
2"	10'	3/8"
2-1/2"	10'	1/2"
3"-6”	8'	1/2"

C. Verticals: Supported at the base and at intervals as follows by use of clamp hangers:

Steel Pipe: Not more than 16 ft.

Copper Pipe and Tubing:

1-1/2" and larger - Not more than 12 ft.
1-1/4" and smaller - Not more than 6 ft.

D. Provide welded insulated steel saddles at each hanger on steel piping systems 4" and larger.

E. PVC and CPVC Piping: Supported at 5' maximum intervals.

F. In grooved installations, use Victaulic Style 107 and 07 rigid couplings with offsetting angle-pattern bolt pads and AGS Series W07, or Grinnell, which permit support and hanging in accordance with ANSI B31.1, B31.3, and B31.9.

3.4 CLOSING IN WORK

A. Cover up or enclose work after it has been properly and completely tested and reviewed.

B. No additional cost to the Owner will be allowed for uncovering or recovering any work that is covered or enclosed prior to required test and review.

3.5 TEST AND ADJUST

A. Piping Systems: Test with water to a pressure of 75 psi and hold for a period of two hours. Repair any leaks and retest the piping system; repeat process until systems are leak-free. Test piping before it is insulated.

B. Before operating any system, flush the piping to remove oil and foreign materials.

C. After the installation is complete and ready for operation, test the system under normal operating conditions in the presence of the Architect and demonstrate that the system functions as designed.

D. Demonstrate that the HVAC systems have free and noiseless circulation of water, that all air has been purged and that systems are watertight.

E. Correct defects which develop in operational testing, conduct additional testing until defect free operation is achieved.

3.6 CLEANUP AND CORROSION PREVENTION

A. Piping and equipment shall be thoroughly cleaned. Dirt, dust, and debris shall be removed and the premises left in a clean and neat condition.

B. Before covering is applied to piping systems, clips, rods, clevises and other hanger attachments, and before uncovered piping is permitted to be concealed, corrosion and rust shall be wire brushed and cleaned and in the case of iron products, a coat of approved protective paint applied to these surfaces. When corrosion is from the effects of hot solder paste, the areas shall be cleaned and polished and a wash of bicarbonate of soda and water used to neutralize the acid condition.

3.7 INSTRUCTIONS

A. On completion of the project, instruct the Owner's representative in the care and operation of the system. The total period of instruction shall not be less than eight (8) hours. The time of instruction shall be arranged with the Owner. In addition to the prime Mechanical Contractor, the control system Contractor, Balancing Contractor, and Owner's representative shall be present and participate in the Owner's instruction.

3.8 FIRESTOPPING

A. Firestopping shall be performed in accordance with Specification Section 07 84 00 “Firestopping”. All penetrations of fire-rated assemblies including walls and floors by mechanical system components (piping, ductwork, conduits, etc.) shall be firestopped as specified.

* END OF SECTION *

APPENDIX A
VARIABLE AIR VOLUME BOXES

Price All-In-One
Terminals Performance Schedule

Report Date: Mar 08, 2017 02:27 PM

Job Name: Maine Media
Job Number: QP00000024
Customer:
Entered By: SP Doel
Reps Job No:
Location: 16 Middle Street, Portland, ME
Engineer: Bennett Engineering, Inc.
Sales Person:

Model	Tag ID	Unit Size	Transducer Type	Max (Primary CFM)	Min (Primary CFM)	Differential SP (in.wg)	Min Oper PD (in.wg)	Max Discharge NC	Max Radiated NC	Min Discharge NC	Min Radiated NC	Reheat(CFM)	Capacity kW	Volts	Steps	Current Amps	EAT °F	LAT °F
SDVLP8	1-1	8	VAV	500	250	0.5	0.01	23	--	--	--	250						
SDVLP8	1-2	5		300	150	0.5	0.01	26	--	20	--	150	1.9	480-1	SCRV	3.96	55	95
SDVLP8	1-3	8	VAV	650	325	0.5	0.01	24	--	20	--	325						
SDVLP8	1-4	5	VAV	300	150	0.5	0.01	26	--	20	--	150	1.9	480-1	SCRV	3.96	55	95
SDVLP8	1-5	8	VAV	475	250	0.5	0.01	22	--	--	--	250	3.16	480-1	SCRV	6.67	55	95
SDVLP8	1-6	8	VAV	600	300	0.5	0.01	24	--	20	--	300	3.8	480-1	SCRV	7.92	55	95
SDVLP8	1-7	6	VAV	325	175	0.5	0.09	20	--	--	--	175	2.22	480-1	SCRV	4.58	55	95
SDVLP8	1-8	5	VAV	200	100	0.5	0.01	25	--	20	--	100	1.27	480-1	SCRV	2.71	55	95
SDVLP8	1-9	8	VAV	550	300	0.5	0.01	23	--	20	--	300	3.8	480-1	SCRV	7.92	55	95
SDVLP8	1-10	6	VAV	450	250	0.5	0.18	25	--	--	--	250	3.16	480-1	SCRV	6.67	55	95
SDVLP8	1-11	5	VAV	350	175	0.5	0.01	29	--	21	--	175	2.22	480-1	SCRV	4.58	55	95
SDVLP8	1-12	5	VAV	300	150	0.5	0.01	26	--	20	--	150						
SDVLP8	1-13	5	VAV	250	125	0.5	0.01	27	--	22	--	125						

Job Name:	Maine Media	**Reps Job No:**	
Job Number:	QP00000024	**Location:**	16 Middle Street, Portland, ME
Customer:		**Engineer:**	Bennett Engineering, Inc.
Entered By:	SP Doel	**Sales Person:**	

Model	Tag ID	Unit Size	Transducer Type	Max (Primary CFM)	Min (Primary CFM)	Differential SP (in.wg)	Min Oper PD (in.wg)	Max Discharge NC	Max Radiated NC	Min Discharge NC	Min Radiated NC	Reheat(CFM)	Capacity kW	Volts	Steps	Current Amps	EAT °F	LAT °F

Footnotes Legend:

1) NC's are derived from sound power levels obtained in accordance with ASHRAE Standard 130-2008 and AHRI Standard 880-2011, which include duct end reflection corrections.
2) Sound power performance resulting in dashes (--) are below significance as outlined by the AHRI880-2011 standard.
3) NC values are calculated based on procedures outlined in AHRI Standard 885-2008, "A Procedure for Estimating Occupied Space Sound Levels in the Application of Air Terminals and Air Outlets."
4) Sound power levels are given in decibels (dB).
5) Airflow is given in cubic feet per minute (cfm).
6) Minimum operating pressure is the minimum static pressure required to operate the terminal unit assembly at maximum primary flow with a wide open damper.
7) Air pressure drop is given in inches water gauge (in. w.g.), and water pressure drop is given in feet of water gauge (ft. w.g.).
8) Terminal unit assembly is ETL certified in accordance with UL1995 and CSA 22.2.236.

SECTION 23 05 00

COMMON WORK RESULTS FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. The General Conditions, Supplemental General Conditions and Instructions to Bidders shall apply to this work. Read these to be familiar with conditions related to the installation of the work.

1.2 WORK SHOWN ON DRAWINGS

A. The drawings accompanying this specification, as a part thereof, are working drawings indicating the location and arrangement of the increments of the systems of this section of work. Material deviation from this arrangement, process or means of application, shall bear the Engineer's review stamp before the change is made on the job or materials are ordered. Changes made without such review shall be ordered removed and items installed as specified shall be provided at no additional expense to the Owner.

B. The drawings are not intended to show in minute detail minor items of installation or materials such as specific fittings or findings.

1.3 MATERIALS AND LABOR

A. Furnish materials and labor necessary to deliver to the Owner a complete and operable system installed in accordance with the contract documents.

B. Materials shall be of the best quality. Workmanship shall be of highest grade and construction shall be done according to best practices of the trade.

C. Provide, when required, labeled samples of material or equipment specified herein or proposed to be used in this work.

D. Where words "furnish", "provide", or "install" are mentioned, either singly or in combination, these words are hereby interpreted to mean "furnish and install" or "provide and install", including materials complete with connections, supplemental devices, accessories and appurtenances, unless specifically otherwise noted. These words are likewise hereby interpreted as being prefixed to materials, equipment, and apparatus hereinafter mentioned, either in abbreviated or scheduled information or in the technical sections of the specifications.

1.4 EQUIPMENT INSTALLATION IN HEATING SEASON

A. The system shall be installed provided that the construction area will have sufficient heat to maintain temperature above 40°F throughout the construction period.

1.5 COOPERATION BETWEEN TRADES

A. Provide information sufficiently in advance of this work, so that work by the other trades may be coordinated and installed without delays. Furnish and locate sleeves, supports, anchors and necessary access panels.

B. Where work is concealed, assure it does not project beyond finished lines of floors, ceilings, or walls.

C. Equipment or piping requiring access found to be located above sheetrock ceilings shall be brought immediately to the attention of the Architect for resolution.

1.6 VISITING THE PREMISES

A. Visit the premises and review the existing conditions, as applicable.

1.7 ORDINANCES, AUTHORITIES, PERMITS, AND FEES

A. Obtain necessary permits and licenses, give notices and comply with laws, ordinances, rules, regulations or orders affecting the work, and pay fees and charges in connection therewith.

B. The "authority having jurisdiction" is the organization, office, or individual responsible for "approving" equipment, an installation, or a procedure.

1.8 PROTECTION OF WORK AND MATERIALS

A. Protect and care for materials delivered and work performed until the completion of the work. Defective equipment or equipment damaged in the course of storage, installation or test shall be replaced or repaired to the satisfaction of the Engineer at no additional cost to the Owner.

1.9 INSURANCE

A. Purchase and maintain Public Liability and Property Insurance during the progress of the work and until completion and acceptance of the entire project by the Owner in the amounts as specified in the General Conditions.

1.10 APPLICABLE CODES

A. Work and materials shall conform to the latest rules and regulations listed below and these rules and regulations hereby are made part of this specification. They include, but are not necessarily limited to the following:

2009 International Energy Conservation Code
American Society for Testing and Materials (ASTM)
Underwriters' Laboratories, Inc. (UL)

Air Moving and Conditioning Assoc. (AMCA)
American Society of Heating, Refrigerating, and Air Conditioning Engineers (ASHRAE)
American Society of Mechanical Engineers (ASME)
National Electrical Manufacturers Association (NEMA)
Institute of Electrical and Electronics Engineers (IEEE)
American National Standards Institute (ANSI)
National Fire Protection Association (NFPA)
American Water Works Association (AWWA)
Local Fire Code
Local Plumbing Codes
American Welding Society

1.11 SHOP DRAWINGS

A. Submit shop drawings, manufacturers' data and certificates for equipment, materials and finish, and pertinent details for each system where specified in each individual section, eight (8) copies, to be submitted to the Architect. Shop drawings will be returned "No Exceptions Taken", "Make Corrections Noted", "Amend and Resubmit", "Submit Specified Item", or "Rejected" less two (2) copies. Work shall progress in accordance with "Reviewed" shop drawings (ONLY).

B. Groups of similar shop drawings shall be submitted as individual bound documents with covers and indexes. Typical similar items would be "Diffusers and Registers", "Valves and Controls". Rejection of individual items shall not be cause for rejection of the entire document.

C. Clearly indicate item(s) to be reviewed on each submission by highlighting or underlining intended item(s). Submissions not clearly marked shall be returned "Amend and Resubmit".

D. Shop drawings must bear the Engineer's review stamp. In the event that the Engineer returns shop drawings "Amend and Resubmit" or "Rejected", the shop drawing must be revised and resubmitted for review.

E. Furnishing of the specified item must still produce the results and performance, dependability and quality reasonably to be expected within the spirit of the specifications, drawings, and the standard of good mechanical performance normal to the trade.

1.12 SUBSTITUTIONS

A. Refer to Specification Section 01 60 00 / 22. Where the specifications allow the substitution of a product, still this product is subject to review by the Engineer in accordance with the paragraph entitled "Shop Drawings". Review of a substitute item is an indication only that the substitute item is compatible with the specified item as a claim of the manufacturer. Insure dimensional propriety, performance, and quality of the substitute item.

B. Reference in the specifications or on the drawings to any product, material, fixture, form or type of construction, by proprietary name, manufacturer, make or catalog number, establishes a standard of quality or design and is not meant to limit competition. Use any equivalent substitute provided favorable written review by the Engineer is first obtained. The (ONLY) notation in the specification is an exception to this and leaves no option.

C. For materials or equipment which are supplied with integral or factory applied finish, the colors will be considered in evaluating substitutions.

D. For the purpose of avoiding conflicts with other trades, contracts, and adjoining work where more than one (1) article, device, material, fixture, form or proprietary name, manufacturer, make or catalog number, the first named shall be used as the basis of design and details. The cost of any changes because of substituted item shall be borne by the Contractor requesting such change.

1.13 COMMISSIONING

A. Mechanical systems in this project will be commissioned by an independent commissioning agent, hired by the Owner. All division 23 contractors and subcontractors will be responsible for carrying out the commissioning requirements specified in Section 019133 - General Commissioning Requirements, and other sections referenced in 019133, at no additional cost to the Owner.

PART 3 - EXECUTION

3.1 GRADES AND ELEVATIONS

A. Establish and maintain grades and elevations in connection with this work.

3.2 EQUIPMENT SUPPORTS

A. Furnish and install equipment supports for mechanical equipment as required. Supports shall be subject to review by the Engineer. All equipment shall be installed level and per the manufacturers recommendations.

3.3 SLEEVES AND PREPARED OPENINGS

A. Coordinate core-drilling, cutting, patching and setting of sleeves, frames, framing and lintels for openings with other trades. Sleeves shall be furnished by the Contractor. Pipe sleeves shall be provided at all floor and wall penetrations. Sleeves shall be Schedule 40 steel pipe for iron pipe, Type “L” copper for copper pipe and Schedule 40 PVC for plastic pipe. Sleeves shall be firestopped, as specified. Piping penetrations thru floors above grade shall have watertight pipe sleeves (LinkSeal, or approved equal).

B. Failure to give timely notice of and to locate openings and furnish sleeves shall cause no additional expense to the Owner.

3.4 CONNECTION TO EQUIPMENT

A. Provide piping connections, supports, brackets, compensators or flexible connections to prevent application of excessive stresses to equipment.

B. Equipment shall be installed with flanges or unions in such a manner as to permit disconnecting for removal of tubes, coils, elements and other equipment for inspection, service and repairs.

3.5 ACCESS TO EQUIPMENT

A. The installation of work performed shall provide reasonable accessibility for operation, inspection, and maintenance of equipment and accessories. The Engineer shall determine the adequacy of such accessibility.

3.6 ACCESS PANELS

A. Access panels shall be provided where indicated on the drawings and as required for access to valves and other serviceable components. Access doors shall be Milcor, Zurn or approved equal hinged with primed finish and with allen wrench operated latch.

B. Access panels installed in fire-rated assemblies shall have the same fire rating as the assembly.

3.7 PAINTING OF EQUIPMENT

A. Exposed ironwork, including steel supports and hangers in unfinished spaces, e.g. boiler rooms, mechanical rooms, pits, and trenches shall be properly cleaned, prepared and painted with two (2) coats of black asphaltum varnish.

3.8 GUARDS

A. Exposed moving and rotating elements of mechanical equipment items shall be protected with suitable guards for personnel protection. Guards shall be of rigid construction, firmly positioned. Holes shall be provided in guards at shaft centers to facilitate tachometer readings.

3.9 LUBRICATION

A. Furnish and install grease fittings for points requiring lubrication. Furnish extension type fittings as required to provide easy access for maintenance lubrication.

B. Furnish initial charges of lubricants for equipment. Lubricants shall be in conformance with the manufacturer's requirements and recommendations.

3.10 ELECTRIC MOTORS AND MOTOR CONTROLS

A. Unless otherwise noted, motors, motor starters and other electrical accessories which are specified under Mechanical specifications shall be selected with characteristics as follows:

1/2 Horsepower and less - 120 volt, 1 phase, 60 Hz.
3/4 Horsepower and larger – 460 or 208 volt, 3 phase, 60 Hz., as indicated.

B. Motors shall be built in accordance with the latest applicable NEMA, IEEE and ANSI Standards. Motors shall be manufactured by Baldor, Magnetek or Toshiba, of the latest type and quality specified under individual items of equipment. Motor efficiencies shall be premium high efficiency type per the Consortium for Energy Efficiency Standard and/or be “Energy Star” compliant.

C. Magnetic motor starters for mechanical items of equipment shall be furnished under Division 26 unless the starter is an integral part of a factory packaged item of equipment. Each starter furnished as an integral item of equipment shall be provided with overload heater elements. Starters shall be combination type with “Hand-Off-Auto” switches and shall have single phase protection or shall have relays installed to provide this feature. Starters shall be equipped with suitable step-down transformers to provide required control voltage.

D. Motors shall have a minimum continuous duty service factor of 1.15. Minimum motor efficiency shall be:

MOTOR HORSEPOWER	PERCENTAGE EFFICIENCY		
	(1200RPM)	(1800 RPM)	(3600 RPM)
1-3	----	86.5	85.5
5	89.5	89.5	86.5
7.5	90.2	91.0	88.5
10	91.7	91.7	89.5
15	91.7	93.0	90.2

3.11 CLEANING OF SYSTEMS

A. Piping and duct systems shall be thoroughly cleaned and flushed prior to initial operation.

B. Thoroughly clean exposed portions of the mechanical installation, removing labels and foreign substance.

C. Furnish detergents, solvents, cleaning compounds, and tools required for cleaning operations.

D. Keep the premises free from accumulation of waste material or rubbish and at the completion of the work, remove from the job site tools, scaffolding, surplus materials, and rubbish, leaving the work areas "broom" clean.

3.12 STARTING OF EQUIPMENT

A. Testing or starting of equipment shall be done in collaboration with trades concerned to insure safe and proper operation of the equipment.

B. Prior to starting equipment, provide lubrication at required points. Before starting any electrical or electric motor driven equipment, a check must be made to insure that proper heater coils are installed in the starters and that the equipment is rotating in the proper direction.

3.13 OPERATIONAL TESTING

A. Operate systems until successful operation is demonstrated to the Engineer. This initial operation shall be in addition to the testing of the system and shall be done after the system is cleaned and finished.

3.14 RECORD DRAWINGS

A. During construction, keep an accurate record of deviations to the installation of the work as indicated on the drawings. Upon completion of the work, furnish a copy of this record to the Engineer. **Submit record drawings before requesting final payment**.

3.15 MANUFACTURER'S REPRESENTATIVE

A. As indicated in the Technical Sections of this specification or as directed by the Engineer, provide the services of a factory trained Engineer or Technician to inspect, adjust, and place in proper operating condition the equipment or item involved. No additional compensation will be allowed for such service.

3.16 MANUFACTURER'S INSTRUCTIONS, OPERATION AND MAINTENANCE DATA

A. Provide for each item of equipment or apparatus furnished, a complete set of printed instructions obtained from the manufacturer covering proper operation, maintenance, lubrication, cleaning, servicing, adjustment, and safety instructions.

B. Manufacturer's data shall include performance data (curves are preferred where applicable) complete parts lists, recommended spare parts lists, piping, and wiring diagrams.

C. Arrange data in complete sets, properly indexed and marked.

D. Data shall include a complete set of shop drawings.

E. Material shall first be submitted in preliminary form for review by the Engineer. After review, submit two (2) copies in bound volumes to the Engineer for distribution.

3.17 GUARANTEES

A. An item becomes "defective" when it ceases to conform to the Contract Documents. Guarantees begin on the date of issuance of a certificate authorizing final payment or certificate of substantial completion with the Owner taking occupancy or beneficial use thereafter.

B. Upon completion of the work and before applying for final payment, furnish a written guarantee, stating that the work complies with the provisions of codes listed herein and the local enforcing authorities, and that it will be free from defects of material and workmanship for not less than one (1) year. Guarantee shall further state that the Contractor will, at his own expense, repair or replace any of his material and work which may become defective during the time of guarantee, together with other work damaged as a consequence of such defects.

C. Where special guarantees, covering installation, operation or performance of any systems, or equipment furnished under are indicated, the full responsibility for the fulfillment of such guarantees must be assumed by the Contractor who shall obtain written guarantees in triplicate, two (2) copies of which shall be filed with the Engineer before final acceptance.

D. Repeated malfunctioning or failure in service of any item or work of the system is sufficient cause for the Engineer to order the removal of the item, and its replacement with new item at the expense of the Contractor.

3.18 EXISTING UTILITIES AND EQUIPMENT

A. The Contractor shall be responsible for correcting any damage to existing systems, components or utilities that are to remain in service.

B. The Contractor shall visit the premises to become familiar with the existing conditions prior to submitting a bid. No additional compensation will be allowed for existing conditions that are readily apparent during a site visit.

3.19 FIRESTOPPING

A. Firestopping shall be performed in accordance with Specification Section 07 84 00 “Firestopping”. All penetrations of fire-rated assemblies including walls and floors by mechanical system components (piping, ductwork, conduits, etc.) shall be firestopped as specified. Coordinate size, location and type of pipe and duct sleeves as required by firestopping systems.

3.20 HAZARDOUS MATERIALS

A. Recognized hazardous materials such as lead, mercury or asbestos shall be prohibited from the project. Submit MSDS sheets to the Owner for review.

* END OF SECTION *

SECTION 23 0 593

TESTING, ADJUSTING AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION: The work covered by this section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required for testing and balancing the air systems.

1.2 RELATED DOCUMENTS

A. The General Conditions, Supplemental General Conditions and Instructions to Bidders shall apply to this work. Read these to be familiar with conditions related to the installation of the work.

1.3 DEFINITIONS

A. Adjust: To regulate the specified fluid flow rate and air patterns at the terminal equipment, (e.g., reduce fan speed, throttling).

B. Balance: To proportion flows within the distribution system (submains, branches and terminals) in accordance with specified design quantities.

C. Procedure: Standardize approach and execution of sequence of work operations to yield reproducible results.

D. Report Forms: Test data sheets arranged for collection of test data in logical order to submission and review. This data should also form the permanent record which shall be used as the basis for any future testing, adjusting, and balancing required.

E. Test: To determine quantitative performance of equipment.

1.4 SUBMITTALS: Submit the following:

A. Standards Compliance:

Testing Agency
Testing Agency Personnel
Professional Engineers
Instrument Calibration

1.5 TESTING AND BALANCING AGENCY

A. Air and Water Systems Testing and Balancing: Upon completion of the installation and field testing, performance test and adjust the supply, return, make-up, and exhaust air systems, and heating water systems to provide the air volume and water flow quantities indicated. Accomplish work in accordance with the agenda and procedures specified and AABC 71679 and standards of the NEBB. Correct air and water system performance deficiencies disclosed by the test before balancing the systems.

B. Agency Qualifications: Obtain the services of a qualified testing organization to perform the testing and balancing work as herein specified. Prior to commencing work under this section of the specifications, the testing organization shall have been reviewed by the Architect. The criteria for determining qualifications shall be membership in the AABC, or certification by the NEBB, or the testing organization shall have submitted proof to satisfy the Architect that the organization meets or exceeds the technical standards for membership of the AABC as published in the AABC 71679. The testing organization shall be independent of both the installing contractors and equipment suppliers for this project.

1.6 AGENDA

A. Preliminary Report: Review drawings and specifications prior to installation of any of the affected system. Submit a written report to the Architect indicating any deficiencies in the system that would preclude the proper adjusting, balancing, and testing of the systems.

1.7 PROCEDURES, GENERAL

A. Requirements: Adjust systems and components thereof that perform as required by drawings and specifications.

B. Test Duration: Operating tests of heating and cooling coils, fans and other equipment shall be of not less than 4 hours duration, after stabilized operating conditions have been established. Capacities shall be based on temperatures and air and water quantities measured during such tests.

C. Instrumentation: Method of application of instrumentation shall be in accordance with the manufacturer's instructions. Furnish personnel, instruments, and equipment for tests specified herein.

D. Accuracy of Instruments: Instruments used for measurements shall be accurate. Provide calibration histories for each instrument for examination. Calibrate each test instrument by an reviewed laboratory or by the manufacturer. The Architect has the right to request instrument recalibration, or the use of other instruments and test methodology, where accuracy of readings is questionable.

E. Accuracy of Thermometers: Plus or minus one graduation at the temperatures to be measured. Graduations shall conform with the following schedule:

Medium	Design Temperature Differential (°F)	Maximum Graduation (°F)
Air	10 or less	1/2
Air	over 10	1

F. Flow Rate Tolerance: Values are based on discussion in ASHRAE "HVAC Applications", Chapter 34. Air filter resistance during tests, artificially imposed if necessary, shall be 80 percent of final values.

1. Air Handling Unit CFM: Minus 0 percent to plus 10 percent.

2. Other Fans: Minus 0 percent to plus 10 percent.

3. Air Terminal Units (VAV Boxes): Minus 5 percent to plus 10 percent.

4. Minimum Outside Air (for manually set dampers): Minus 0 percent to plus 10 percent.

5. Individual Room Air Outlets and Inlets, and Air Flow Rates Not mentioned Above: Minus 10 percent to plus 10 percent.

PART 2 - PRODUCTS

NOT USED

PART 3 - EXECUTION

3.1 AIR SYSTEM PROCEDURES

A. Adjustments: Adjust air handling systems to provide the required design air quantity to, or through, each component. Conduct adjusting and balancing of systems during periods of the year approximating maximum seasonal operation.

B. Balance: Use flow adjusting (volume control) devices to balance air quantities only; i.e., proportion flow between various terminals comprising system, and only to the extent that their adjustments do not create objectionable air motion or sound, i.e., in excess of specified limits.

C. Balancing Between Runs (submains, branch mains, and branches): Use flow regulating devices at, or in, the divided - flow fitting. Minimize restriction imposed by flow regulating devices in or at terminals.

D. Final Measurements of Air Quantity: Make final measurements of air quantity, after the air terminal has been adjusted to provide the optimum air patterns of diffusion.

E. Fan Adjustment: Total air system quantities, generally, shall be varied by adjustment of fan speeds, or axial-flow fan wheel blade pitch. For systems with direct-connected fans (without adjustable pitch blades), damper restrictions of a system's total flow or variable speed rheostats shall be adjusted as appropriate.

F. Air Measurement:

1. Pitot Tube: Except as specifically indicated herein, make pitot tube traverses of each duct to measure air flow therein. Pitot tubes, associated instruments, traverses, and techniques shall conform with the ASHRAE Handbook Fundamentals.

2. Pitot Tube Traverse: Pitot-tube traverse may be omitted if the duct serves only a single room or space and its design volume is less than 2000 cfm. In lieu of Pitot-tube traverse, determine air flow in the duct by totalling volume of individual terminals served, measured as described herein.

3. Measurements of Air Quantity: Where duct's design velocity and air quantity are both less than 1000 (fpm/cfm), air quantity may be determined by measurements at terminals served.

G. Air Terminal Balancing: Measurement of flow rates by means of velocity meters applied to individual terminals, with or without cones or other adapters, shall be used only for balancing.

3.2 WATER SYSTEM PROCEDURES

A. Adjustment: Adjust heating, water systems to provide required quantity to, or through each component.

B. Metering: Measure water quantities and pressures with calibrated meters.

C. Water Measurements and Balancing: Use venturi tubes, orifices, or other metering fittings and pressure gages. Adjust systems to provide the design flow rates through the heat transfer equipment prior to the capacity testing. Perform measurement of temperature differential with the air system, adjusted as described herein, in operation.

D. Automatic Controls: Position automatic control valves for full flow through the heat transfer equipment of the system during tests.

E. Flow: Flow through by-pass circuits at three-way valves shall be adjusted to balance that through the supply circuit.

F. Distribution: Adjust distribution by means of balancing devices (cocks, valves, and fittings) and automatic flow control valves. Do not use service valves for adjustment. Where automatic flow control valves are utilized in lieu of venturi tubes, record only the pressure drop across the valve if within the pressure drop rating on the valve tag.

G. Special Procedures: Where available, pump capacity (as designed) is less than total flow requirements of individual heat transfer units of system served, full flow may be simulated by the temporary restriction of flow to portions of the system.

3.3 CERTIFIED REPORTS

A. Submittal: Submit three copies of the reports described herein, covering air and water system performance, air motion (fpm), to the Architect prior to final tests and inspection.

B. Instrument Records: Include types, serial numbers, and dates calibration of instruments.

C. Reports: Reports shall identify conspicuously items not conforming to contract requirements, or obvious maloperation and deficiencies.

D. Certification: The reports shall be certified by an independent Registered Professional Engineer who is versed in the field of air and water balancing and who is not affiliated with any firm involved in the design or construction phases of the project.

3.4 AIR SYSTEM DATA

A. Report: The certified report shall include for each air-handling system the data listed below:

1. Equipment (fan or factory fabricated station unit):

a. Installation Data:

1) Manufacturer and Model
2) Size
3) Arrangement, Discharge, and Class
4) Motor H.P., Voltage, Phase, Cycles, and Full Load Amps.
5) Location and Local Identification Data

b. Design Data: Data listed in schedules on drawings and specifications.

c. Fan Recorded (Test) Data

1) C.F.M.
2) Static Pressure
3) R.P.M.
4) Motor Operating Amps.
5) Motor Operating B.H.P.

2. Duct Systems:

a. Duct Air Quantities (Maximum and Minimum) - Main, Submains, Branches, Outdoor (Outside) Air, Total-Air, and Exhaust

1) Duct size(s)
2) Number of Pitot-tube (Pressure) Measurements
3) Sum of Velocity Measurement, excluding pressure measurements
4) Average Velocity
5) Recorded (Test) C.F.M.
6) Design C.F.M.

b. Individual Air Terminals:

1) Terminal Identification (Supply or Exhaust, Location and Number Designation)
2) Type Size, Manufacturer, and Catalog Identification
3) Design and Recorded Quantities - C.F.M.
4) Deflector Vane or Diffusion Cone Settings
5) Applicable Factor for Application, Velocity, Area
6) Design and Recorded Velocities - F.P.M. (State "core" "inlet," as applicable)

3.5 WATER SYSTEM DATA

A. Report: Include data listed below:

1. Pumps:

a. Installation Data:

1) Manufacturer and Model
2) Size
3) Type Drive
4) Motor H.P., Voltage, Phase, and Full Load Amps.

b. Design Data:

1) G.P.M.
2) Head
3) R.P.M.
4) B.H.P. and Amps.

c. Recorded Data:

1) Discharge Pressures (Full-Flow and No-Flow)
2) Suction Pressures (Full-Flow and No-Flow)
3) Operating Head
4) Operating G.P.M. (from pump curves if metering is not provided)
5) No-Load Amps. (where possible)
6) Full-Flow Amps
7) No-Flow Amps

2. Air Heating and Cooling Equipment:

a. Design Data:

1) Load in Btu per hr
2) G.P.M.
3) Entering and Leaving Water Temperature
4) Entering and Leaving Air Conditions (D.B. and W.B.)
5) C.F.M.
6) Water Pressure Drop

b. Recorded Data:

1) Type of Equipment and Identification (location or number designation)
2) Entering and Leaving Air Conditions (D.B. and W.B.)
3) Entering and Leaving Water Temperatures
4) G.P.M. (if metered)
5) Temperature Rise or Drop

3. Converters and Heat Exchangers:

a. Installation Data:

1) Manufacturer, Model, and Type
2) G.P.M.
3) Inlet (entering) and Outlet (leaving) Temperatures
4) Water Pressure Drop

b. Recorded Data:

1) G.P.M. (if metered)
2) Entering and Leaving Water Temperature - System
3) Water pressure drop
4) Heating (or Cooling) Media Steam Pressure and Temperature and Condensate Temperature, or Entering and Leaving Water Temperature
5) Heating (or Cooling) Media - Flow (G.P.M. or lbs. per hour)

3.6 FINAL TESTS, REVIEW, AND ACCEPTANCE

A. Capacity and Performance Tests: Make tests to demonstrate that capacities and general performance of air and water systems comply with contract requirements.

B. Final Inspection: At the time of final review, recheck, in the presence of the Engineer, random selections of data water and air quantities and air motion recorded in the certified report.

C. Points and Areas for Recheck: As selected by the Architect.

D. Measurement and Test Procedures: As reviewed for work forming basis of certified report.

E. Selections for Recheck (specific plus random): In general, selections for recheck will not exceed 25 percent of the total number tabulated in the report.

F. Retests: If random tests elicit a measured flow deviation of ten percent or more from, at ten percent or more of the rechecked selections, the report shall be automatically rejected. In the event the report is rejected, systems shall be readjusted and tested, new data recorded, new certified reports submitted, and new inspection tests made.

G. Marking of Settings: Following final acceptance of certified reports by the Architect, the settings of valves, dampers, and other adjustment devices shall be permanently marked, so that adjustment can be restored if disturbed at any time. Do not mark devices until after final review.

3.7 DUCT LEAK TESTING

A. Medium pressure ductwork systems shall be leak-tested in accordance with SMACNA and as follows:

1. Medium pressure ductwork and associated components shall be tested at a minimum static pressure of 3.0" w.g. or 1.5 times the actual operating pressure (whichever pressure is greater) and maximum allowable leakage shall not exceed SMACNA Class 3 or 3.0 CFM/100 sf (@ a static pressure of 1.0" w.g.) of duct surface area. Total maximum leakage shall not exceed 2% of total system design airflow. Leak testing equipment shall be United-McGill "Leak Detective", or approved equal.

B. The leakage testing shall be witnessed by a representative of the Owner and the results shall be submitted to the Engineer for review.

* END OF SECTION *

SECTION 23 07 00

HVAC INSULATION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and the specifications including the project manual are hereby made a part of the work of this section.

1.2 DESCRIPTION

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to insulate the heating, ventilating, air conditioning, and plumbing systems.

1.3 SUBMITTALS

A. Substitutions: Your attention is directed to Section 23 05 00-"Substitutions", relative to competition and the (ONLY) notation. Familiarity with this section shall be achieved before reading the PRODUCTS section of this specification.

B. The items for which the submittals paragraph in Section 23 05 00, Common Work Results for HVAC, apply are as follows:

1. Piping insulation.
2. Duct insulation.
3. Equipment and component insulation.
4. Insulation application schedule.

1.4 DEFINITIONS

A. Finished Spaces: Spaces other than furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawl spaces, and tunnels, unless specifically listed below as an unfinished space.

B. Unfinished Spaces: Mechanical rooms and Elevator machine rooms.

C. Unconditioned Spaces: Spaces exposed to near outside ambient temperatures, such as unheated attic spaces or non-air conditioned areas.

D. Outside: Areas beyond the exterior side of walls or above the roof, unexcavated spaces, and crawl spaces.

E. Concealed: Not visible in finished or unfinished spaces. For example, above ceilings, below floors, between double walls, furred-in areas, pipe and duct shafts, and similar spaces.

F. Exposed: Visible from a finished or unfinished space.

1.5 MANUFACTURER'S STAMP OR LABEL

A. Packages or standard containers of insulation, jackets, cements, adhesives, and coatings delivered to the project site for use must have the manufacturer's stamp or label attached giving name of manufacturer, brand, and description of material. Insulation shall be asbestos-free.

1.6 FLAME SPREAD AND SMOKE DEVELOPED RATINGS

A. Materials shall have a flame-spread rating of not more than 25 and a smoke developed rating of not more than 50 when tested in accordance with NFPA 255, ASTM E84, or UL 723.

B. Provide materials with flame resistant treatments not subject to deterioration due to aging, moisture, high humidity, oxygen, ozone, or heat.

C. Materials Exempt From Fire-Resistant Rating: Nylon anchors for securing insulation to ducts or equipment.

PART 2 PRODUCTS

2.1 PIPING INSULATION

A. Fiberglass: Heavy density preformed fiberglass with thermal conductivity of 0.29 Btu-in/hr-ft^2-^{o}F at 150^{o}F mean temperature, Johns Manville Micro-Lok HP, or approved equal. Insulation shall conform to ASTM C547 Class I and shall be suitable for 850^{o}F service. Fitting insulation shall be of same material used for pipe. The flame spread / smoke developed rating shall be 25 / 50.

1. Insulation Jacket: All service (ASJ) type conforming to Fed. Spec. HH-B-100B Type I. Jacket permeability shall not exceed 0.02 perms (ASTM E96). Pipe fitting jacket shall be factory premolded, one-piece, PVC covers with pressure sensitive taped joints. Jackets in exposed locations shall have a white surface suitable for field painting. Provide vapor barrier as required by service.

2. Aluminum Jackets: ASTM B 209M (ASTM B 209), Temper H14, minimum thickness of 27 gage (0.016 inch), with factory-applied polyethylene and kraft paper moisture barrier on inside surface. Provide smooth surface jackets for jacket outside diameters less than 8 inches. Provide corrugated surface jackets for jacket outside diameters 8 inches and larger. Provide 1/2" wide stainless steel bands. Provide factory prefabricated aluminum covers for insulation on fittings, valves, and flanges.

3. PVC Jacket: Glossy white finish, ASTM 1784, minimum thickness 0.030", over insulation and vapor barrier with solvent-welded joints. Jacket shall be overlapped 2" minimum on down side.
Provide jacketing over insulation in finished areas where exposed to view. See the Reflected Ceiling Plans for additional information. Provide jacketing on insulated exterior piping.

B. Flexible Unicellular: Flexible unicellular with thermal conductivity of 0.27 Btu-in/hr-ft^2-^{o}F at 75^{o}F mean temperature. Insulation shall conform to ASTM C534, Type I, Tubular and shall be suitable for 200^{o}F service. Fitting insulation shall be of same material used for pipe. Permeability shall not exceed 0.10 perms (ASTM E96). Insulation adhesive shall conform to Mil. Spec. MIL-A-24179A, Type II, Class 1.

C. Fittings, Flanges, Hydronic Components and Accessories, Pump Casings and Valves: Provide insulation for fittings, flanges, and valves premolded, precut, or job fabricated of the same thickness and conductivity as used on adjacent piping.

D. Insulation Kit: Insulate exposed supply and waste piping at handicapped accessible sinks with fully molded insulation kit. McGuire Products ProWrap, 3/16" thick closed vinyl with anti-microbial additive, 1.02 Btu-in/hr-F^2-^{o}F thermal conductivity, white color.

2.2 DUCT INSULATION

A. Fiberglass (Ductwrap): Fiberglass duct wrap with foil-scrim-kraft facing/vapor barrier, 1.0 lb/cu.ft. density (0.75 lb/cu.ft. for 3" thickness only), 0.29 Btu-in/hr-ft^2-^{o}F conductivity at 75^{o}F mean temperature, 0.05 permeance rating. Insulation shall meet the requirements of NFPA 90A & B and shall be UL rated. Provide foil-scrim-kraft (FSK) tape.

B. Fiberglass (Ductboard): Fiberglass insulation board with foil-scrim-kraft facing/vapor barrier, 3.0 lb./CF density, 0.25 Btu-in/hr-ft^2-^{o}F conductivity at 75^{o}F mean temperature, 0.05 permeance rating. Insulation shall meet the requirements of NFPA 90A and B and shall be UL rated. Provide foil-scrim-kraft (FSK) tape.

2.3 EQUIPMENT INSULATION

A. Fiberglass (Hot Equipment): Semi-rigid fiberglass board conforming to Fed. Spec. HH-I-558B, Form B, Type I. Thermal conductivity shall be 0.32 Btu-in/hr-ft^2-^{o}F at 150^{o}F mean temperature (ASTM C177), insulation shall be suitable for 650^{o}F service. Insulation jacket shall be "all service" type conforming to Fed. Spec. HH-I-100B Type I or II. Jacket permeability shall not exceed 0.02 perms (ASTM E96).

B. Flexible Unicellular (Cold Equipment and Piping): Flexible unicellular with thermal conductivity of 0.27 Btu-in/hr-ft^2-^{o}F at 75^{o}F mean temperature. Insulation shall conform to ASTM C534, Type II, sheet and shall be suitable for 200^{o}F service. Permeability shall not exceed 0.10 perms (ASTM E96). Insulation adhesive shall conform to Mil. Spec. MIL-A-24179A, Type II, Class 1.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

2. Verify that the insulation systems may be installed in accordance with pertinent codes and regulations and the reviewed Submittals.

3.2 GENERAL

A. Insulate after system tests have been completed and surfaces to be insulated have been cleaned of dirt, rust, and scale and are dry.

B. Install insulation with jackets drawn tight and cement down longitudinal and end laps. Do not use scrap pieces where a full length section will fit. Insulation shall be continuous through sleeves, wall and ceiling openings, except at fire dampers in duct systems and pipe penetrations through fire rated assemblies. Extend surface finishes to protect ends, and raw edges of insulation. Apply coatings and adhesives at the manufacturer's recommended coverage per gallon. Individually insulate piping and ductwork. Keep insulation and piping dry during the application of the finish. Bevel and seal the edges of exposed insulation.

C. Unless otherwise indicated, do not insulate the following:

1. Factory preinsulated flexible ductwork.
2. Factory pre-insulated ductwork, plenums, casings, mixing boxes, and filter boxes.
3. Chrome plated pipes and fire protection pipes.
4. Vibration isolating connections.
5. Adjacent insulation.
6. ASME stamps, nameplates, access plates.
7. Ductwork exposed to view in a normally occupied space.

3.3 PIPING INSULATION

A. Pipe Insulation (Fiberglass): Place sections of insulation around the pipe and joints, tightly butt into place. Draw jacket laps tight and smooth. Secure jacket with fire resistant adhesive, or factory applied self sealing lap. Cover circumferential joints with butt strips, not less than 3-inches wide, of material identical to the jacket material. Overlap longitudinal laps of jacket material not less than 1-1/2 inches. Adhesive used to secure the butt strip shall be the same as used to secure the jacket laps.

B. Flanges, Flexible Connectors, Pump Connectors, Unions, Valves and Fittings Insulation (Fiberglass): Factory fabricated removable and reusable insulation covers. Place factory premolded, precut or field-fabricated segmented insulation of the same thickness and conductivity as the adjoining pipe insulation around the flange, union, valve, and fitting abutting the adjoining pipe insulation. Install factory premolded one-piece PVC fitting covers over the insulation and secure by stapling or with metal or plastic tacks made for securing PVC fitting covers and secure with PVC vapor barrier tape.

C. Pipe Insulation (Flexible Unicellular): Bond cuts, butt joints, ends, and longitudinal joints with adhesive. Miter 90-degree turns and elbows, tees, and valve insulation. Insulate flanges, flexible connectors, pump connectors, unions, valves, pump casings, hydronic accessories and components and fittings.

D. Where penetrating roofs and exterior walls, insulate piping to a point flush with the underside of the deck or wall and seal with a vapor barrier coating.

E. Hangers and Anchors: Pipe insulation shall be continuous through pipe hangers. Where pipe is supported by the insulation, provide MSS SP-58, Type 40 galvanized steel shields (16 gage minimum). For fiberglass insulation systems on pipe sizes 2 inches through 3", provide insulation inserts at points of hangers and supports. Insulation inserts shall be of molded glass fiber (minimum 12 pcf). Insulation inserts shall cover the bottom half of the pipe circumference, 180 degrees, and be not less than 12" long and shall not compress the insulation. Vapor-barrier facing of the insert shall be of the same material as the facing on the adjacent insulation. Seal inserts into the insulation. Insulation inserts for pipe sizes 4" and larger shall be welded pipe saddles. Install insulation in void area of saddle of same material used on adjacent insulation. **For pipe sizes 2" and smaller, insulation inserts for flexible unicellular insulation systems shall be wooden doweling set on end of length equal to insulation thickness. Seal dowel to insulation with adhesive.**

F. PVC or Metal Jackets: Provide over exterior insulation exposed to the weather. Machine cut jacket to smooth edge of circumferential joints. Overlap metal jacket not less than 2 inches at longitudinal and circumferential joints and secure with metal bands at not more than 9 inch centers. Overlap longitudinal joints down to shed water. Seal circumferential joints with a coating recommended by insulation manufacturer for weatherproofing. Solvent weld PVC jacket system to provide continuous watertight seal.

3.4 DUCT INSULATION

A. Rigid Insulation: Secure rigid insulation by impaling over pins or anchors located not more than 3 inches from joint edges of boards, spaced not more than 12 inches on centers and secure with washers and clips. Spot weld anchor pins or attach with a waterproof adhesive especially designed for use on metal surfaces. Each pin or anchor shall be capable of supporting a 20-pound load. Cut off protruding ends of pins. After installing washers, provide foil-scrim-kraft (FSK) tape to seal break in vapor barrier, tape shall extend 1" minimum around pin. Apply insulation with joints tightly butted. Bevel insulation around name plates and access plates and doors. Seal joints with FSK tape. Provide additional adhesive or staples to assist tape adhesion in difficult applications.

B. Flexible Blanket Insulation: Apply insulation with joints tightly butted. Staple laps of jacket with outward clinching staples and seal with foil scrim kraft (FSK) tape. Sagging of flexible duct insulation shall not be permitted. For ductwork over 24-inches wide on horizontal duct runs, provide pins, washers and clips. Install speed washers with pins and pin trimmed to washer. Cut off protruding ends of pins after clips are secured. Seal with FSK tape, extend tape 1" minimum around pin. Use pins on sides of vertical ductwork being insulated. Space pins and clips on 18 inch centers and not more than 18 inches from duct corners. Carry insulation over standing seams and trapeze-type hangers.

3.5 EQUIPMENT INSULATION

A. General Procedures: Apply equipment insulation suitable for temperature and service to fit as closely as possible to equipment. Join sections of insulation with adhesive. Bevel insulation around nameplates, ASME Stamp, and access plates. For insulation on equipment that must be opened periodically for inspection, cleaning, or repair, construct insulation to be removable and replaceable without damage. Provide vapor barrier seal at joints and seams for "cold" equipment.

B. Heating Equipment: Provide semi-rigid mineral fiberboard insulation. Seal longitudinal and lateral seams with FSK tape. Bond cuts, ends, and mitered sections with adhesive. Provide a vinyl-acrylic mastic coating on exposed fiberglass ends.

C. Cold Equipment, Valves, Pump Casings, Flexible Connections and Accessories: Provide flexible unicellular sheet insulation, bond cuts, butt joints, longitudinal joints and ends with vapor barrier adhesive. Vapor seal exposed edges to equipment.

3.7 INSULATION APPLICATION SCHEDULE

SERVICE	THICKNESS	MATERIAL/JACKET
PIPING:		
Domestic Cold Water Piping		
1" and smaller	1/2"	Fiberglass w/ASJ or Flexible Unicellular
1¼" and larger	1"	Fiberglass w/ASJ or Flexible Unicellular
Domestic Hot Water Piping		
2" and smaller	1½"	Fiberglass w/ASJ or Flexible Unicellular
Water and Drain Piping Under Handicap Accessible Fixtures		Insulation Kit
Domestic Water Branch Piping Less than 10 ft in Stud Walls	1/2"	Fiberglass w/ASJ or Flexible Unicellular
Condensate Drain Piping	½"	Flexible Unicellular
DUCTWORK:		
Acoustically Lined Ductwork: Unless indicated otherwise, acoustical duct liner shall be 1" thick. Acoustically lined ductwork in unconditioned spaces (such as mechanical rooms) shall have 1½" thick fiberglass ductwrap. Exposed ductwork in finished spaces shall be double-wall insulated construction.		
Concealed Supply Ductwork from the AC Unit(s) / to Spaces Served	2"	Ductwrap, FSK
Return Ductwork from the Spaces Served to the Air Handling Units (in conditioned spaces) and all ductwork exposed in finished spaces	N.A.	N.A.
Supply and Return Ductwork In unconditioned spaces	2"	Ductwrap, FSK

(Such as mechanical rooms)		
Exhaust Ductwork from a point three (3) feet interior of the motorized control damper or backdraft damper to the exterior wall, roof, or louver.	2"	Ductboard, FSK

3.8 FIELD INSPECTION

A. Visually inspect to ensure that materials used conform to specifications. Inspect installations progressively for compliance with requirements.

* END OF SECTION *

SECTION 23 09 00

INSTRUMENTATION AND CONTROLS FOR HVAC

PART 1 - GENERAL

1.1 DESCRIPTION

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to install the automatic temperature control system indicated. The system shall be a direct digital control (DDC) system with dynamic color graphics software to provide the sequences as described in these specifications. The ATC system shall be complete with required components including, low voltage and line voltage wiring and conduit. Control wiring shall include all control-related components and devices and associated interlock wiring, including that furnished or required by the HVAC equipment manufacturers, including sensors, controllers, valves, etc. Coordinate with the respective equipment manufacturers. Wiring shall be in accordance with Division 26, "Electrical" of the specifications and NFPA 70, National Electrical Code. See “System Input-Output Summary” for additional requirements and information.

B. Recognized hazardous materials such as lead, mercury or asbestos shall be prohibited from the project. Submit MSDS sheets to the Owner for review.

1.2 ACCEPTABLE MANUFACTURERS

A. Maine Controls, Presumpscot Street, Portland, ME.
B. Siemens.
C. IB Controls.
D. Basix.
E. Trident.

1.3 RELATED DOCUMENTS

A. The drawings and the specifications including SECTION 23 05 00 “Common Work Results for HVAC” are hereby made a part of the work of this section.

B. Section 23 00 00 – HVAC.

1.4 SUBMITTALS

A. Substitutions: Your attention is directed to Section 23 05 00 relative to competition and the (ONLY) notation. Familiarity with this section shall be achieved before reading the PRODUCTS section of this specification.

B. The items for which the shop drawings paragraph in Section 23 05 00 “Common Work Results for HVAC”, apply are as follows:

1. Temperature control system schematic including variables, flow diagrams, ladder diagrams, and point to point wiring diagrams, indicating set points, reset ranges,

throttling ranges, controller gains, differentials, operating ranges, normal positions, controller action, dial ranges, voltages, currents, mounting locations, indicators, and terminal strip points.

2. Sequence of operation for each system and function.

3. Generic, functional description of each control component indicated.

4. Equipment interlocks required by sequence of operation.

5. Automatic valve schedule showing flow, Cv, and pressure drop.

6. Manufacturer's Data:

   a. Dampers, valves and operators.
   b. Controllers, including wiring and connection diagrams.
   c. Thermostats, temperature sensors, including wiring and connection diagrams.
   d. Temperature and pressure indicators.
   e. Pressure sensors, including wiring and connection diagrams.
   f. Switches, relays, transmitters, transformers, including wiring and connection diagrams.

7. Dynamic color graphics software data.

8. Airflow measuring stations.

9. Flowmeters.

1.5 WARRANTY

A. The automatic temperature control system shall have a **two (2) year parts and labor** warranty.

PART 2 – PRODUCTS AND FEATURES

2.1 CONTROL PANELS

A. In general, relays, transformers, or other control devices (not including room thermostats or duct-mounted instruments) shall be grouped and mounted in a factory-built cabinet enclosure.

2.2 AUTOMATIC CONTROL DAMPERS

A. Automatic dampers not furnished with equipment shall be furnished under this paragraph. Automatic dampers shall be constructed and installed in accordance with the following specifications:

1. Damper Blades: All automatic dampers, including dampers for static pressure control, shall be of the balanced type, factory-fabricated, with fully gasketed galvanized steel airfoil blades, mounted in welded frames. Damper blades shall be not more than 8

inches wide, shall have interlocking edges, edge and jamb seals and be capable of operation against 4" static pressure differential. Dampers shall be Arrow "Arrow-Foil" Model PBDAF-206, OBDAF-207, Ruskin Model CD-60 or Tamco Series 1000.

2. Modulating Dampers: All modulating dampers shall be of the opposed blade type.

3. Damper Size and Bearings: Damper blades shall have steel trunnions mounted in oil-impregnated bearings. Dampers shall be not more than 48 inches in length between bearings.

4. Frames: Damper frames shall be of welded channel or angle-iron, with heavy steel corner gussets and braces or stiffened with steel tie-rods where necessary. Frames shall be painted with aluminum paint to prevent rusting.

5. Dampers shall be guaranteed to close tightly, and shall provide substantially the full area of the opening when open. All outdoor air intakes and all exhaust ducts to outside and all fresh air, return air and exhaust air dampers in systems shall have damper blades with inflatable seals or other devices to guarantee low leakage, not to exceed 6 CFM/SF at 1 in. WG pressure differential.

6. Damper Linkages: Damper-operating links shall be cadmium plated steel or brass rods, adjustable in length with ball and socket joints and of such proportions that they will withstand, without appreciable deflection, a load equal to not less than twice the maximum operating force of the damper motor. Linkages shall be concealed in the frame.

B. Damper Actuators: For each automatically controlled damper, a suitable damper actuator or actuators shall be provided in accordance with the following specifications:

1. Actuator: Damper actuators shall be electronic, direct-coupled, spring-return type and have a rating of not less than twice the torque needed for actual operation of the damper.

2. Adjustments: Provide adjustable stops for the open and closed positions.

3. Mounting: Damper actuators shall be direct-coupled over the shaft. The damper actuators and mounting base shall not be mounted directly on cold or insulated ducts and casings, but shall be mounted outside the insulated covering in such a manner as to prevent sweating and interference with the insulation.

4. Where indicated, damper actuators shall be provided with an auxiliary switch rated at 120 V AC, and accept a 0 to 20 ma input.

2.3 TEMPERATURE SENSORS

A. Temperature Sensors: RTD Elements, accuracy of $\pm$0.1% at 70^{o}F, sensors shall be securely attached to a single gang electrical box or other suitable base, securely mounted on the wall or other building surface. Each sensor shall be located where shown or, if not shown, where it will respond to the average temperature in the room. Sensors, generally, shall be mounted

48 inches above the floor, and shall not be mounted on outside walls if other locations are possible. If located on an outside wall, it shall have an insulated base. Sensors shall have locked or concealed adjustment devices, by means of which the operating points can be adjusted through a range of not less than 10 degrees above and below the operating points specified.

B. Room temperature sensors shall be equal to Vaisala, Kele or Honeywell, with blank covers. Provide an override button with LED indicator light. Provide tamperproof cast aluminum guards, where indicated. Temperature sensors / thermostats with guards shall have a blank, lockable cover (tamperproof).

2.4 CO_2 and IAQ SENSORS

A. Duct mounted: CO_2 sensors shall be Vaisala Carbocap Series, Model GMD20, Kele, Telaire or TSI and utilize Non-Dispersive Infrared Detection (NDIR) or Photo-Acoustic Sensing and be capable of daily self-calibration during "unoccupied" periods.

B. Wall-mounted room sensors: CO2 sensors shall be equal to Vaisala Carbocap Series, Model GMW20, Kele, Telaire or TSI combination temperature and CO_2 without CO_2 display. IAQ sensors shall be BAPI "AQS", or equal. Sensors shall be mounted at 48" A.F.F.

2.5 SEQUENCE OF CONTROL

A. Provide and install electronic/electric components to enable the mechanical system to operate in the following sequences:

1. Combination Fire / Smoke Dampers:

a. The dampers shall open prior to their respective air handling systems operating. If smoke is detected, the damper(s) shall close and the respective air handling system(s) shut down. The fire alarm system shall be notified if smoke is detected.

2. Rooftop Air Conditioning Unit (**AC-***): The units shall operate on an "occupied-unoccupied" cycle. During scheduled "occupied" periods, the gas heating and DX cooling and economizer shall be enabled as required to maintain the room temperature setpoint, and the unit shall operate continuously with the outside air damper open to the minimum outside air position. A return air CO2 sensor shall open the outside air damper as required to maintain the setpoint subject to a mixed air low limit sensor (setpoint 55F.). The enthalpy economizer shall operate to provide free cooling when available. A manual reset freeze-protection thermostat shall shut down the unit and if the discharge temperature drops below 50F.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

2. Verify that the automatic temperature control system may be installed in strict accordance with pertinent codes and regulations and the reviewed Shop Drawings.

3.2 INSTALLATION

A. Provide wiring, and conduit to connect the ATC components for an operational ATC system. Wiring and installation shall conform to NFPA 70.

B. Identification: Label or code each field wire at each end. Permanently label or code each point of field terminal strips to show the instrument or item served. Color-coded cable with annotated cable diagrams may be used to accomplish cable identification.

C. Temperature Sensors: Stabilize sensors to permit on-the-job installation that will require minimum field adjustment or calibration. Temperature sensor assemblies shall be readily accessible and adaptable to each type of application to allow quick, easy replacement and servicing without special tools or skills. Strap-on sensor mountings, using helical screw stainless steel clamps, shall be permitted on new piping for unit heater or other on-off operation only, after pipe is cleaned to bright metal. Strap-on bulb and pipe shall be insulated after installation. Strap-on sensor mountings are also permitted for hot water piping sizes up to 2 inches. Other liquid temperature sensors shall be provided with wells.

D. Duct Sensors: Provide sensors in ductwork; specific location within duct shall be selected to accurately sense air properties. Do not locate sensors in dead air spaces or positions obstructed by ducts or equipment. Installation shall be within the vibration and velocity limits of the sensing element. Where an extended surface element is required to sense the average or lowest air temperature, position and securely mount sensor within duct in accordance with sensor manufacturer's recommendations. Temperature sensing elements shall be thermally isolated from brackets and supports. Provide separate duct flange for each sensing element; securely seal ducts where elements or connections penetrate duct. Seal penetrations of duct insulation vapor barrier with vapor barrier coating compound to provide a vapor-tight covering. Mount sensor enclosures to allow easy removal and servicing without disturbance or removal of duct insulation or vapor barrier. On downstream side of each sensor, provide access doors.

E. Pipe Sensors: Provide wells for sensors measuring temperatures in pressure vessels or in pipes. Wells shall be noncorrosive to the medium being measured and shall have sufficient physical strength to withstand the working and test pressures and velocities. Locate wells to sense continuous flow conditions. Do not install wells using extension couplings. Where piping diameters are smaller than the length of the wells, provide wells in the piping at elbows to effect proper flow across the entire area of the well. Wells may either look upstream or downstream. Provide thermal transmission material within the well to speed the response of temperature measurement. Provide wells with sealing nuts to contain the thermal transmission material and allow for easy removal. Wells shall not restrict flow area to less than 70 percent of line-size-pipe normal flow area. Increase piping size as required to avoid restriction.

3.3 ADJUSTMENTS

A. Adjust controls and equipment to maintain the conditions indicated, to perform the functions indicated, and to operate in the sequence specified.

3.4 DUCT SMOKE DETECTORS

A. The Fire Alarm Contractor shall furnish and wire duct smoke detectors. Installation shall be accomplished by the sheetmetal contractor and be wired by the Fire Alarm Contractor.

3.5 INSTRUCTING OPERATING PERSONNEL

A. Upon completion of the work and when designated by the Architect, furnish the services of a competent technician regularly employed by the temperature control manufacturer for the instruction of Owner in the operation and maintenance of each automatic space temperature control system. The period of instruction shall be for not less than three (3) 8-hour non-concurrent working days (twenty-four (24) hours total) and shall include video tape demonstration of controllers.

3.6 FIELD INSPECTION AND TESTS

A. Tests shall be performed or supervised by employees of the ATC system or manufacturer of the ATC system, or by an authorized representative of the ATC manufacturer. Give Architect 14 calendar days advance written notice prior to the date of the field acceptance testing. If the Architect witnesses tests, such tests shall be subject to approval. If the Architect does not witness tests, provide performance certification.

B. Plan for Inspections and Tests: Furnish a written inspections and tests plan at least 60 days prior to the field acceptance test date. This plan shall be developed by the manufacturer of the ATC system. The plan shall delineate the inspections and testing procedures required for the ATC system to demonstrate compliance with the requirements specified. Additionally, the test plan shall indicate how ATC system is to be tested, what variables will be monitored during test, names of individuals performing tests, and what criteria for acceptance should be used. Indicate how operation of H&V system and ATC system in each seasonal condition will be simulated.

C. Field Acceptance Testing: Upon completion of 72 hours of continuous H&V and ATC systems operation and before final acceptance of work, test the automatic temperature control systems in service with the heating, ventilating and air conditioning systems to demonstrate compliance with contract requirements. Test controls through each cycle of operation, including simulation of each season insofar as possible. Test safety controls to demonstrate performance of required function. Adjust or repair defective or malfunctioning automatic space temperature control equipment or replace with new equipment. Repeat tests to demonstrate compliance with contract requirements.

SECTION 23 30 00

HVAC FOR DISTRIBUTION

PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The drawings and the specifications including SECTION 23 05 00 “Common Work Results for HVAC” are hereby made a part of the work of this section.

1.2 DESCRIPTION OF WORK

A. The work covered by this Section of the specifications includes the furnishing of labor, materials, equipment, transportation, permits, inspections and incidentals and the performing of operations required to install the ductwork systems indicated.

1.3 SUBMITTALS

A. Substitutions: Your attention is directed to Section 23 05 00-"Substitutions", relative to competition and the (ONLY) notation. Familiarity with this section should be achieved before reading the PRODUCTS section of this specification.

B. The items for which the submittals paragraph in Section 23 05 00 “Common Work Results for HVAC”, apply are as follows:

1. Ductwork.
2. Ductwork accessories.
3. Air devices.
4. Acoustical duct liner.
5. Firestopping materials and methods.
6. Louvers and dampers.
7. Ductwork sealing products.

PART 2 PRODUCTS

2.1 DUCTWORK

A. Classification of Ductwork: Low pressure ductwork: up to 2" W.G. static pressure. Medium pressure ductwork: 2" to 6" W.G. static pressure. The duct pressure class shall be determined by multiplying the total static pressure scheduled in the fan schedules by 1.2.

B. Materials: Unless otherwise indicated low pressure ductwork shall be galvanized steel. Galvanized sheet metal shall be new galvanized steel sheets of lock forming quality with zinc coating that will not flake or peel under forming operation.

C. Construction for Low Pressure Round and Rectangular Ductwork:

1. Material: Galvanized steel conforming to ASTM A527, weight of galvanized coating shall be not less than 1-1/4 ounces total for both sides of one sq.ft. of a sheet.

Construction, metal gage, and reinforcements shall conform with SMACNA "Duct Construction Standards" and NFPA 90A for 2" W.G. pressure class.

2. Fittings: Shall be constructed in accordance with SMACNA Standards and shall be of the types indicated (ONLY).

3. Longitudinal seams shall be Pittsburgh lockseam (ONLY). Button punch snap locks are not acceptable.

4. Joints and seams shall be sealed to SMACNA seal class B (Leakage Class 12 for rectangular ducts and Leakage Class 6 for round and flat oval ducts).

5. Unless indicated otherwise, exhaust ductwork above the roof shall be Type 304 stainless steel construction.

D. Construction for Spiral Seam Round and Flat Oval Ductwork:

1. Ductwork and fittings shall be United McGill Uni-seal or Uni-rib, Eastern Sheetmetal, Lindab, Semco or Monroe Sheetmetal, galvanized steel, factory fabricated, spiral lockseam or welded longitudinal seam, round or flat oval type, as indicated. Seams shall be solid welded or spot-welded and factory sealed airtight. Ducts and fittings shall be specifically designed for medium pressure application. Round or flat oval ductwork indicated as acoustically lined or double-wall (DW) shall be United-McGill Acousti-K27, double wall medium pressure construction with solid 26 gauge sheetmetal inner liner and 1" thick fiberglass insulation. Fittings shall be furnished with solid liners. Insulation shall be provided with thermal conductivity of 0.27 BTU/HR-^{o}F-FT^{2}-IN. Exposed ductwork in finished spaces specified to be painted shall be “Paint-Grip” galvanized material. Interior ductwork shall be constructed of galvanized sheetmetal. Exposed supply ductwork shall be double-wall construction with “Paint-Grip” galvanized outer shell.

a. Sheetmetal Gauges: Per SMACNA for listed pressure class.

b. Fittings: Fittings shall be machine formed type or welded multi-segment type. All seams shall be factory sealed or welded airtight. Tap offs shall be 90^{o} conical type or 45^{o} standard type, with smooth, machine formed entrance, designed for low pressure drop and low noise generation. 90^{o} elbows shall be 5 piece construction (where space permits) or vaned type mitered elbow where space is restricted. Unless specifically indicated (and field-verified) as 5 piece construction, use vaned 90^{o} elbows. Vanes shall be single thickness, solid-welded in place.

c. Joints on round spiral ductwork shall be slip type, coupling type, Van Stone flanges, or factory fabricated flange system type connectors, as standard with the manufacturer. Flat oval joints shall be Van Stone flanges (gasketed) or factory fabricated flange system type connectors. Joints shall be made up with joint sealer applied in strict accordance with the manufacturer's recommendations. Joint sealer shall be as recommended by the manufacturer.

d. Duct and fittings shall have been tested for air friction loss and leakage in an independent testing laboratory. Test results shall be submitted with the Shop Drawings for review.

e. External reinforcing angles shall be provided in accordance with the manufacturer's recommendations. External reinforcing angles shall be galvanized or painted with a rust inhibiting aluminum paint. Include reinforcing data with Shop Drawing submittal. Duct and reinforcing shall be designed for a positive static pressure of 6 inches of water gage.

f. No internal tie rod reinforcing will be allowed.

g. Hangers shall be of the clamp-on or trapeze type. Exposed ductwork shall use clamp-on hangers only. Holes shall not be drilled through the ducts.

E. Acoustical duct liner for rectangular ductwork shall be Type AP Armaflex SA duct liner. The liner shall be elastomeric unicellular (closed cell) and have a thermal conductivity of 0.27 Btuh/^{0}F.-sf-in. and be cleanable and suitable for duct velocities of 4000 FPM. Duct liner thickness shall be 1" unless indicated otherwise. The installation shall include 100% coverage of the manufacturer’s recommended adhesive and protective Z-strips at all exposed upstream edges. Mechanical fasteners shall be used in addition to adhesive. Insulation shall comply with NFPA 90A and NFPA 90B and be approved by Factory Mutual.

F. Exposed Ductwork: Interior exposed ductwork shall be “Paint-Grip” galvanized, suitable for field-painting without dents or other visible cosmetic damage.

2.2 DUCTWORK ACCESSORIES

A. Access Doors:

1. Medium Pressure Duct Systems: Ruskin Model ADHP-3, 12"x12" size, 16 gauge galvanized steel, foam gasket, insulated door, spring latches.

2. Low Pressure Duct Systems: Ruskin Model ADC2, 12"x12" size, 24 gauge galvanized steel, steel on both sides of door, foam gasket seals, 1" insulation, 2 cam locks, no hinge.

B. Counter Balanced Dampers (CBD): Aluminum frame and blades, extruded vinyl edge seals, 2-1/4" deep, set 0.06" WG.

C. Backdraft Dampers (BDD): Ruskin Model CBD2 or American Warming and Ventilating aluminum frame and blades, extruded vinyl edge seals, field set at 0.10" W.G. pressure differential for full open operation.

D. Fire Dampers: Greenheck DFD-series, Ruskin Model IBD2, or Cesco, curtain type, 100% free area (ONLY), Style C for round duct installations, and Style B or ODFD type for rectangular duct applications. Fire dampers located immediately behind transfer grilles may be Style A dampers. The dampers shall be UL rated for 1-1/2 hours and have a 165^{o}F fusible link. Fire dampers shall be “dynamic” rated and shall comply with UL “Standard for Safety” 555.

E. Drawbands for Flexible Ducts: Clinch type stainless steel with screwdriver adjustment, or nylon with lever action tightening tool provided by the drawband manufacturer.

F. Turning Vanes: (Low Pressure):

1. Solid blade, mounted with the long edge down stream in accordance with duct construction details indicated. Submit a 12"x12" sample elbow for review prior to fabrication.

G. Volume Dampers:

1. Factory fabricated as specified, or shop fabricated in accordance with SMACNA "HVAC Duct Construction Standards".

2. Rectangular: Ruskin Model MD-35, or American Warming and Ventilating, 12 gauge galvanized steel, locking quadrant, opposed blade over 11", single blade 11" and under.

3. Round: Ruskin Model MDRS25, or American Warming and Ventilating, 20 gauge galvanized steel with locking quadrant(ONLY). Dampers may be provided integral with spin-in fittings.

H. Flexible Ductwork:

1. Not allowed.

I. Joint Sealer:

1. Duro-Dyne DDS181, Design Polymerics DP 1010 water-based polymeric duct sealant, Hardcast DT tape and FTA-50 activator or Airseal #33 fiber-reinforced water-based brush-on sealer by Polymer Adhesive Sealant Systems, Inc. (UL181A-M or 181B-M labeled).

2. Provide waterproof sealer where watertight seal is specified.

2.3 AIR DEVICES (Krueger, Price, Metal Aire, Titus) ONLY

A. Material and Finishes: Construct diffusers, registers, and grilles of aluminum. Exterior and exposed edges shall be rolled, or otherwise stiffened and rounded. Steel parts shall be factory zinc-phosphate treated prior to priming and painting or have a baked-on enamel finish. Aluminum parts shall be finish painted. Provide frame style compatible with ceiling or wall type. Colors shall be selected by Architect. Devices to be installed on exposed duct installations shall be furnished in primer suitable for field application of color coat.

B. **Sound Level**: Manufacturer certified sound level rating of inlets and outlets in accordance with ADC 1062 R4. Conform with the maximum permissible room / diffuser noise criteria (NC) level for each device as scheduled. Provide submittal data accordingly.

C. Throw: Defined as distance from the diffuser, register, or grille to the point which the resultant room air velocity is 50 to 35 feet per minute.

D. Ceiling Diffusers: Equip with core styles required to provide air distribution pattern indicated. Internal parts shall be removable through the diffuser-neck for access to the duct and without the use of special tools. Construct each diffuser of four or more concentric elements designed to deliver air in a generally horizontal direction. The interior elements of square and rectangular ceiling diffusers may be square or rectangular as manufacturer's standard. Screws or bolts in exposed face of frames or core elements are not acceptable. Diffusers shall have an opposed blade volume damper in the diffuser neck if no damper is indicated in the branch duct (see Drawings). Diffusers shall have a 24"x24" lay-in panel for areas with acoustical ceilings and surface-mount frame for GWB ceilings. Ceiling diffusers shall be Price AMX series, high induction type with induction vanes.

E. Grilles and Registers: Construction and finish as indicated, 1/2" louver spacing, 45^{o} curved blade. Registers shall have opposed-blade volume dampers with screwdriver adjuster. Unless otherwise indicated, registers shall be provided.

F. Linear Diffusers and Bar Grilles: Linear bar grilles/registers and linear slot diffusers shall be as scheduled and indicated. Provide opposed blade volume dampers for each diffuser (unless a volume damper is provided in the branch duct) and adjustable pattern controllers. Return air slots shall be without pattern controllers. “Revers-A-Core” diffusers shall have deflection vanes. Construction shall be extruded aluminum with an anodized finish.

G. General: The interior of all sheetmetal connections to grilles, registers and diffusers shall be painted with a non-specular flat black paint so that no sheetmetal surfaces are visible from the finished space.

2.4 COMBINATION FIRE / SMOKE DAMPERS

A. Combination fire / smoke dampers shall be Greenheck Model FSD-33, 1½ hour fire rating, with dynamic rating, UL-listed.

B. Furnish with an integral 16 gauge sleeve with break-away connections, and smoke detector.

C. Damper shall be constructed of galvanized steel with airfoil blades. Sleeve type shall accommodate rectangular, round or flat oval ductwork, as required, with **Class I** leakage construction.

D. Provide suitable access doors, as required.

E. Installation shall be per the manufacturer’s recommendations and the performance listing.

F. Actuator: Belimo, Internally-mounted electric actuator, with end switch interlocked with the smoke detector and associated air handling system. Provide access, as required.

PART 3 - EXECUTION

3.1 SURFACE CONDITIONS

A. Inspection:

1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.

2. Verify that the duct systems may be installed in accordance with pertinent codes and regulations and the reviewed Submittals.

3.2 INSTALLATION OF DUCTWORK AND AIR DEVICES

A. Provide and erect in accordance with the best practice of the trade ductwork shown on the drawings and as required to complete the intended installation. Make offsets as shown or required to place ductwork in proper position to avoid conflicts with other work and to allow the application of insulation and finish painting to the satisfaction of the Architect. Sizes given are "inside - clear" dimensions and not necessarily that of sheet metal. Ducts shall be arranged to adjust to "field conditions". The Sheet Metal trades shall coordinate his work with other trades. Work shall conform to ASHRAE duct construction recommendations, SMACNA "Duct Construction Standards", NFPA, and the requirements of the IBC code.

B. Joint Sealing: See PRODUCTS section.

C. Longitudinal joints: See PRODUCTS section.

D. Turns shall be made with long radius elbows or, if physically impossible to use long radius elbows, shall be square turns with specified turning vanes. CAUTION: Turns not conforming to this requirement shall be ordered removed and replaced with properly built turns.

E. Access Doors: Provide access doors for concealed apparatus requiring service and inspection in the duct system including but not limited to dampers, sensors and motors, and upstream and downstream from duct coils.

F. Duct Sleeves and Prepared Openings: Install duct sleeves and prepared openings for duct mains, duct branches, and ducts passing through walls, roofs, and ceilings. Insure the proper size and location of sleeves and prepared openings. Allow one-inch clearance between duct and sleeve or one-inch clearance between insulation and sleeve for insulated ducts, except at grilles, registers, and diffusers.

G. Duct Supports: Unless otherwise indicated, provide one-inch wide by 16 gage galvanized steel sheet metal strips on each side of ducts. Anchor risers in the center of the vertical run to allow ends or riser free vertical movements. Attach supports only to structural framing members. Do not anchor supports to metal decking unless a means is provided (architectural review required) for preventing the anchors from puncturing the metal decking. Where supports are required between structural framing members, provide suitable intermediate metal framing. Where C clamps are used, use retainer clips.

H. Flexible Collars and Connections: Provide flexible collars between fans and ducts or casings and where ducts are of dissimilar metals, except where fans are internally connected to the casing with flexible connectors. For round ducts, securely fasten flexible connections using stainless steel clinch-type draw-band. Nylon drawbands may be used if installed using the drawband manufacturer's lever-action tightening tool. For rectangular ducts, lock flexible

connections to metal collars. All air handling equipment fan connections to the duct systems shall have flexible connections, factory or field-installed.

I. Flexible Ducts: Provide where indicated. No fiberglass shall be exposed or in contact with air flow. Flexible duct length shall not be more than 4'-0". Install with metal band hangers and without excess length, provide maximum extension of flex duct. Securely fasten flexible ducts to metal collars using a stainless steel or tool-tightened nylon drawband on the duct core and a second drawband on the insulation vapor barrier. If the duct exceeds 12 inches diameter, position the drawband behind a bead on the metal collar. Taping in lieu of drawbands is not allowed.

J. Any deviation in the duct system must be submitted as a shop drawing and stamped. CAUTION: Any deviation not submitted and favorably reviewed will be ordered removed from the system and replaced with that which is shown on the Drawings.

K. Discrepancies between actual field conditions and the Contract Documents shall be brought to the attention of the Architect prior to fabrication.

L. Field Changes to Ductwork: Field changes of ducts such as those required to suit the sizes of factory-fabricated equipment actually furnished shall be designed to minimize expansion and contraction. Use 4:1 transitions in field changes as well as modifications to connecting ducts.

M. Transitions with a slope greater than 4 to 1 shall be ordered removed from the system and replaced with a transition which meets this criteria.

N. Joints and seams at intake and exhaust plenums and joints on intake and exhaust ductwork for a distance of 3 feet from the plenum shall be sealed watertight on the bottom and side joints and seams.

O. Isolation dampers at intake and exhaust louvers and vent hoods shall be sealed to the ductwork to provide an airtight assembly with similar performance characteristics to the isolation damper.

P. The inside of sheetmetal connections to grilles, registers and diffusers shall be painted flat black so that no sheetmetal is visible from the finished space.

Q. All sharp edges and corners on ductwork, hangers or equipment located within 7'-0" of the finished floor shall be protected with a suitable padding material and identified with fluorescent orange paint.

3.3 CLOSING IN WORK

A. Cover up or enclose work after it has been properly and completely tested and reviewed.

B. No additional cost to the Owner will be allowed for uncovering or recovering any work that is covered or enclosed prior to required test and review.

3.4 TEST AND ADJUST

A. Ductwork shall be leak tested in accordance with Section 23 05 93 "Testing and Balancing for HVAC". Provide end cap and closure pieces. Close off and seal openings in ductwork to be tested. Ductwork shall be tested before it is insulated.

B. Before operating any system, the system shall be cleaned out to remove dust and foreign materials.

C. After the installation is complete and ready for operation, test the system under normal operating conditions in the presence of the Architect and demonstrate that the system functions as designed.

D. Correct defects which develop during the test period, conduct additional testing until defect free operation is achieved.

3.5 CLEANUP AND CORROSION PREVENTION

A. Ductwork and equipment shall be thoroughly cleaned. Dirt, dust, and debris shall be removed and the premises left in a clean and neat condition.

B. Before covering is applied to duct systems, clips, rods, clevises and other hanger attachments, and before uncovered piping is permitted to be concealed, corrosion and rust shall be wire brushed and cleaned and in the case of iron products, a coat of approved protective paint applied to these surfaces.

3.6 INSTRUCTIONS

A. On completion of the project, instruct the Owner's representative in the care and operation of the system. The total period of instruction shall not exceed four (4) hours. The time of instruction shall be arranged with the Owner. In addition to the prime Mechanical Contractor, the control system Contractor, Balancing Contractor, and Owner's representative shall be present and participate in the Owner's instruction.

3.7 FIRESTOPPING

A. Firestopping shall be performed in accordance with Specification Section 078400 “Firestopping”. All penetrations of fire-rated assemblies including walls and floors by mechanical system components (piping, ductwork, conduits, etc.) shall be firestopped as specified.

* END OF SECTION *

SECTION 260000

GENERAL ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Basic Electrical Requirements specifically applicable to Divisions 26, 27 and 28 Sections.

1.02 REFERENCES

A. ANSI/NFPA 70 - National Electrical Code.

B. ANSI C2 - National Electrical Safety Code.

C. ANSI/NFPA 101 - Life Safety Code.

1.03 RELATED REQUIREMENTS

A. Conditions of the Contract and Division 1 - General Requirements, apply to all work, including work of this Division. Examine all contract documents for requirements affecting this work.

1.04 SUBMITTALS

A. Submit under provisions of Division 01.

B. Submit shop drawings and product data grouped to include complete submittals of related systems, products, and accessories in a single submittal.

C. Mark dimensions and values in units to match those specified.

D. Provide fixture schedule, lighting drawings, panelboard schedules and single line or risers diagram(s) to supplier for assistance in pricing as applicable. Contractor shall receive one set of black line drawings for reproduction from the engineer for this purpose.

1.05 REGULATORY REQUIREMENTS

A. Conform to applicable local, State and Federal Building Code for the State of Maine.

B. Electrical: Conform to NFPA 70, NFPA72, NFPA 99, NFPA 101, ANSI C2, 2 FM, UL, and applicable ASTM and ANSI Standards.

C. Contractor shall visit the site to become familiar with all existing conditions affecting this work. No claim shall be recognized for extra compensation due to failure of contractor to familiarize himself/herself with the conditions and extent of proposed work.

D. Obtain permits and request inspections by local authority having jurisdiction.

1.06 PROJECT/SITE CONDITIONS

A. Install Work in locations shown on Drawings, unless prevented by Project conditions.

B. Prepare drawings showing proposed rearrangement of Work to meet Project conditions, including changes to Work specified in other Sections. Obtain permission of Engineer before proceeding.

1.08 TEMPORARY LIGHT AND POWER

A. Temporary light and power shall be installed and maintained by the Electrical Contractor for use by all trades for the duration of construction complete with all wiring, switches, protective devices and similar equipment as may be required. Arrangement for the temporary service with the Power Company is the responsibility of the Electrical Contractor. Power bills will be paid by the General Contractor. Provide 120/208 volt or 120/240 volt 100 ampere, drop box similar to standard CMP detail 980-31.1.4. Provide 15-20 watt self ballasted compact fluorescent, lamps with plastic “cages” as needed. or 4 foot twin lamp (T8) fluorescent tamper-proof, gasketted and water-tight as required.

1.09 CONTRACT DRAWINGS AND SPECIFICATIONS

A. It is to be understood that drawings accompanying these specifications are intended to show general arrangement and extent of work to be done, but exact location and arrangement of all components shall be determined as work progresses. Anything shown on the drawings and not specifically mentioned in specifications or vice versa shall be considered as required in both.

B. Locations of equipment, and materials, etc., as given on drawings are approximate unless dimensioned. It shall be understood they are subject to such modifications as may be found necessary or desirable at time of installation in order to meet any structural conditions. Such changes shall be made by the contractor without extra charges.

C. Because of small scale drawings, all required offsets, etc., as may be required to clear work of other Contractors, may not be shown. Contractor, however, shall provide all necessary offsets, etc., as required to complete the installation of their work and not conflict with that of others.

D. It is the intention that wiring systems shall be complete and fully operational. The contractor shall identify system components during the bid process that clearly constitute conditions that would cause the system to be incomplete. Clarification: The remedy to these discrepancies shall be communicated by the engineer to all bidders or included as an addenda.

1.10 MATERIALS AND LABOR

A. Bidders for this work shall carefully examine the Plans and Specifications, as the Contractor shall be required to furnish all materials and labor necessary to deliver to the Owner a complete system installed in full accordance with Local State and Federal laws. The system shall be furnished as specified, tested, and turned over to the Owner in perfect operating

condition.

B. All materials shall be new and of best quality of their respective kinds. Workmanship in all respects shall be of highest grade and all construction shall be done according to best practices of the trade. Materials shall be warrantied directly by the manufacturer.

C. Contractor shall provide, when required for review of Engineer, labeled samples of any material or equipment specified herein or proposed to be used on this project.

D. Where words "furnish", "provide" or "install" are mentioned, either singly or in combination, these words are hereby interpreted to mean "furnish and install" or "provide and install," including all materials complete with all connections, supplemental devices, accessories and appurtenances, unless specifically otherwise noted. These words are likewise hereby interpreted as being prefixed to all materials, equipment, and apparatus hereinafter mentioned, either in abbreviated or schedule information.

1.11 PROTECTION OF WORK AND MATERIALS

A. Contractors shall be responsible for the care and protection of all materials delivered and labor performed until the completion of the work.

B. Cap all uncompleted lines, raceways, and ducts until ready for final connections, or future work as indicated.

C. All portions of the work liable to damage by weather or by those engaged on the project, must be securely protected by temporary, but substantial covering which must be maintained in position until Engineer authorizes removal.

1.12 REPLACEMENTS

A. In the event of damage to any equipment or materials, immediately make all repairs and replacements necessary to the approval of the Engineer at no additional cost to the Owner.

1.13 SAFETY REGULATIONS

A. All work to be performed and/or installed shall conform to all requirements of the Occupational Safety and Health Act (OSHA) of 1970 and all Amendments thereto.

1.14 INSURANCE

A. The Contractor shall purchase and maintain all Workmen's Compensation Insurance, Public Liability and Property Damage Insurance during the progress of the work and until completion and acceptance of the entire project by the Owner.

1.15 QUALITY ASSURANCE/CONTROL OF INSTALLATION

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

B. Comply fully with manufacturers' instructions, including each step-in sequence.

C. Should manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.

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

E. Perform work using persons qualified to produce workmanship of specified quality.

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

1.16 UNDERWRITER'S APPROVALS

A. All electrical materials and equipment shall bear label of Underwriter's Laboratories, shall be listed by them in their list of electrical fittings and shall be approved by them for purpose for which they are to be used, unless materials and equipment are of a type for which Underwriter's Laboratories does not list or provide label service.

1.17 SUBSTITUTIONS

A. Where the specifications allow the substitution of a product for that which has been specified, said substitution must be reviewed by the Engineer and shall be equivalent in all respects to that which is specified. The Engineer's decision shall be obtained on all questions as follows, and his/her judgment shall be final and binding on all parties.

B. Reference in the specifications or on the drawings to any product, material, fixture, form or type of construction, etc., by proprietary name, manufacturer, make or catalog number, shall be interpreted as establishing a standard of quality or design and shall not be construed as limiting competition. The Contractor may, at his/her option, use any fully equivalent substitute provided written review by the Engineer is first obtained indicating acceptance of the equality of the substitute preferred.

C. For materials or equipment which are supplied with integral or factory applied finish, the colors of same shall be considered in evaluating substitutions.

D. For the purpose of avoiding conflicts with other trades, contracts, and adjoining work where more than one (1) article, device, material, fixture, form or type of construction, etc., is referred to by proprietary name, manufacturer, make or catalog number, the first named shall be used as the basis of design and details. The cost of any changes of approved equivalent item shall be borne by the Contractor requesting such change.

1.18 RECORD DRAWINGS

A. During construction, the Contractor shall keep an accurate record of all deviations to the installation of the work as indicated on the drawings. Upon completion of the work, the Contractor shall furnish a copy of this record to the Engineer, on a black line of the original

which will be available from the Engineer. Submit record drawings before requesting final payment.

1.19 MANUFACTURER'S REPRESENTATIVE

A. At appropriate times, or as directed by the Engineer, provide the services of a competent factory trained Engineer or Technician of the manufacturer of equipment or item involved, to inspect, adjust, and place in proper operating condition any and all such items of manufacture. No additional compensation shall be allowed Contractors for such service.

1.20 MANUFACTURERS' INSTRUCTIONS, AND OPERATION AND MAINTENANCE DATA

A. Provide for each item of equipment or apparatus furnished, a complete set of printed instructions obtained from the manufacturer covering proper operation, care, lubrication, cleaning, servicing, adjustment, etc., together with any special safety instructions.

B. Manufacturers' data shall further include performance data (time current curves, where applicable), complete parts lists, recommended spare parts lists, and wiring diagrams.

C. Data shall be arranged in complete sets, properly indexed and marked.

D. Data shall include complete set of shop drawings.

E. Material shall first be submitted in preliminary fashion for review by Engineer. After approval, Contractor shall submit two (2) copies in bound volumes to the Engineer for distribution.

F. Provide contacts for service agencies for all major system components.

1.21 GUARANTEES

A. An item becomes "defective" when it ceases to conform to this Contract Document. Guarantees beginning on the date of issuance of the Owner's final payment, or certificate of substantial completion, with Owner taking occupancy or beneficial use thereafter.

B. Upon completion of the work and before applying for final payment, furnish a written guarantee, stating that the work complies with the provisions of codes listed herein and the local enforcing authorities, and that it will be free from defects of material and workmanship for the required guarantee period. Guarantee shall further state that the Contractor will, at his own expense, repair and/or replace any of his material and work which may become defective during the time of guarantee, together with other work damaged as a consequence of such defects. All manufacturers written warranties shall apply to materials. Warranties other than that of the manufacturer are not acceptable.

C. The guarantee period shall be one (1) year except when longer periods are indicated for specific equipment.

D. All materials in Division 26 where a written warranty is published shall require the warranty to

be offered by the product manufacturer.

1.22 EXISTING UTILITIES AND EQUIPMENT

A. Extreme care shall be taken to protect existing utilities and equipment above and below grade and in all other locations. Information contained on drawings is not guaranteed as to location, invert, etc. but represent the best information available as to the location of underground and concealed utilities and equipment. The Contractor shall be responsible for the replacement of all damaged or broken utilities or equipment due to their work or operations.

1.23 ENERGIZING EQUIPMENT

A. Obtain Owner’s written approval before energizing any equipment.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01 CONNECTION TO EQUIPMENT

A The Contractor shall be responsible for proper wiring and raceway connections to equipment, make sure of alignment, both initially and under operating conditions, and provide proper supports, brackets, means of expansion, etc., to make sure that no excessive stresses are applied to equipment. Raceways shall be run to the equipment and alignment checked before final bolting and fastening.

B At the request of the Engineer, dismantle equipment connections to demonstrate proper installation and make such corrections necessary without additional compensation for disassembly, re-connection, or the required corrective work.

C Equipment shall be installed in such a manner as to permit disconnecting for service and repairs without the necessity of rigging.

3.02 CLOSING IN UNINSPECTED WORK

A General: Do not cover up or enclose work until it has been properly and completely inspected and approved. Engineer may waive this requirement by written permission.

B Noncompliance: Should any of the work be covered up or enclosed prior to all required inspections and approvals, uncover the work as required, and after it has been completely inspected and approved, make all repairs and replacements with such materials as are necessary to the approval of the Engineer and at no additional cost to the Owner.

3.03 CLEANING OF SYSTEMS

A All wiring systems shall be thoroughly cleaned prior to initial operation and in accordance with manufacturer's instructions for equipment to be furnished and/or installed.

B Furnish all detergents, solvents, cleaning compounds, tools, etc., required in connection with cleaning operations.

C Thoroughly clean all exposed portions of all equipment, remove all labels, and wipe clean with a damp rag.

3.04 TESTING, BALANCING, AND ADJUSTING

A Electrical loads shall be balanced on all phase legs to a tolerance of plus or minus 10 percent. Include testing circuits for shorts to ground. Measure grounding system resistance. Correct all deficiencies. Provide all test equipment.

3.05 INSTRUCTIONS

A On completion of the job, Contractor shall provide competent technicians to thoroughly instruct the Owner's representative in the care and operation of the system. The total period of instruction shall not exceed 2 hours and be performed in a minimum of one interval. The time of instruction shall be arranged with the Owner. The Electrical subcontractor shall be present and participate in the Owner’s instruction.

3.06 FIRESTOPPING

A Firestopping shall be performed in accordance with Specification Section “Firestopping”. All penetrations of fire-rated assemblies including walls and floors by electrical system components (conduits, cables, trays, etc.) shall be firestopped as specified. Coordinate size, location and type of sleeves as required by firestopping systems.

*** END OF SECTION ***

SECTION 260519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Building wires and cables rated 600 V and less.
2. Connectors, splices, and terminations rated 600 V and less.

B. Related Requirements:

1. Section 271500 "Communications Horizontal Cabling" for cabling used for voice and data circuits.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 CONDUCTORS AND CABLES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. General Cable Technologies Corporation.
2. Southwire Incorporated.
3. The Okonite Company.

B. Copper Conductors: Comply with NEMA WC 70/ICEA S-95-658.

C. Conductor Insulation: Comply with NEMA WC 70/ICEA S-95-658 for Type THHN-2-THWN-2.

D. Multiconductor Cable: Comply with NEMA WC 70/ICEA S-95-658 for Metal Clad cable, Type MC or SO cable.

2.2 CONNECTORS AND SPLICES

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. AFC Cable Systems, Inc.
2. Gardner Bender.
3. Hubbell Power Systems, Inc.
4. Ideal Industries, Inc.
5. Ilsco; a branch of Bardes Corporation.
6. NSi Industries LLC.
7. O-Z/Gedney; a brand of the EGS Electrical Group.
8. 3M; Electrical Markets Division.
9. Tyco Electronics.

B. Description: Factory-fabricated connectors and splices of size, ampacity rating, material, type, and class for application and service indicated.

2.3 SYSTEM DESCRIPTION

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

PART 3 - EXECUTION

3.1 CONDUCTOR MATERIAL APPLICATIONS

A. Feeders: Copper. Solid for No. 10 AWG and smaller; stranded for No. 8 AWG and larger.

B. Branch Circuits: Copper. Solid for No. 12 AWG and smaller; stranded for No. 10 AWG and larger.

3.2 CONDUCTOR INSULATION AND MULTICONDUCTOR CABLE APPLICATIONS AND WIRING METHODS

A. Service Entrance: Type THHN-2-THWN-2, single conductors in raceway.

B. Feeders: Type THHN-2-THWN-2, single conductors in raceway.

C. Exposed Branch Circuits, Including in Crawlspaces: Type THHN-2-THWN-2, single conductors in raceway.

D. Branch Circuits Concealed in Ceilings, Walls, and Partitions: Metal Clad Cable, Type MC.

E. Branch Circuits Concealed in Concrete, below Slabs-on-Grade, and Underground: Type THHN-2-THWN-2, single conductors in raceway.

F. Cord Drops and Portable Appliance Connections: Type SO, hard service cord with stainless-steel, wire-mesh, strain relief device at terminations to suit application.

3.3 INSTALLATION OF CONDUCTORS AND CABLES

A. Conceal cables in finished walls, ceilings, and floors unless otherwise indicated.

B. Complete raceway installation between conductor and cable termination points according to Section "Raceways and Boxes for Electrical Systems" prior to pulling conductors and cables.

C. Use manufacturer-approved pulling compound or lubricant where necessary; compound used must not deteriorate conductor or insulation. Do not exceed manufacturer's recommended maximum pulling tensions and sidewall pressure values.

D. Use pulling means, including fish tape, cable, rope, and basket-weave wire/cable grips that will not damage cables or raceway.

E. Install exposed cables parallel and perpendicular to surfaces of exposed structural members, and follow surface contours where possible.

3.4 CONNECTIONS

A. Tighten electrical connectors and terminals according to manufacturer's published torque-tightening values. If manufacturer's torque values are not indicated, use those specified in UL 486A-486B.

B. Make splices, terminations, and taps that are compatible with conductor material.

C. Wiring at Outlets: Install conductor at each outlet, with at least 6 inches of slack.

3.5 IDENTIFICATION

A. Identify and color-code conductors and cables according to Section "Identification for Electrical Systems."

B. Identify each spare conductor at each end with identity number and location of other end of conductor, and identify as spare conductor.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. After installing conductors and cables and before electrical circuitry has been energized, test service entrance and feeder conductors for compliance with requirements.

2. Perform each visual and mechanical inspection and electrical test stated in NETA Acceptance Testing Specification. Certify compliance with test parameters.

B. Test and Inspection Reports: Prepare a written report to record the following:

1. Procedures used.
2. Results that comply with requirements.
3. Results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

C. Cables will be considered defective if they do not pass tests and inspections.

END OF SECTION 260519

SECTION 260526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes: Grounding systems and equipment.

B. Section includes grounding systems and equipment, plus the following special applications:

1. Underground distribution grounding.

1.3 ACTION SUBMITTALS

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

1.4 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with UL 467 for grounding and bonding materials and equipment.

PART 2 - PRODUCTS

2.1 CONDUCTORS

A. Insulated Conductors: Copper or tinned-copper wire or cable insulated for 600 V unless otherwise required by applicable Code or authorities having jurisdiction.

B. Bare Copper Conductors:

1. Solid Conductors: ASTM B 3.
2. Stranded Conductors: ASTM B 8.
3. Tinned Conductors: ASTM B 33.
4. Bonding Cable: 28 kcmil, 14 strands of No. 17 AWG conductor, 1/4 inch (6 mm) in diameter.
5. Bonding Conductor: No. 4 or No. 6 AWG, stranded conductor.

6. Bonding Jumper: Copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.
7. Tinned Bonding Jumper: Tinned-copper tape, braided conductors terminated with copper ferrules; 1-5/8 inches (41 mm) wide and 1/16 inch (1.6 mm) thick.

C. Grounding Bus: Predrilled rectangular bars of annealed copper, 1/4 by 4 inches (6.3 by 100 mm) in cross section, with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart. Stand-off insulators for mounting shall comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

2.2 CONNECTORS

A. Listed and labeled by an NRTL acceptable to authorities having jurisdiction for applications in which used and for specific types, sizes, and combinations of conductors and other items connected.

B. Bolted Connectors for Conductors and Pipes: Copper or copper alloy, pressure type with at least two bolts.

1. Pipe Connectors: Clamp type, sized for pipe.

C. Welded Connectors: Exothermic-welding kits of types recommended by kit manufacturer for materials being joined and installation conditions.

D. Bus-bar Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.

2.3 GROUNDING ELECTRODES

A. Ground Rods: Copper-clad steel; 3/4 inch by 10 feet.

1. Termination: Factory-attached No. 4/0 AWG bare conductor at least 48 inches (1200 mm) long.
2. Backfill Material: Electrode manufacturers recommended material.

PART 3 - EXECUTION

3.1 APPLICATIONS

A. Conductors: Install solid conductor for No. 8 AWG and smaller, and stranded conductors for No. 6 AWG and larger unless otherwise indicated.

B. Underground Grounding Conductors: Install bare tinned-copper conductor, No. 2/0 AWG minimum.

1. Bury at least 24 inches (600 mm) below grade.
2. Duct-Bank Grounding Conductor: Bury 12 inches (300 mm) above duct bank when indicated as part of duct-bank installation.

C. Grounding Bus: Install in electrical and telephone equipment rooms, in rooms housing service equipment, and elsewhere as indicated.

1. Install bus on insulated spacers 2 inches (50 mm) minimum from wall, 6 inches (150 mm) above finished floor unless otherwise indicated.
2. Where indicated on both sides of doorways, route bus up to top of door frame, across top of doorway, and down to specified height above floor; connect to horizontal bus.

D. Conductor Terminations and Connections:

1. Pipe and Equipment Grounding Conductor Terminations: Bolted connectors.
2. Underground Connections: Welded connectors except at test wells and as otherwise indicated.
3. Connections to Ground Rods at Test Wells: Bolted connectors.
4. Connections to Structural Steel: Welded connectors.

3.2 GROUNDING UNDERGROUND DISTRIBUTION SYSTEM COMPONENTS

A. Comply with IEEE C2 grounding requirements.

A. Install insulated equipment grounding conductors with all feeders and branch circuits.

B. Air-Duct Equipment Circuits: Install insulated equipment grounding conductor to duct-mounted electrical devices operating at 120 V and more, including air cleaners, heaters, dampers, humidifiers, and other duct electrical equipment. Bond conductor to each unit and to air duct and connected metallic piping.

C. Water Heater, Heat-Tracing, and Antifrost Heating Cables: Install a separate insulated equipment grounding conductor to each electric water heater and heat-tracing cable. Bond conductor to heater units, piping, connected equipment, and components.

D. Metal Poles Supporting Outdoor Lighting Fixtures: Install grounding electrode and a separate insulated equipment grounding conductor in addition to grounding conductor installed with branch-circuit conductors.

3.4 INSTALLATION

A. Grounding Conductors: Route along shortest and straightest paths possible unless otherwise indicated or required by Code. Avoid obstructing access or placing conductors where they may be subjected to strain, impact, or damage.

B. Ground Rods: Drive rods until tops are 2 inches (50 mm) below finished floor or final grade unless otherwise indicated.

1. Interconnect ground rods with grounding electrode conductor below grade and as otherwise indicated. Make connections without exposing steel or damaging coating if any.

2. For grounding electrode system, install at least three rods spaced at least one-rod length from each other and located at least the same distance from other grounding electrodes, and connect to the service grounding electrode conductor.

C. Bonding Straps and Jumpers: Install in locations accessible for inspection and maintenance except where routed through short lengths of conduit.

1. Bonding to Structure: Bond straps directly to basic structure, taking care not to penetrate any adjacent parts.
2. Bonding to Equipment Mounted on Vibration Isolation Hangers and Supports: Install bonding so vibration is not transmitted to rigidly mounted equipment.
3. Use exothermic-welded connectors for outdoor locations; if a disconnect-type connection is required, use a bolted clamp.

D. Grounding and Bonding for Piping:

1. Metal Water Service Pipe: Install insulated copper grounding conductors, in conduit, from building's main service equipment, or grounding bus, to main metal water service entrances to building. Connect grounding conductors to main metal water service pipes; use a bolted clamp connector or bolt a lug-type connector to a pipe flange by using one of the lug bolts of the flange. Where a dielectric main water fitting is installed, connect grounding conductor on street side of fitting. Bond metal grounding conductor conduit or sleeve to conductor at each end.
2. Water Meter Piping: Use braided-type bonding jumpers to electrically bypass water meters. Connect to pipe with a bolted connector.

E. Bonding Interior Metal Ducts: Bond metal air ducts to equipment grounding conductors of associated fans, blowers, electric heaters, and air cleaners. Install bonding jumper to bond across flexible duct connections to achieve continuity.

3.5 LABELING

A. Comply with requirements in Section 260553 "Identification for Electrical Systems" for instruction signs. The label or its text shall be green.

3.6 FIELD QUALITY CONTROL

A. Perform tests and inspections.

1. Manufacturer's Field Service: Engage a factory-authorized service representative to inspect components, assemblies, and equipment installations, including connections, and to assist in testing.

B. Tests and Inspections:

1. After installing grounding system but before permanent electrical circuits have been energized, test for compliance with requirements.

2. Inspect physical and mechanical condition. Verify tightness of accessible, bolted, electrical connections with a calibrated torque wrench according to manufacturer's written instructions.

C. Grounding system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Report measured ground resistances that exceed the following values:

1. Power and Lighting Equipment or System with Capacity of 500 kVA and less: 10 ohms.

F. Excessive Ground Resistance: If resistance to ground exceeds specified values, notify Architect promptly and include recommendations to reduce ground resistance.

END OF SECTION 260526

SECTION 260533 - RACEWAYS AND BOXES FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Metal conduits, tubing, and fittings.
2. Boxes, enclosures, and cabinets.

1.3 DEFINITIONS

A. GRC: Galvanized rigid steel conduit.

1.4 ACTION SUBMITTALS

A. Product Data: For surface raceways, wireways and fittings, floor boxes, hinged-cover enclosures, and cabinets.

PART 2 - PRODUCTS

2.1 METAL CONDUITS, TUBING, AND FITTINGS

A. Listing and Labeling: Metal conduits, tubing, and fittings shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. GRC: Comply with ANSI C80.1 and UL 6.

C. EMT: Comply with ANSI C80.3 and UL 797.

D. FMC: Comply with UL 1; zinc-coated steel or aluminum.

E. LFMC: Flexible steel conduit with PVC jacket and complying with UL 360.

F. Fittings for Metal Conduit: Comply with NEMA FB 1 and UL 514B.

1. Fittings for EMT:

a. Material: Steel or die cast.
b. Type: Setscrew.

G. Joint Compound for GRC: Approved, as defined in NFPA 70, by authorities having jurisdiction for use in conduit assemblies, and compounded for use to lubricate and protect threaded conduit joints from corrosion and to enhance their conductivity.

2.2 BOXES, ENCLOSURES, AND CABINETS

A. General Requirements for Boxes, Enclosures, and Cabinets: Boxes, enclosures, and cabinets installed in wet locations shall be listed for use in wet locations.

B. Sheet Metal Outlet and Device Boxes: Comply with NEMA OS 1 and UL 514A.

C. Cast-Metal Outlet and Device Boxes: Comply with NEMA FB 1, aluminum, Type FD, with gasketed cover.

D. Metal Floor Boxes:

1. Material: Cast metal.
2. Type: Fully adjustable.
3. Shape: Rectangular.
4. Listing and Labeling: Metal floor boxes shall be listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

E. Luminaire Outlet Boxes: Nonadjustable, designed for attachment of luminaire weighing 50 lb (23 kg). Outlet boxes designed for attachment of luminaires weighing more than 50 lb (23 kg) shall be listed and marked for the maximum allowable weight.

F. Small Sheet Metal Pull and Junction Boxes: NEMA OS 1.

G. Cast-Metal Access, Pull, and Junction Boxes: Comply with NEMA FB 1 and UL 1773, cast aluminum with gasketed cover.

H. Box extensions used to accommodate new building finishes shall be of same material as recessed box.

I. Device Box Dimensions: 4 inches square by 2-1/8 inches deep (100 mm square by 60 mm deep).

J. Gangable boxes are allowed.

K. Hinged-Cover Enclosures: Comply with UL 50 and NEMA 250, Type 3R with continuous-hinge cover with flush latch unless otherwise indicated.

1. Metal Enclosures: Steel, finished inside and out with manufacturer's standard enamel.
2. Interior Panels: Steel; all sides finished with manufacturer's standard enamel.

PART 3 - EXECUTION

3.1 RACEWAY APPLICATION

A. Outdoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed Conduit: GRC.
2. Concealed Conduit, Aboveground: GRC.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC.
4. Boxes and Enclosures, Aboveground: NEMA 250, Type 3R.

B. Indoors: Apply raceway products as specified below unless otherwise indicated:

1. Exposed: EMT.
2. Concealed in Ceilings and Interior Walls and Partitions: EMT.
3. Connection to Vibrating Equipment (Including Transformers and Hydraulic, Pneumatic, Electric Solenoid, or Motor-Driven Equipment): FMC, except use LFMC in damp or wet locations.
4. Damp or Wet Locations: GRC.
5. Boxes and Enclosures: NEMA 250, Type 1, except use NEMA 250, Type 4 stainless steel in damp or wet locations.

C. Minimum Raceway Size: 3/4-inch (21-mm) trade size.

D. Raceway Fittings: Compatible with raceways and suitable for use and location.

1. Rigid Steel Conduit: Use threaded rigid steel conduit fittings unless otherwise indicated. Comply with NEMA FB 2.10.
2. EMT: Use setscrew, steel fittings. Comply with NEMA FB 2.10.
3. Flexible Conduit: Use only fittings listed for use with flexible conduit. Comply with NEMA FB 2.20.

3.2 INSTALLATION

A. Comply with NECA 1 and NECA 101 for installation requirements except where requirements on Drawings or in this article are stricter. Comply with NECA 102 for aluminum conduits. Comply with NFPA 70 limitations for types of raceways allowed in specific occupancies and number of floors.

B. Keep raceways at least 6 inches (150 mm) away from parallel runs of flues and steam or hot-water pipes. Install horizontal raceway runs above water and steam piping.

C. Complete raceway installation before starting conductor installation.

D. Arrange stub-ups so curved portions of bends are not visible above finished slab.

E. Install no more than the equivalent of three 90-degree bends in any conduit run except for control wiring conduits, for which fewer bends are allowed. Support within 12 inches (300 mm) of changes in direction.

F. Conceal conduit and EMT within finished walls, ceilings, and floors unless otherwise indicated. Install conduits parallel or perpendicular to building lines.

G. Support conduit within 12 inches (300 mm) of enclosures to which attached.

H. Stub-ups to Above Recessed Ceilings:

1. Use EMT for raceways.
2. Use a conduit bushing or insulated fitting to terminate stub-ups not terminated in hubs or in an enclosure.

I. Threaded Conduit Joints, Exposed to Wet, Damp, Corrosive, or Outdoor Conditions: Apply listed compound to threads of raceway and fittings before making up joints. Follow compound manufacturer's written instructions.

J. Raceway Terminations at Locations Subject to Moisture or Vibration: Use insulating bushings to protect conductors including conductors smaller than No. 4 AWG.

K. Terminate threaded conduits into threaded hubs or with locknuts on inside and outside of boxes or cabinets. Install bushings on conduits up to 1-1/4-inch (35mm) trade size and insulated throat metal bushings on 1-1/2-inch (41-mm) trade size and larger conduits terminated with locknuts. Install insulated throat metal grounding bushings on service conduits.

L. Install raceways square to the enclosure and terminate at enclosures with locknuts. Install locknuts hand tight plus 1/4 turn more.

M. Do not rely on locknuts to penetrate nonconductive coatings on enclosures. Remove coatings in the locknut area prior to assembling conduit to enclosure to assure a continuous ground path.

N. Cut conduit perpendicular to the length. For conduits 2-inch (53-mm) trade size and larger, use roll cutter or a guide to make cut straight and perpendicular to the length.

O. Install pull wires in empty raceways. Use polypropylene or monofilament plastic line with not less than 200-lb (90-kg) tensile strength. Leave at least 12 inches (300 mm) of slack at each end of pull wire. Cap underground raceways designated as spare above grade alongside raceways in use.

P. Flexible Conduit Connections: Comply with NEMA RV 3. Use a maximum of 72 inches (1830 mm) of flexible conduit for equipment subject to vibration, noise transmission, or movement; and for transformers and motors.

1. Use LFMC in damp or wet locations subject to severe physical damage.

Q. Mount boxes at heights indicated on Drawings. If mounting heights of boxes are not individually indicated, give priority to ADA requirements. Install boxes with height measured to center of box unless otherwise indicated.

R. Horizontally separate boxes mounted on opposite sides of walls so they are not in the same vertical channel.

S. Locate boxes so that cover or plate will not span different building finishes.

T. Support boxes of three gangs or more from more than one side by spanning two framing members or mounting on brackets specifically designed for the purpose.

U. Fasten junction and pull boxes to or support from building structure. Do not support boxes by conduits.

V. Set metal floor boxes level and flush with finished floor surface.

3.3 INSTALLATION OF ELECTRICAL BOXES IN FIRE RATED WALLS

A. Outlet boxes on opposite sides of the wall shall be separated as follows:

1. By a horizontal distance of not less than 24 inches (610 mm);

2. By a horizontal distance of not less than the depth of the wall cavity where the wall cavity is filled with cellulose loose fill, rockwool or slag mineral wool insulation.

3. By protecting both outlet boxes by listed putty pads, 3M Catalog # MPP+ or equal.

B. Boxes exceeding 16 sq. in. (103 sq. cm) must be protected by listed putty pads, 3M Catalog # MPP+ or equal.

END OF SECTION 260533

SECTION 260553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Identification for raceways.
2. Identification of power and control cables.
3. Identification for conductors.
4. Underground-line warning tape.
5. Warning labels and signs.
6. Instruction signs.
7. Equipment identification labels.
8. Miscellaneous identification products.

1.3 ACTION SUBMITTALS

A. Product Data: For each electrical identification product indicated.

1.4 QUALITY ASSURANCE

A. Comply with ANSI A13.1.

B. Comply with NFPA 70.

C. Comply with 29 CFR 1910.144 and 29 CFR 1910.145.

D. Comply with ANSI Z535.4 for safety signs and labels.

E. Adhesive-attached labeling materials, including label stocks, laminating adhesives, and inks used by label printers, shall comply with UL 969.

1.5 COORDINATION

A. Coordinate identification names, abbreviations, colors, and other features with requirements in other Sections requiring identification applications, Drawings, Shop Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual; and with those required by codes, standards, and 29 CFR 1910.145. Use consistent designations throughout Project.

B. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.

C. Coordinate installation of identifying devices with location of access panels and doors.

D. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 POWER AND CONTROL RACEWAY IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each raceway size.

B. Colors for Raceways Carrying Circuits at 600 V or Less:

1. Black letters on an white field.
2. Legend: Indicate voltage.

C. Vinyl Labels for Raceways Carrying Circuits at 600 V or Less: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Snap-Around Labels for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, preprinted, color-coded acrylic sleeve, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

E. Snap-Around, Color-Coding Bands for Raceways Carrying Circuits at 600 V or Less: Slit, pretensioned, flexible, solid-colored acrylic sleeve, 2 inches (50 mm) long, with diameter sized to suit diameter of raceway or cable it identifies and to stay in place by gripping action.

F. Tape and Stencil for Raceways Carrying Circuits More Than 600 V: 4-inch- (100-mm-) wide black stripes on 10-inch (250-mm) centers diagonally over orange background that extends full length of raceway or duct and is 12 inches (300 mm) wide. Stop stripes at legends.

2.2 ARMORED AND METAL-CLAD CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Colors for Cables Carrying Circuits at 600 V and Less:

1. Black letters on an white field.
2. Legend: Indicate voltage.

C. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

D. Self-Adhesive Vinyl Tape: Colored, heavy duty, waterproof, fade resistant; 2 inches (50 mm) wide; compounded for outdoor use.

E. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.3 POWER AND CONTROL CABLE IDENTIFICATION MATERIALS

A. Comply with ANSI A13.1 for minimum size of letters for legend and for minimum length of color field for each cable size.

B. Vinyl Labels: Preprinted, flexible label laminated with a clear, weather- and chemical-resistant coating and matching wraparound clear adhesive tape for securing ends of legend label.

C. Self-Adhesive, Self-Laminating Polyester Labels: Preprinted, 3-mil- (0.08-mm-) thick flexible label with acrylic pressure-sensitive adhesive that provides a clear, weather- and chemical-resistant, self-laminating, protective shield over the legend. Labels sized to fit the cable diameter such that the clear shield overlaps the entire printed legend.

D. Heat-Shrink Preprinted Tubes: Flame-retardant polyolefin tube with machine-printed identification label. Sized to suit diameter of and shrinks to fit firmly around cable it identifies. Full shrink recovery at a maximum of 200 deg F (93 deg C). Comply with UL 224.

2.4 UNDERGROUND-LINE WARNING TAPE

A. Tape:

1. Recommended by manufacturer for the method of installation and suitable to identify and locate underground electrical and communications utility lines.
2. Printing on tape shall be permanent and shall not be damaged by burial operations.
3. Tape material and ink shall be chemically inert, and not subject to degrading when exposed to acids, alkalis, and other destructive substances commonly found in soils.

B. Color and Printing:

1. Comply with ANSI Z535.1 through ANSI Z535.5.
2. Inscriptions for Red-Colored Tapes: ELECTRIC LINE.
3. Inscriptions for Orange-Colored Tapes: TELEPHONE CABLE, CATV CABLE, COMMUNICATIONS CABLE.

2.5 WARNING LABELS AND SIGNS

A. Comply with NFPA 70 and 29 CFR 1910.145.

B. Self-Adhesive Warning Labels: Factory-printed, multicolor, pressure-sensitive adhesive labels, configured for display on front cover, door, or other access to equipment unless otherwise indicated.

C. Baked-Enamel Warning Signs:

1. Preprinted aluminum signs, punched or drilled for fasteners, with colors, legend, and size required for application.
2. 1/4-inch (6.4-mm) grommets in corners for mounting.
3. Nominal size, 7 by 10 inches (180 by 250 mm).

D. Warning label and sign shall include, but are not limited to, the following legends:

1. Multiple Power Source Warning: "DANGER - ELECTRICAL SHOCK HAZARD - EQUIPMENT HAS MULTIPLE POWER SOURCES."
2. Workspace Clearance Warning: "WARNING - OSHA REGULATION - AREA IN FRONT OF ELECTRICAL EQUIPMENT MUST BE KEPT CLEAR FOR 36 INCHES (915 MM)."

2.6 INSTRUCTION SIGNS

A. Engraved, laminated acrylic or melamine plastic, minimum 1/16 inch (1.6 mm) thick for signs up to 20 sq. inches (129 sq. cm) and 1/8 inch (3.2 mm) thick for larger sizes.

1. Engraved legend with black letters on white face.
2. Punched or drilled for mechanical fasteners.
3. Framed with mitered acrylic molding and arranged for attachment at applicable equipment.

B. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

2.7 EQUIPMENT IDENTIFICATION LABELS

A. Adhesive Film Label: Machine printed, in black, by thermal transfer or equivalent process. Minimum letter height shall be 3/8 inch (10 mm).

B. Self-Adhesive, Engraved, Laminated Acrylic or Melamine Label: Adhesive backed, with white letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

C. Engraved, Laminated Acrylic or Melamine Label: Punched or drilled for screw mounting. White letters on a dark-gray background. Minimum letter height shall be 3/8 inch (10 mm).

2.8 MISCELLANEOUS IDENTIFICATION PRODUCTS

A. Paint: Comply with requirements in painting Sections for paint materials and application requirements. Select paint system applicable for surface material and location (exterior or interior).

B. Fasteners for Labels and Signs: Self-tapping, stainless-steel screws or stainless-steel machine screws with nuts and flat and lock washers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Verify identity of each item before installing identification products.

B. Location: Install identification materials and devices at locations for most convenient viewing without interference with operation and maintenance of equipment.

C. Apply identification devices to surfaces that require finish after completing finish work.

D. Self-Adhesive Identification Products: Clean surfaces before application, using materials and methods recommended by manufacturer of identification device.

E. Underground-Line Warning Tape: During backfilling of trenches install continuous underground-line warning tape directly above line at 6 to 8 inches (150 to 200 mm) below finished grade. Use multiple tapes where width of multiple lines installed in a common trench exceeds 16 inches (400 mm) overall.

3.2 IDENTIFICATION SCHEDULE

A. Accessible Raceways and Metal-Clad Cables, 600 V or Less, for Service, Feeder, and Branch Circuits More Than 30 A, and 120 V to ground: Identify with self-adhesive vinyl label. Install labels at 30-foot (10-m) maximum intervals.

B. Power-Circuit Conductor Identification, 600 V or Less: For conductors in vaults, pull and junction boxes, manholes, and handholes, use color-coding conductor tape to identify the phase.

1. Color-Coding for Phase Identification, 600 V or Less: Use colors listed below for ungrounded feeder and service conductors.

a. Color shall be factory applied or field applied for sizes larger than No. 8 AWG, if authorities having jurisdiction permit.
b. Colors for 208/120-V Circuits:

1) Phase A: Black.
2) Phase B: Red.
3) Phase C: Blue.

c. Colors for 480/277-V Circuits:

1) Phase A: Brown.
2) Phase B: Orange.
3) Phase C: Yellow.

C. Install instructional sign including the color-code for grounded and ungrounded conductors using adhesive-film-type labels.

D. Control-Circuit Conductor Identification: For conductors and cables in pull and junction boxes, and handholes, use self-adhesive vinyl labels with the conductor or cable designation, origin, and destination.

E. Control-Circuit Conductor Termination Identification: For identification at terminations provide self-adhesive vinyl labels with the conductor designation.

F. Auxiliary Electrical Systems Conductor Identification: Identify field-installed alarm, control, and signal connections.

1. Identify conductors, cables, and terminals in enclosures and at junctions, terminals, and pull points. Identify by system and circuit designation.
2. Use system of marker tape designations that is uniform and consistent with system used by manufacturer for factory-installed connections.
3. Coordinate identification with Project Drawings, manufacturer's wiring diagrams, and the Operation and Maintenance Manual.

G. Locations of Underground Lines: Identify with underground-line warning tape for power, lighting, communication, and control wiring.

1. Install underground-line warning tape for both direct-buried cables and cables in raceway.

H. Warning Labels for Indoor Cabinets, Boxes, and Enclosures for Power and Lighting: Self-adhesive warning labels.

1. Comply with 29 CFR 1910.145.
2. Identify system voltage with black letters on an orange background.
3. Apply to exterior of door, cover, or other access.
4. For equipment with multiple power or control sources, apply to door or cover of equipment including, but not limited to, the following:

    a. Power transfer switches.
    b. Controls with external control power connections.

I. Operating Instruction Signs: Install instruction signs to facilitate proper operation and maintenance of electrical systems and items to which they connect. Install instruction signs with approved legend where instructions are needed for system or equipment operation.

J. Equipment Identification Labels: On each unit of equipment, install unique designation label that is consistent with wiring diagrams, schedules, and the Operation and Maintenance Manual. Apply labels to disconnect switches and protection equipment, central or master units, control panels, control stations, terminal cabinets, and racks of each system. Systems include power, lighting, control, communication, signal, monitoring, and alarm systems unless equipment is provided with its own identification.

1. Labeling Instructions:

    a. Indoor Equipment: Self-adhesive, engraved, laminated acrylic or melamine label. Unless otherwise indicated, provide a single line of text with 1/2-inch- (13-mm-)

high letters on 1-1/2-inch- (38-mm-) high label; where two lines of text are required, use labels 2 inches (50 mm) high.

b. Outdoor Equipment: Engraved, laminated acrylic or melamine label.
c. Elevated Components: Increase sizes of labels and letters to those appropriate for viewing from the floor.
d. Unless provided with self-adhesive means of attachment, fasten labels with appropriate mechanical fasteners that do not change the NEMA or NRTL rating of the enclosure.

2. Equipment to Be Labeled:

a. Panelboards: Typewritten directory of circuits in the location provided by panelboard manufacturer. Panelboard identification shall be self-adhesive, engraved, laminated acrylic or melamine label.
b. Enclosures and electrical cabinets.
c. Access doors and panels for concealed electrical items.
d. Enclosed switches.
e. Enclosed circuit breakers.
f. Enclosed controllers.
g. Variable-speed controllers.
h. Push-button stations.
i. Contactors.
j. Remote-controlled switches, dimmer modules, and control devices.

END OF SECTION 260553

SECTION 260924
LIGHTING CONTROL DEVICES

PART 1 – GENERAL

1.1 SUMMARY

A. Section Includes:
   1. Wall box mounted, wall/corner mounted, and ceiling mounted occupancy sensors including dual technology, ultrasonic, and passive infrared technologies. This includes self contained PIR sensors as well as low voltage sensors that work with Switchpacks.

B. Related Sections:
   1. Section 265100 – Interior Lighting.

1.2 REFERENCES

A. American National Standards Institute/Institute of Electrical and Electronic Engineers (ANSI/IEEE)
   1. C62.41-1991 – Recommended Practice for Surge Voltages in Low Voltage AC Power Circuits.

B. ASTM International (ASTM)
   1. D4674 -02a Standard Test Method for Accelerated Testing for Color Stability of Plastics Exposed to Indoor Fluorescent Lighting and Window-Filtered Daylight.

C. National Electrical Manufacturers Association (NEMA)
   1. WD1 (R2005) - General Color Requirements for Wiring Devices.

D. Underwriters Laboratories, Inc. (UL):
   1. 94 – Flammability Rating
   2. 916 – Energy Management Equipment.
   3. 508 (2005) - Standard for Industrial Control Equipment.
   4. 244A – Appliance Controls

1.3 SYSTEM DESCRIPTION

A. Permanently installed
   1. Wall switch occupancy sensors
   2. Ceiling mounted occupancy sensors

1.4 SUBMITTALS

A. Submit under provisions of Section 013300.

B. Specification Conformance Document: Indicate whether the submitted equipment:
   1. Meets specification exactly as stated.
   2. Meets specification via an alternate means and indicate the specific methodology used.

C. Shop Drawings; include:
   1. Load schedule indicating actual connected load, load type, and voltage per circuit, circuits and their respective control zones, circuits that are on emergency, and capacity, phase, and corresponding circuit numbers.
   2. Schematic of system.
   3. Lighting plan clearly marking product type, location and orientation of each sensor.

D. Product Data: Catalog specification sheets with performance specifications demonstrating

compliance with specified requirements.

1.5 QUALITY ASSURANCE

A. Manufacturer: Minimum 20 years' experience in manufacture of occupancy sensor lighting controls.
B. Manufacturer's Quality System: Registered to ISO 9001:2000 Quality Standards, including in-house engineering for product design activities.
C. Occupancy Sensing Lighting Controls:
   1. Listed by UL specifically for the required loads. Provide evidence of compliance upon request.
D. Installer Qualifications: Installer shall be one who is experienced in performing the work of this section, and who has specialized in installation of work similar to that required for this project.
E. Source Limitations: To assure compatibility, obtain occupancy sensors from a single source with complete responsibility over all lighting controls, including accessory products. The use of subcontracted component assemblers is not acceptable.

1.6 PROJECT CONDITIONS

A. Do not install equipment until following conditions can be maintained in spaces to receive equipment:
   1. Ambient temperature: 0° to 40° C (32° to 104° F).
   2. Relative humidity: Maximum 90 percent, non-condensing.
   3. Occupancy Sensors must be protected from dust during installation.

1.7 WARRANTY

A. Provide manufacturer's 5-year parts warranty.

1.8 MAINTENANCE

A. Make ordering of new equipment for expansions, replacements, and spare parts available to end user.
B. Make new replacement parts available for minimum of ten years from date of manufacture.
C. Provide factory direct technical support.

PART 2- PRODUCTS

2.1 MANUFACTURERS

A. Acceptable Manufacturer: Eaton Lighting Systems (formerly Cooper Controls)
B. Substitutions: Allowed under provisions of Division 1.

2.2 SENSOR PERFORMANCE REQUIREMENTS

A. Sensing mechanism:
   1. Infrared: Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.
   2. Dual technology:
      a. Utilize multiple segmented lens, with internal grooves to eliminate dust and residue build-up.

b. Utilize an operating frequency of 32 kHz or 40 kHz that shall be crystal controlled to operate within plus or minus 0.005% tolerance.
c. Incorporate Doppler shift ultrasonic and passive infrared motion detection technologies. Products that react to noise or ambient sound shall not be considered.

B. Power failure memory:
1. Controls incorporate non-volatile memory. Should power be interrupted and subsequently restored, settings and parameters saved in protected memory shall not be lost.

C. Designed and tested to withstand discharges without impairment of performance when subjected to discharges of 15,000 volts per IEC 801-2.

D. Products tested in identical manner, complaint to NEMA WD 7 -2011 Occupancy Motion Sensors Standards.

E. Sensor shall have time delays from 10 to 30 min.

F. When specified, sensors shall automatically adjust time delay and sensitivity settings.

G. All sensors shall provide an LED as a visual means of indication at all times to verify that motion is being detected during both testing and normal operation.

H. All sensors shall have readily accessible, user adjustable settings for time delay and sensitivity. Settings shall be located on the sensor (not the control unit) and shall be recessed to limit tampering.

I. Where specified, sensor shall have an internal additional isolated relay with Normally Open, Normally Closed, and Common outputs for use with HVAC control, Data Logging and other control options. Sensors utilizing separate components or specially modified units to achieve this function are not acceptable.

2.3 LINE VOLTAGE CEILING MOUNTED OCCUPANCY SENSORS

A. Product: OAC-DT-2000-MV, OAC-DT-2000-DMV

B. Provide all necessary mounting hardware and instructions.

C. Capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet

D. Shall accommodate loads from 0-800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have 180 degree coverage capability.

E. Shall be able to have their visible plastic parts replaced, for color changes in the field, without removing the body of the control from the wall and without requiring special tools.

F. Shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor’s longevity.

G. Shall have no leakage current to load, in manual or in Auto/Off Mode for safety purposes and shall have voltage drop protection.

H. Where specified, dual relay sensors shall offer daylighting foot-candle adjustment control for either or both relays.

2.4 OCCUPANCY WALL SWITCHES

A. Product: OSW-P-0451-MV-*, ONW-P-1001-MV-*, ONW-P-1001-347-*, ONW-P-1001-DMV-*, ONW-P-1001-D347-*, ONW-P-1001-SP-*, ONW-P-1001-RR7-*

B. Capable of detection of occupancy at desktop level up to 300 square feet, and gross motion up to 1000 square feet

C. Shall accommodate loads from 0-800 watts at 120 volts; 0 to 1200 watts at 277 volts and shall have

180 degree coverage capability.

D. Shall be able to have their visible plastic parts replaced, for color changes in the field, without removing the body of the control from the wall and without requiring special tools.

E. Shall utilize Zero Crossing Circuitry which increases relay life, protects from the effects of inrush current, and increases sensor's longevity.

F. Shall have no leakage current to load, in manual or in Auto/Off Mode for safety purposes and shall have voltage drop protection.

G. Where specified, wall switch sensors shall provide a field selectable option to convert sensor operation from Automatic On to Manual On.

H. Where specified, dual relay sensors shall offer daylighting footcandle adjustment control for either or both relays.

2.5 0-10V DIMMER SENSOR

A. Product: OSW-P-010-*

2.6 SOURCE QUALITY CONTROL

A. Perform full-function testing on 100% of all system components and panel assemblies at the factory.

PART 3- EXECUTION

3.1 INSTALLATION

A. Install equipment in accordance with manufacturer's installation instructions.

B. Provide complete installation of system in accordance with Contract Documents.

C. Provide equipment at locations and in quantities indicated on Drawings. Provide any additional equipment required to provide control intent.

3.2 TESTING

A. Upon completion of all wiring and after all fixtures are installed and lamped, a representative shall check the installation prior to energizing the system. Each installed occupancy sensor shall be tested in the Test Mode to see that lights turn OFF and on based on occupancy.

B. At the time testing, the owner's representative shall be thoroughly instructed in the proper operation of the system.

END OF SECTION

SECTION 261900
SUPPORTING DEVICES

PART 1 GENERAL

1.01 WORK INCLUDED

A. Conduit and equipment supports.

B. Fastening hardware.

1.02 RELATED WORK

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

PART 2 PRODUCTS

2.01 MATERIAL

A. Support Channel: Galvanized or painted steel.

B. Hardware: Corrosion resistant.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install products in accordance with manufacturer’s instructions.

B. Fasten hanger rods, conduit clamps, and outlet and junction boxes to building structure using pre-cast insert system, expansion anchors, beam clamps.

C. Anchors and Fasteners

1) Concrete Structural Elements: Use pre-cast insert system, expansion anchors, powder actuated anchors and preset inserts.
2) Steel Structural Elements: Use beam clamps, steel ramset fasteners, and welded fasteners.
3) Concrete Surfaces: Use self-drilling anchors and expansion anchors.
4) Hollow Masonry, Plaster, and Gypsum Board Partitions: Use toggle bolts and hollow wall fasteners.
5) Solid Masonry Walls: Use expansion anchors and preset inserts.
6) Sheet Metal: Use sheet metal screws.
7) Wood Elements: Use wood screws.

D. Do not fasten supports to piping, ductwork, mechanical equipment, or conduit.

E. Do not use power-actuated anchors.

F. Do not drill structural steel members.

G. Fabricate supports or trapeze hangers 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.

H. In wet locations install free-standing electrical equipment on concrete pads.

I. Install surface-mounted cabinets and panelboards with minimum of four anchors. Provide steel channel supports to stand cabinet one inch off wall.

*** END OF SECTION ***

SECTION 262726 - WIRING DEVICES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Receptacles, receptacles with integral GFCI, and associated device plates.
2. Weather-resistant receptacles.
3. Snap switches and wall-box dimmers.
4. Cord and plug sets.

1.3 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Receptacles for Owner-Furnished Equipment: Match plug configurations.
2. Cord and Plug Sets: Match equipment requirements.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:

1. Cooper Wiring Devices; Division of Cooper Industries, Inc. (Cooper).
2. Hubbell Incorporated; Wiring Device-Kellems (Hubbell).
3. Leviton Mfg. Company Inc. (Leviton).
4. Pass & Seymour/Legrand (Pass & Seymour).

B. Source Limitations: Obtain each type of wiring device and associated wall plate from single source from single manufacturer.

2.2 GENERAL WIRING-DEVICE REQUIREMENTS

A. Wiring Devices, Components, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

C. Devices that are manufactured for use with modular plug-in connectors may be substituted under the following conditions:

1. Connectors shall comply with UL 2459 and shall be made with stranding building wire.
2. Devices shall comply with the requirements in this Section.

2.3 STRAIGHT-BLADE RECEPTACLES

A. Convenience Receptacles, 125 V, 20 A: Comply with NEMA WD 1, NEMA WD 6 Configuration 5-20R, UL 498, and FS W-C-596.

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

2.4 GFCI RECEPTACLES

A. General Description:

1. Straight blade, non-feed-through type.
2. Comply with NEMA WD 1, NEMA WD 6, UL 498, UL 943 Class A, and FS W-C-596.
3. Include indicator light that shows when the GFCI has malfunctioned and no longer provides proper GFCI protection.

B. Duplex GFCI Convenience Receptacles, 125 V, 20 A:

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

2.5 CORD AND PLUG SETS

A. Description:

1. Match voltage and current ratings and number of conductors to requirements of equipment being connected.
2. Cord: Rubber-insulated, stranded-copper conductors, with Type SOW-A jacket; with green-insulated grounding conductor and ampacity of at least 130 percent of the equipment rating.
3. Plug: Nylon body and integral cable-clamping jaws. Match cord and receptacle type for connection.

2.6 TOGGLE SWITCHES

A. Comply with NEMA WD 1, UL 20, and FS W-S-896.

B. Switches, 120/277 V, 20 A:

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

2.7 WALL-BOX DIMMERS

A. Control: Continuously adjustable slider; with single-pole or three-way switching. Comply with UL 1472.

2.8 WALL PLATES

A. Single and combination types shall match corresponding wiring devices.
1. Plate-Securing Screws: Metal with head color to match plate finish.
2. Material for Finished Spaces: Smooth, high-impact thermoplastic.
3. Material for Unfinished Spaces: Galvanized steel.
4. Material for Damp Locations: Cast aluminum with spring-loaded lift cover, and listed and labeled for use in wet and damp locations.

B. Wet-Location, Weatherproof Cover Plates: NEMA 250, complying with Type 3R, weather-resistant**,** die-cast aluminum with lockable cover.

2.9 FLOOR SERVICE FITTINGS

A. Type: Modular, flush-type, dual-service units suitable for wiring method used.

B. Compartments: Barrier separates power from voice and data communication cabling.

C. Service Plate: Round, die-cast aluminum with satin finish.

D. Power Receptacle: NEMA WD 6 Configuration 5-20R, gray finish, unless otherwise indicated.

E. Voice and Data Communication Outlet: Two modular, keyed, color-coded, RJ-45 jacks for UTP cable complying with requirements in Section 271500 "Communications Horizontal Cabling."

2.10 FINISHES

A. Device Color:

1. Wiring Devices Connected to Normal Power System: As selected by Architect unless otherwise indicated or required by NFPA 70 or device listing.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1, including mounting heights listed in that standard, unless otherwise indicated.

B. Coordination with Other Trades:

1. Protect installed devices and their boxes. Do not place wall finish materials over device boxes and do not cut holes for boxes with routers that are guided by riding against outside of boxes.
2. Keep outlet boxes free of plaster, drywall joint compound, mortar, cement, concrete, dust, paint, and other material that may contaminate the raceway system, conductors, and cables.
3. Install device boxes in brick or block walls so that the cover plate does not cross a joint unless the joint is troweled flush with the face of the wall.
4. Install wiring devices after all wall preparation, including painting, is complete.

C. Conductors:

1. Do not strip insulation from conductors until right before they are spliced or terminated on devices.
2. Strip insulation evenly around the conductor using tools designed for the purpose. Avoid scoring or nicking of solid wire or cutting strands from stranded wire.
3. The length of free conductors at outlets for devices shall meet provisions of NFPA 70, Article 300, without pigtails.

D. Device Installation:

1. Replace devices that have been in temporary use during construction and that were installed before building finishing operations were complete.
2. Keep each wiring device in its package or otherwise protected until it is time to connect conductors.
3. Do not remove surface protection, such as plastic film and smudge covers, until the last possible moment.
4. Connect devices to branch circuits using pigtails that are not less than 6 inches (152 mm) in length.
5. When there is a choice, use side wiring with binding-head screw terminals. Wrap solid conductor tightly clockwise, two-thirds to three-fourths of the way around terminal screw.
6. Use a torque screwdriver when a torque is recommended or required by manufacturer.
7. When conductors larger than No. 12 AWG are installed on 15- or 20-A circuits, splice No. 12 AWG pigtails for device connections.
8. Tighten unused terminal screws on the device.
9. When mounting into metal boxes, remove the fiber or plastic washers used to hold device-mounting screws in yokes, allowing metal-to-metal contact.

E. Receptacle Orientation:

1. Install ground pin of vertically mounted receptacles down, and on horizontally mounted receptacles to the right.

F. Device Plates: Do not use oversized or extra-deep plates. Repair wall finishes and remount outlet boxes when standard device plates do not fit flush or do not cover rough wall opening.

G. Dimmers:

1. Install dimmers within terms of their listing.
2. Install unshared neutral conductors on line and load side of dimmers according to manufacturers' device listing conditions in the written instructions.

H. Arrangement of Devices: Unless otherwise indicated, mount flush, with long dimension vertical and with grounding terminal of receptacles on top. Group adjacent switches under single, multigang wall plates.

I. Adjust locations of floor service outlets and service poles to suit arrangement of partitions and furnishings.

3.2 GFCI RECEPTACLES

A. Install non-feed-through-type GFCI receptacles where protection of downstream receptacles is not required.

3.3 IDENTIFICATION

A. Comply with Section 260553 "Identification for Electrical Systems."

B. Identify each receptacle with panelboard identification and circuit number. Use hot, stamped, or engraved machine printing with black-filled lettering on face of plate, and durable wire markers or tags inside outlet boxes.

3.4 FIELD QUALITY CONTROL

A. Test straight-blade for the retention force of the grounding blade according to NFPA 99. Retention force shall be not less than 4 oz. (115 g).

B. Wiring device will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 262726

SECTION 264700

PANELBOARDS

PART 1 GENERAL

1.01 WORK INCLUDED

A. Branch Circuit panelboards.

1.02 RELATED WORK

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

1.03 REFERENCES

A. NECA (National Electrical Contractors Assoc.) “Standard of Installation”.

B. FS W-C-375 - Circuit Breakers, Molded Case, Branch Circuit and Service.

C. NEMA AB 1 - Molded Case Circuit Breakers.

D. NEMA PB 1 - Panelboards.

E. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

F. NEMA PB 1.2 - Application Guide for Ground-Fault Protective Devices for Equipment.

G. NFPA 70 - National Electrical Code.

1.04 SUBMITTALS

A. Submit shop drawings for equipment and component devices.

B. Include outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

1.05 SPARE PARTS

A. Keys: Furnish 4 each to Owner.

PART 2 PRODUCTS

2.01 PANELBOARDS

Branch Circuit Panelboards

1. Lighting and Appliance Branch Circuit Panelboards: NEMA PB 1; circuit breaker type. FS W-P-115; Type I, Class 1.
2. Enclosure: NEMA PB 1; Type 1.
3. Cabinet Size: 6 inches deep; 20 inches wide for 240 volt and less panelboards.
4. Provide surface cabinet front with concealed trip clamps, concealed hinge and flush lock all keyed alike. Finish in manufacturer's standard gray enamel.
5. Provide panelboards with aluminum bus, ratings as scheduled on Drawings. Provide copper ground bus in all panelboards.
6. Minimum Integrated Short Circuit Rating: as shown on Drawings.
7. Molded Case Circuit Breakers: NEMA AB 1 FS W-C- 375; bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles. Provide circuit breakers UL listed as Type SWD for lighting circuits. Provide UL Class A ground fault interrupter circuit breakers where scheduled on Drawings.
8. Current Limiting Molded Case Circuit Breakers: NEMA AB 1 FS W-C-375; provide circuit breakers with integral thermal and instantaneous magnetic trip in each pole, coordinated with automatically resetting current limiting elements in each pole. Interrupting rating 100,000 symmetrical amperes, let-through current and energy level less than permitted for same size Class RK-5 fuse.
9. Provide circuit breaker accessory trip units and auxiliary contacts as indicated.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install panelboards plumb and flush with wall finishes, in conformance with NEMA PB 1.1.

B. Height: 6 feet to top of panelboard maximum.

C. Provide filler plates for unused spaces in panelboards.

D. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads. Label Panels per Section 261950.

E. Provide 6 – 1" EMT conduits from recessed panelboards to accessible point above the ceiling wherever possible.

3.02 FIELD QUALITY CONTROL

A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

B. Visual and Mechanical Inspection: Inspect for physical damage, proper alignment, anchorage, and grounding. Check proper installation and tightness of connections for circuit breakers, fusible switches, and fuses.

*** END OF SECTION ***

SECTION 265100

INTERIOR LIGHTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Interior lighting fixtures, LEDs and drivers.
2. Emergency lighting units.
3. Exit signs.
4. Lighting fixture supports.

1.3 DEFINITIONS

A. CCT: Correlated color temperature.

B. CRI: Color-rendering index.

C. LER: Luminaire efficacy rating.

D. Lumen: Measured output of lamp and luminaire, or both.

E. Luminaire: Complete lighting fixture, including ballast housing if provided.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of lighting fixture, arranged in order of fixture designation. Include data on features, accessories, finishes, and the following:

1. Physical description of lighting fixture including dimensions.
2. Emergency lighting units including battery and charger.
3. Energy-efficiency data.
4. Life, output (lumens, CCT, and CRI), and energy-efficiency data for lamps.
5. Lamp data including dimensions, color temperature and power consumption
6. Photometric data and adjustment factors based on laboratory tests, complying with IESNA Lighting Measurements Testing & Calculation Guides, of each lighting fixture type. The adjustment factors shall be for lamps, ballasts, and accessories identical to those indicated for the lighting fixture as applied in this Project.

a. Testing Agency Certified Data: For indicated fixtures, photometric data shall be certified by a qualified independent testing agency. Photometric data for remaining fixtures shall be certified by manufacturer.
b. Manufacturer Certified Data: Photometric data shall be certified by a manufacturer's laboratory with a current accreditation under the National Voluntary Laboratory Accreditation Program for Energy Efficient Lighting Products.

B. Installation instructions.

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For lighting equipment and fixtures to include in emergency, operation, and maintenance manuals.

1. Provide a list of all lamp types used on Project; use ANSI and manufacturers' codes.

1.6 MAINTENANCE MATERIAL SUBMITTALS

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

1. Lamps: 10 of each type and rating installed. Furnish at least one of each type.
2. Plastic Diffusers and Lenses: One of each type and rating installed. Furnish at least one of each type.
3. Ballasts: 2 of each type and rating installed. Furnish at least one of each type.
4. Globes and Guards: 1 of each type and rating installed. Furnish at least one of each type.

1.7 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

B. Comply with NFPA 70.

1.8 COORDINATION

A. Coordinate layout and installation of lighting fixtures and suspension system with other construction that penetrates ceilings or is supported by them, including HVAC equipment, fire-suppression system, and partition assemblies.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

A. Products: Subject to compliance with requirements, available products that may be incorporated into the Work include, but are not limited to, product(s) indicated on Drawings.

2.2 GENERAL REQUIREMENTS FOR LIGHTING FIXTURES AND COMPONENTS

A. Recessed Fixtures: Comply with NEMA LE 4 for ceiling compatibility for recessed fixtures.

B. Metal Parts: Free of burrs and sharp corners and edges.

C. Sheet Metal Components: Steel unless otherwise indicated. Form and support to prevent warping and sagging.

D. Doors, Frames, and Other Internal Access: Smooth operating, free of light leakage under operating conditions, and designed to permit relamping without use of tools. Designed to prevent doors, frames, lenses, diffusers, and other components from falling accidentally during relamping and when secured in operating position.

E. Diffusers and Globes:

1. Acrylic Lighting Diffusers: 100 percent virgin acrylic plastic. High resistance to yellowing and other changes due to aging, exposure to heat, and UV radiation.

    a. Lens Thickness: At least 0.125 inch (3.175 mm) minimum unless otherwise indicated.
    b. UV stabilized.

2. Glass: Annealed crystal glass unless otherwise indicated.

2.3 LEDs:

1. The light source of the luminaires shall consist of LED arrays or bars. If required, the LED arrays or bars shall be removable.
2. The LEDs shall be either white or RGB, according to the light fixture schedule and Drawings. For luminaires specified with white light, it is not acceptable to provide RGB LEDs mixed to produce white light.
3. Refer to the light fixture schedule and Drawings for the specified correlated color temperature (CCT) of each luminaire.
4. Individual LEDs shall be binned by manufacturer to comply with ANSI C78.377.
5. The LEDs shall be manufactured by Cree, Philips, Toshiba, Osram, Samsung, or Nichia, unless otherwise noted.

2.4 DRIVERS:

1. The driver or power supply for the luminaire shall be modular and replaceable.
2. The rated life of the driver shall match the rated life of the LEDs and luminaire.
3. In general, the drive current rating of the driver shall be minimized, while still maintaining the required lumen output, to improve luminaire efficiency and life.
4. The driver shall meet the emission standards of IEC EN-61000-6-3 at a minimum. For healthcare or other applications with EMI sensitive equipment, provide drivers that meet more stringent standards as required.

2.5 EXIT SIGNS

A. General Requirements for Exit Signs: Comply with UL 924; for sign colors, visibility, luminance, and lettering size, comply with authorities having jurisdiction.

B. Internally Lighted Signs:

1. Lamps for AC Operation: LEDs, 50,000 hours minimum rated lamp life.
2. Self-Powered Exit Signs (Battery Type): Integral automatic charger in a self-contained power pack.

    a. Battery: Sealed, maintenance-free, nickel-cadmium type.
    b. Charger: Fully automatic, solid-state type with sealed transfer relay.
    c. Operation: Relay automatically energizes lamp from battery when circuit voltage drops to 80 percent of nominal voltage or below. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
    d. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
    e. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

2.6 EMERGENCY LIGHTING UNITS

A. General Requirements for Emergency Lighting Units: Self-contained units complying with UL 924.

1. Battery: Sealed, maintenance-free, lead-acid type.
2. Charger: Fully automatic, solid-state type with sealed transfer relay.
3. Operation: Relay automatically turns lamp on when power-supply circuit voltage drops to 80 percent of nominal voltage or below. Lamp automatically disconnects from battery when voltage approaches deep-discharge level. When normal voltage is restored, relay disconnects lamps from battery, and battery is automatically recharged and floated on charger.
4. Test Push Button: Push-to-test type, in unit housing, simulates loss of normal power and demonstrates unit operability.
5. LED Indicator Light: Indicates normal power on. Normal glow indicates trickle charge; bright glow indicates charging at end of discharge cycle.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Lighting fixtures:

1. Set level, plumb, and square with ceilings and walls unless otherwise indicated.
2. Install lamps in each luminaire.

B. Temporary Lighting: If it is necessary, and approved by Architect, to use permanent luminaires for temporary lighting, install and energize the minimum number of luminaires necessary. When construction is sufficiently complete, remove the temporary luminaires, disassemble, clean thoroughly, install new lamps, and reinstall.

C. Suspended Lighting Fixture Support:

1. Pendants and Rods: Where longer than 48 inches (1200 mm), brace to limit swinging.
2. Stem-Mounted, Single-Unit Fixtures: Suspend with twin-stem hangers.
3. Continuous Rows: Use tubing or stem for wiring at one point and tubing or rod for suspension for each unit length of fixture chassis, including one at each end.
4. Do not use grid as support for pendant luminaires. Connect support wires or rods to building structure.

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.2 IDENTIFICATION

A. Install labels with panel and circuit numbers on concealed junction and outlet boxes. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.3 FIELD QUALITY CONTROL

A. Test for Emergency Lighting: Interrupt power supply to demonstrate proper operation. Verify transfer from normal power to battery and retransfer to normal.

3.4 STARTUP SERVICE

A. Burn-in all lamps that require specific aging period to operate properly, prior to occupancy by Owner. Burn-in fluorescent and compact fluorescent lamps intended to be dimmed, for at least 100 hours at full voltage.

3.5 ADJUSTING

A. Occupancy Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting aimable luminaires to suit actual occupied conditions. Provide up to two visits to Project during other-than-normal occupancy hours for this purpose. Some of this work may be required after dark.

1. Adjust aimable luminaires in the presence of Architect.

END OF SECTION 265100

SECTION 271100

COMMUNICATIONS EQUIPMENT ROOM FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. Telecommunications mounting elements.
2. Telecommunications equipment racks.
3. Grounding.

B. Related Requirements:

1. Section 271500 "Communications Horizontal Cabling" for voice and data cabling associated with system panels and devices.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. LAN: Local area network.

C. RCDD: Registered Communications Distribution Designer.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for equipment racks.
2. Include rated capacities, operating characteristics, electrical characteristics, and furnished specialties and accessories.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer, qualified layout technician, installation supervisor, and field inspector.

PART 2 - PRODUCTS

2.1 EQUIPMENT FRAMES

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

1. Belden Inc.
2. Cooper B-Line.
3. Emerson Network Power Connectivity Solutions.
4. Hubbell Premise Wiring.
5. Leviton Commercial Networks Division.
6. Middle Atlantic Products, Inc.
7. Ortronics, Inc.
8. Panduit Corp.
9. Siemon Co. (The).
10. Tyco Electronics Corporation; AMP Products.

B. General Frame Requirements:

1. Distribution Frames: Freestanding and wall-mounting, modular-steel units designed for telecommunications terminal support and coordinated with dimensions of units to be supported.
2. Module Dimension: Width compatible with EIA 310-D standard, 19-inch (480-mm) panel mounting.
3. Finish: Manufacturer's standard, baked-polyester powder coat.

C. Floor-Mounted Racks: Modular-type, steel construction.

1. Vertical and horizontal cable management channels, top and bottom cable troughs, grounding lug**,** and a power strip.
2. Baked-polyester powder coat finish.

D. Cable Management for Equipment Frames:

1. Metal, with integral wire retaining fingers.
2. Baked-polyester powder coat finish.
3. Vertical cable management panels shall have front and rear channels, with covers.

4. Provide horizontal crossover cable manager at the top of each relay rack, with a minimum height of two rack units each.

2.2 POWER STRIPS

A. Power Strips: Comply with UL 1363.

1. Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
2. Rack mounting.
3. Six 20-A, 120-V ac, NEMA WD 6, Configuration 5-20R receptacles.
4. LED indicator lights for power and protection status.
5. LED indicator lights for reverse polarity and open outlet ground.
6. Circuit Breaker and Thermal Fusing: When protection is lost, circuit opens and cannot be reset.
7. Circuit Breaker and Thermal Fusing: Unit continues to supply power if protection is lost.
8. Close-coupled, direct plug-in line cord.
9. Rocker-type on-off switch, illuminated when in on position.
10. Peak Single-Impulse Surge Current Rating: 33 kA per phase.
11. Protection modes shall be line to neutral, line to ground, and neutral to ground. UL 1449 clamping voltage for all three modes shall be not more than 330 V.

2.3 GROUNDING

A. Comply with requirements in Section "Grounding and Bonding" for grounding conductors and connectors.

B. Telecommunications Main Bus Bar:

1. Connectors: Mechanical type, cast silicon bronze, solderless compression-type wire terminals, and long-barrel, two-bolt connection to ground bus bar.
2. Ground Bus Bar: Copper, minimum 1/4 inch thick by 4 inches wide (6 mm thick by 100 mm wide) with 9/32-inch (7.14-mm) holes spaced 1-1/8 inches (28 mm) apart.
3. Stand-Off Insulators: Comply with UL 891 for use in switchboards, 600 V. Lexan or PVC, impulse tested at 5000 V.

C. Comply with J-STD-607-A.

2.4 LABELING

A. Comply with TIA/EIA-606-A and UL 969 for a system of labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Comply with NECA 1.

B. Comply with BICSI TDMM for layout and installation of communications equipment rooms.

C. Bundle, lace, and train conductors and cables to terminal points without exceeding manufacturer's limitations on bending radii. Install lacing bars and distribution spools.

D. Coordinate layout and installation of communications equipment with Owner's telecommunications and LAN equipment and service suppliers. Coordinate service entrance arrangement with local exchange carrier.

1. Meet jointly with telecommunications and LAN equipment suppliers, local exchange carrier representatives, and Owner to exchange information and agree on details of equipment arrangements and installation interfaces.
2. Record agreements reached in meetings and distribute them to other participants.
3. Adjust arrangements and locations of distribution frames, cross-connects, and patch panels in equipment rooms to accommodate and optimize arrangement and space requirements of telephone switch and LAN equipment.
4. Adjust arrangements and locations of equipment with distribution frames, cross-connects, and patch panels of cabling systems of other communications, electronic safety and security, and related systems that share space in the equipment room.

E. Coordinate location of power raceways and receptacles with locations of communications equipment requiring electrical power to operate.

3.2 FIRESTOPPING

A. Comply with TIA-569-B, Annex A, "Firestopping."

B. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.3 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

1. Bond the shield of shielded cable to the grounding bus bar in communications rooms and spaces.

3.4 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements in Section "Identification for Electrical Systems."

B. Labels shall be preprinted or computer-printed type.

END OF SECTION 271100

SECTION 271500

COMMUNICATIONS HORIZONTAL CABLING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

A. Section Includes:

1. UTP cabling.
2. Coaxial Cable
3. Cable connecting hardware, patch panels, and cross-connects.
4. Telecommunications outlet/connectors.
5. Cabling system identification products.

1.3 DEFINITIONS

A. BICSI: Building Industry Consulting Service International.

B. Cross-Connect: A facility enabling the termination of cable elements and their interconnection or cross-connection.

C. EMI: Electromagnetic interference.

D. IDC: Insulation displacement connector.

E. LAN: Local area network.

F. Outlet/Connectors: A connecting device in the work area on which horizontal cable or outlet cable terminates.

G. RCDD: Registered Communications Distribution Designer.

H. UTP: Unshielded twisted pair.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordinate layout and installation of telecommunications cabling with Owner's telecommunications and LAN equipment and service suppliers.

B. Coordinate telecommunications outlet/connector locations with location of power receptacles at each work area.

1.5 ACTION SUBMITTALS

A. Product Data: For each type of product.

1.6 INFORMATIONAL SUBMITTALS

A. Qualification Data: For Installer**,** qualified layout technician, installation supervisor, and field inspector.

B. Source quality-control reports.

C. Field quality-control reports.

1.7 MAINTENANCE MATERIAL SUBMITTALS

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

1. Patch-Panel Units: One of each type.
2. Connecting Blocks: One of each type.
3. Device Plates: One of each type.

1.8 QUALITY ASSURANCE

A. Installer Qualifications: Cabling Installer must have personnel certified by BICSI on staff.

1. Layout Responsibility: Preparation of Shop Drawings and Cabling Administration Drawings an RCDD.
2. Installation Supervision: Installation shall be under the direct supervision of Registered Technician, who shall be present at all times when Work of this Section is performed at Project site.
3. Testing Supervisor: Currently certified by BICSI as an RCDD to supervise on-site testing.

1.9 DELIVERY, STORAGE, AND HANDLING

A. Test cables upon receipt at Project site.
1. Test each pair of UTP cable for open and short circuits.

PART 2 - PRODUCTS

2.1 HORIZONTAL CABLING DESCRIPTION

A. Horizontal cable and its connecting hardware provide the means of transporting signals between the telecommunications outlet/connector and the horizontal cross-connect located in the communications equipment room. This cabling and its connecting hardware are called a "permanent link," a term that is used in the testing protocols.

1. TIA/EIA-568-B.1 requires that a minimum of two telecommunications outlet/connectors be installed for each work area.
2. Horizontal cabling shall contain no more than one transition point or consolidation point between the horizontal cross-connect and the telecommunications outlet/connector.
3. Bridged taps and splices shall not be installed in the horizontal cabling.

B. The maximum allowable horizontal cable length is 295 feet (90 m). This maximum allowable length does not include an allowance for the length of 16 feet (4.9 m) to the workstation equipment or in the horizontal cross-connect.

2.2 PERFORMANCE REQUIREMENTS

A. General Performance: Horizontal cabling system shall comply with transmission standards in TIA/EIA-568-B.1 when tested according to test procedures of this standard.

B. Surface-Burning Characteristics: Comply with ASTM E 84; testing by a qualified testing agency. Identify products with appropriate markings of applicable testing agency.

1. Flame-Spread Index: 25 or less.
2. Smoke-Developed Index: 50 or less.

C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

D. Grounding: Comply with J-STD-607-A.

2.3 UTP CABLE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ADC.
2. Belden Inc.
3. Berk-Tek; a Nexans company.
4. CommScope, Inc.
5. Draka Cableteq USA.
6. Genesis Cable Products; Honeywell International, Inc.
7. Mohawk; a division of Belden Networking, Inc.
8. Superior Essex Inc.

9. SYSTIMAX Solutions; a CommScope, Inc. brand.
10. 3M Communication Markets Division.
11. Tyco Electronics Corporation; AMP Products.

B. Description: 100-ohm, four-pair UTP, covered with a blue thermoplastic jacket.

1. Comply with ICEA S-90-661 for mechanical properties.
2. Comply with TIA/EIA-568-B.1 for performance specifications.
3. Comply with TIA/EIA-568-B.2, **Category 6**.
4. Listed and labeled by an NRTL acceptable to authorities having jurisdiction as complying with UL 444 and NFPA 70 for the following types:

    a. Communications, General Purpose: Type CM or CMG.
    b. Communications, Plenum Rated: Type CMP, complying with NFPA 262.
    c. Communications, Riser Rated: Type CMR, complying with UL 1666.
    d. Communications, Limited Purpose: Type CMX.
    e. Multipurpose: Type MP or MPG.
    f. Multipurpose, Plenum Rated: Type MPP, complying with NFPA 262.
    g. Multipurpose, Riser Rated: Type MPR, complying with UL 1666.

2.4 UTP CABLE HARDWARE

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. ADC.
2. American Technology Systems Industries, Inc.
3. Belden Inc.
4. Dynacom Inc.
5. Hubbell Premise Wiring.
6. Leviton Commercial Networks Division.
7. Molex Premise Networks; a division of Molex, Inc.
8. Panduit Corp.
9. Siemon Co. (The).
10. Tyco Electronics Corporation; AMP Products.

B. General Requirements for Cable Connecting Hardware: Comply with TIA/EIA-568-B.2, IDC type, with modules designed for punch-down caps or tools. Cables shall be terminated with connecting hardware of same category or higher.

C. Connecting Blocks: 110-style IDC for **Category 6**. Provide blocks for the number of cables terminated on the block, plus 25 percent spare. Integral with connector bodies, including plugs and jacks where indicated.

D. Cross-Connect: Modular array of connecting blocks arranged to terminate building cables and permit interconnection between cables.

E. Patch Panel: Modular panels housing multiple-numbered jack units with IDC-type connectors at each jack for permanent termination of pair groups of installed cables.

F. Jacks and Jack Assemblies: Modular, color-coded, eight-position modular receptacle units with integral IDC-type terminals.

1. Patch cords shall have bend-relief-compliant boots and color-coded icons to ensure **Category 6** performance. Patch cords shall have latch guards to protect against snagging.

2.5 COAXIAL CABLE

A. The drop cable shall be plenum rated RG-6U with 100% shielding. The cable shall be West Penn Wire 25841, or approved equal.

2.6 TELECOMMUNICATIONS OUTLET/CONNECTORS

A. Jacks: 100-ohm, balanced, twisted-pair connector; four-pair, eight-position modular. Comply with TIA/EIA-568-B.1.

B. Workstation Outlets: Port-connector assemblies, with quantities shown on drawings, mounted in single faceplate.

1. Plastic Faceplate: High-impact plastic. Coordinate color with Section 262726 "Wiring Devices."
2. For use with snap-in jacks accommodating any combination of UTP.
3. Legend: Machine printed, in the field, using adhesive-tape label.
4. Legend: Snap-in, clear-label covers and machine-printed paper inserts.

2.7 GROUNDING

A. Comply with requirements in Section 260526 "Grounding and Bonding for Electrical Systems" for grounding conductors and connectors.

B. Comply with J-STD-607-A.

2.8 IDENTIFICATION PRODUCTS

A. Comply with TIA/EIA-606-A and UL 969 for labeling materials, including label stocks, laminating adhesives, and inks used by label printers.

B. Comply with requirements in Section 260553 "Identification for Electrical Systems."

PART 3 - EXECUTION

3.1 WIRING METHODS

A. Install cables in pathways and cable trays except within consoles, cabinets, desks, and counters and except in accessible ceiling spaces and in gypsum board partitions where

unenclosed wiring method may be used. Conceal pathways and cables except in unfinished spaces.

1. Install plenum cable in environmental air spaces, including plenum ceilings.

B. Conceal conductors and cables in accessible ceilings, walls, and floors where possible.

C. Wiring within Enclosures:

1. Bundle, lace, and train conductors to terminal points with no excess and without exceeding manufacturer's limitations on bending radii.
2. Install lacing bars and distribution spools.
3. Install conductors parallel with or at right angles to sides and back of enclosure.

3.2 INSTALLATION OF CABLES

A. Comply with NECA 1.

B. General Requirements for Cabling:

1. Comply with TIA/EIA-568-B.1.
2. Comply with BICSI ITSIM, Ch. 6, "Cable Termination Practices."
3. Install 110-style IDC termination hardware unless otherwise indicated.
4. Terminate conductors; no cable shall contain unterminated elements. Make terminations only at indicated outlets, terminals, cross-connects, and patch panels.
5. Cables may not be spliced. Secure and support cables at intervals not exceeding 30 inches (760 mm) and not more than 6 inches (150 mm) from cabinets, boxes, fittings, outlets, racks, frames, and terminals.
6. Install lacing bars to restrain cables, to prevent straining connections, and to prevent bending cables to smaller radii than minimums recommended by manufacturer.
7. Bundle, lace, and train conductors to terminal points without exceeding manufacturer's limitations on bending radii, but not less than radii specified in BICSI ITSIM, "Cabling Termination Practices" Chapter. Install lacing bars and distribution spools.
8. Do not install bruised, kinked, scored, deformed, or abraded cable. Do not splice cable between termination, tap, or junction points. Remove and discard cable if damaged during installation and replace it with new cable.
9. In the communications equipment room, install a 10-foot- (3-m-) long service loop on each end of cable.
10. Pulling Cable: Comply with BICSI ITSIM, Ch. 4, "Pulling Cable." Monitor cable pull tensions.

C. UTP Cable Installation:

1. Comply with TIA/EIA-568-B.2.
2. Do not untwist UTP cables more than 1/2 inch (12 mm) from the point of termination to maintain cable geometry.

D. Open-Cable Installation:

1. Install cabling with horizontal and vertical cable guides in telecommunications spaces with terminating hardware and interconnection equipment.
2. Suspend UTP cable not in a wireway or pathway a minimum of 8 inches (200 mm) above ceilings by cable supports not more than 60 inches (1524 mm) apart.
3. Cable shall not be run through structural members or in contact with pipes, ducts, or other potentially damaging items.

E. Group connecting hardware for cables into separate logical fields.

F. Separation from EMI Sources:

1. Comply with BICSI TDMM and TIA-569-B for separating unshielded copper voice and data communication cable from potential EMI sources, including electrical power lines and equipment.
2. Separation between open communications cables or cables in nonmetallic raceways and unshielded power conductors and electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 5 inches (127 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 12 inches (300 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 24 inches (610 mm).

3. Separation between communications cables in grounded metallic raceways and unshielded power lines or electrical equipment shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: A minimum of 2-1/2 inches (64 mm).
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 6 inches (150 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 12 inches (300 mm).

4. Separation between communications cables in grounded metallic raceways and power lines and electrical equipment located in grounded metallic conduits or enclosures shall be as follows:

    a. Electrical Equipment Rating Less Than 2 kVA: No requirement.
    b. Electrical Equipment Rating between 2 and 5 kVA: A minimum of 3 inches (76 mm).
    c. Electrical Equipment Rating More Than 5 kVA: A minimum of 6 inches (150 mm).

5. Separation between Communications Cables and Electrical Motors and Transformers, 5 kVA or HP and Larger: A minimum of 48 inches (1200 mm).
6. Separation between Communications Cables and Fluorescent Fixtures: A minimum of 5 inches (127 mm).

3.3 FIRESTOPPING

A. Comply with requirements in Section 078413 "Penetration Firestopping."

B. Comply with TIA-569-B, Annex A, "Firestopping."

C. Comply with BICSI TDMM, "Firestopping Systems" Article.

3.4 GROUNDING

A. Install grounding according to BICSI TDMM, "Grounding, Bonding, and Electrical Protection" Chapter.

B. Comply with J-STD-607-A.

C. Locate grounding bus bar to minimize the length of bonding conductors. Fasten to wall allowing at least 2-inch (50-mm) clearance behind the grounding bus bar. Connect grounding bus bar with a minimum No. 4 AWG grounding electrode conductor from grounding bus bar to suitable electrical building ground.

D. Bond metallic equipment to the grounding bus bar, using not smaller than No. 6 AWG equipment grounding conductor.

3.5 IDENTIFICATION

A. Identify system components, wiring, and cabling complying with TIA/EIA-606-A. Comply with requirements for identification specified in Section "Identification for Electrical Systems."

B. Cable Schedule: Post in prominent location in each equipment room and wiring closet. List incoming and outgoing cables and their designations, origins, and destinations. Protect with rigid frame and clear plastic cover. Furnish an electronic copy of final comprehensive schedules for Project.

C. Cabling Administration Drawings: Show building floor plans with cabling administration-point labeling. Identify labeling convention and show labels for telecommunications closets, terminal hardware and positions, horizontal cables, work areas and workstation terminal positions, grounding buses and pathways, and equipment grounding conductors. Follow convention of TIA/EIA-606-A. Furnish electronic record of all drawings, in software and format selected by Owner.

D. Cable and Wire Identification:

1. Label each cable within 4 inches (100 mm) of each termination and tap, where it is accessible in a cabinet or junction or outlet box, and elsewhere as indicated.
2. Each wire connected to building-mounted devices is not required to be numbered at device if color of wire is consistent with associated wire connected and numbered within panel or cabinet.
3. Exposed Cables and Cables in Cable Trays and Wire Troughs: Label each cable at intervals not exceeding 15 feet (4.5 m).

4. Label each terminal strip and screw terminal in each cabinet, rack, or panel.

    a. Individually number wiring conductors connected to terminal strips, and identify each cable or wiring group being extended from a panel or cabinet to a building-mounted device shall be identified with name and number of particular device as shown.
    b. Label each unit and field within distribution racks and frames.

5. Identification within Connector Fields in Equipment Rooms and Wiring Closets: Label each connector and each discrete unit of cable-terminating and connecting hardware. Where similar jacks and plugs are used for both voice and data communication cabling, use a different color for jacks and plugs of each service.

E. Labels shall be preprinted or computer-printed type with printing area and font color that contrasts with cable jacket color but still complies with requirements in TIA/EIA-606-A.

1. Cables use flexible vinyl or polyester that flex as cables are bent.

3.6 FIELD QUALITY CONTROL

A. Perform the following tests and inspections:

1. Visually inspect UTP and optical fiber cable jacket materials for NRTL certification markings. Inspect cabling terminations in communications equipment rooms for compliance with color-coding for pin assignments, and inspect cabling connections for compliance with TIA/EIA-568-B.1.
2. Visually confirm **Category 6**, marking of outlets, cover plates, outlet/connectors, and patch panels.
3. Visually inspect cable placement, cable termination, grounding and bonding, equipment and patch cords, and labeling of all components.

B. End-to-end cabling will be considered defective if it does not pass tests and inspections.

C. Prepare test and inspection reports.

END OF SECTION 271500

SECTION 283111

DIGITAL, ADDRESSABLE FIRE-ALARM SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Manual fire-alarm boxes.
2. System smoke detectors.
3. Heat detectors.
4. Notification appliances.
5. Addressable interface device.

1.2 SYSTEM DESCRIPTION

A. Extend existing addressable system, with multiplexed signal transmission, dedicated to fire-alarm service only.

1.3 ACTION SUBMITTALS

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

B. Shop Drawings: For fire-alarm system. Include plans, elevations, sections, details, and attachments to other work.

1. Comply with recommendations in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter in NFPA 72.
2. Include voltage drop calculations for notification appliance circuits.
3. Include battery-size calculations.
4. Include performance parameters and installation details for each detector, verifying that each detector is listed for complete range of air velocity, temperature, and humidity possible when air-handling system is operating.
5. Include plans, sections, and elevations of heating, ventilating, and air-conditioning ducts, drawn to scale and coordinating installation of duct smoke detectors and access to them. Show critical dimensions that relate to placement and support of sampling tubes, detector housing, and remote status and alarm indicators. Locate detectors according to manufacturer's written recommendations.
6. Include floor plans to indicate final outlet locations showing address of each addressable device. Show size and route of cable and conduits.

C. General Submittal Requirements:

1. Submittals shall be approved by authorities having jurisdiction prior to submitting them to Architect.
2. Shop Drawings shall be prepared by persons with the following qualifications:

    a. Trained and certified by manufacturer in fire-alarm system design.
    b. NICET-certified fire-alarm technician, Level III minimum.

D. Delegated-Design Submittal: For smoke and heat detectors indicated to comply with performance requirements and design criteria, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1. Drawings showing the location of each smoke and heat detector, ratings of each, and installation details as needed to comply with listing conditions of the detector.
2. Design Calculations: Calculate requirements for selecting the spacing and sensitivity of detection, complying with NFPA 72.

1.4 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For fire-alarm systems and components to include in emergency, operation, and maintenance manuals.

1. Comply with the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
2. Provide "Record of Completion Documents" according to NFPA 72 article "Permanent Records" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter.
3. Record copy of site-specific software.
4. Provide "Maintenance, Inspection and Testing Records" according to NFPA 72 article of the same name and include the following:

    a. Frequency of testing of installed components.
    b. Frequency of inspection of installed components.
    c. Requirements and recommendations related to results of maintenance.
    d. Manufacturer's user training manuals.

5. Manufacturer's required maintenance related to system warranty requirements.

B. Software and Firmware Operational Documentation:

1. Software operating and upgrade manuals.
2. Program Software Backup: On magnetic media or compact disk, complete with data files.
3. Device address list.
4. Printout of software application and graphic screens.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Personnel shall be trained and certified by manufacturer for installation of units required for this Project.

B. Installer Qualifications: Installation shall be by personnel certified by NICET as fire-alarm Level II technician.

C. Source Limitations for Fire-Alarm System and Components: Obtain fire-alarm system from single source from single manufacturer. Components shall be compatible with, and operate as, an extension of existing system.

D. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

PART 2 - PRODUCTS

2.1 MANUAL FIRE-ALARM BOXES

A. General Requirements for Manual Fire-Alarm Boxes: Comply with UL 38. Boxes shall be finished in red with molded, raised-letter operating instructions in contrasting color; shall show visible indication of operation; and shall be mounted on recessed outlet box. If indicated as surface mounted, provide manufacturer's surface back box.

1. Double-action mechanism requiring two actions to initiate an alarm, pull-lever type; with integral addressable module arranged to communicate manual-station status (normal, alarm, or trouble) to fire-alarm control unit.
2. Station Reset: Key- or wrench-operated switch.

2.2 SYSTEM SMOKE DETECTORS

A. General Requirements for System Smoke Detectors:

1. Comply with UL 268; operating at 24-V dc, nominal.
2. Detectors shall be four-wire type.
3. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.
4. Base Mounting: Detector and associated electronic components shall be mounted in a twist-lock module that connects to a fixed base. Provide terminals in the fixed base for connection to building wiring.
5. Self-Restoring: Detectors do not require resetting or readjustment after actuation to restore them to normal operation.
6. Integral Visual-Indicating Light: LED type indicating detector has operated and power-on status.

B. Photoelectric Smoke Detectors:

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

    a. Primary status.

b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

C. Duct Smoke Detectors: Photoelectric type complying with UL 268A.

1. Detector address shall be accessible from fire-alarm control unit and shall be able to identify the detector's location within the system and its sensitivity setting.
2. An operator at fire-alarm control unit, having the designated access level, shall be able to manually access the following for each detector:

a. Primary status.
b. Device type.
c. Present average value.
d. Present sensitivity selected.
e. Sensor range (normal, dirty, etc.).

3. Weatherproof Duct Housing Enclosure: NEMA 250, Type 4X; NRTL listed for use with the supplied detector.
4. Each sensor shall have multiple levels of detection sensitivity.
5. Sampling Tubes: Design and dimensions as recommended by manufacturer for specific duct size, air velocity, and installation conditions were applied.
6. Relay Fan Shutdown: Rated to interrupt fan motor-control circuit.

2.3 HEAT DETECTORS

A. General Requirements for Heat Detectors: Comply with UL 521.

B. Heat Detector, Combination Type: Actuated by either a fixed temperature of 135 deg F (57 deg C) or a rate of rise that exceeds 15 deg F (8 deg C) per minute unless otherwise indicated.

1. Mounting: Twist-lock base interchangeable with smoke-detector bases.
2. Integral Addressable Module: Arranged to communicate detector status (normal, alarm, or trouble) to fire-alarm control unit.

2.4 NOTIFICATION APPLIANCES

A. General Requirements for Notification Appliances: Connected to notification appliance signal circuits, zoned as indicated, equipped for mounting as indicated and with screw terminals for system connections.

1. Combination Devices: Factory-integrated audible and visible devices in a single-mounting assembly, equipped for mounting as indicated and with screw terminals for system connections.

B. Horns: Electric-vibrating-polarized type, 24-V dc; with provision for housing the operating mechanism behind a grille. Comply with UL 464. Horns shall produce a sound-pressure level

of 90 dBA, measured 10 feet (3 m) from the horn, using the coded signal prescribed in UL 464 test protocol.

C. Visible Notification Appliances: Xenon strobe lights comply with UL 1971, with clear or nominal white polycarbonate lens mounted on an aluminum faceplate. The word "FIRE" is engraved in minimum 1-inch- (25-mm-) high letters on the lens.

1. Rated Light Output:

a. 15/30/75/110 cd, selectable in the field.

2. Mounting: Wall mounted unless otherwise indicated.
3. For units with guards to prevent physical damage, light output ratings shall be determined with guards in place.
4. Flashing shall be in a temporal pattern, synchronized with other units.
5. Strobe Leads: Factory connected to screw terminals.
6. Mounting Faceplate: Factory finished, red.

2.5 ADDRESSABLE INTERFACE DEVICE

A. Description: Microelectronic monitor module, NRTL listed for use in providing a system address for alarm-initiating devices for wired applications with normally open contacts.

PART 3 - EXECUTION

3.1 EQUIPMENT INSTALLATION

A. Comply with NFPA 72 for installation of fire-alarm equipment.

B. Install wall-mounted equipment, with tops of cabinets not more than 72 inches (1830 mm) above the finished floor.

C. Duct Smoke Detectors: Comply with NFPA 72 and NFPA 90A. Install sampling tubes so they extend the full width of duct.

D. Heat Detectors in Elevator Shafts: Coordinate temperature rating and location with sprinkler rating and location.

E. Remote Status and Alarm Indicators: Install near each smoke detector and each sprinkler water-flow switch and valve-tamper switch that is not readily visible from normal viewing position.

F. Audible Alarm-Indicating Devices: Install not less than 6 inches (150 mm) below the ceiling. Install bells and horns on flush-mounted back boxes with the device-operating mechanism concealed behind a grille.

G. Device Location-Indicating Lights: Locate in public space near the device they monitor.

3.2 CONNECTIONS

A. For fire-protection systems related to doors in fire-rated walls and partitions and to doors in smoke partitions, comply with requirements in Section "Door Hardware." Connect hardware and devices to fire-alarm system.

1. Verify that hardware and devices are NRTL listed for use with fire-alarm system in this Section before making connections.

B. Make addressable connections with a supervised interface device to the following devices and systems. Install the interface device less than 3 feet (1 m) from the device controlled. Make an addressable confirmation connection when such feedback is available at the device or system being controlled.

1. Alarm-initiating connection to elevator recall system and components.
2. Supervisory connections at valve supervisory switches.
3. Supervisory connections at elevator shunt trip breaker.

3.3 IDENTIFICATION

A. Identify system components, wiring, cabling, and terminals. Comply with requirements for identification specified in Section 260553 "Identification for Electrical Systems."

3.4 FIELD QUALITY CONTROL

A. Tests and Inspections:

1. Visual Inspection: Conduct visual inspection prior to testing.

   a. Inspection shall be based on completed Record Drawings and system documentation that is required by NFPA 72 in its "Completion Documents, Preparation" Table in the "Documentation" Section of the "Fundamentals of Fire Alarm Systems" Chapter.
   b. Comply with "Visual Inspection Frequencies" Table in the "Inspection" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72; retain the "Initial/Reacceptance" column and list only the installed components.

2. System Testing: Comply with "Test Methods" Table in the "Testing" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.
3. Test audible appliances for the public operating mode according to manufacturer's written instructions. Perform the test using a portable sound-level meter complying with Type 2 requirements in ANSI S1.4.
4. Test audible appliances for the private operating mode according to manufacturer's written instructions.
5. Test visible appliances for the public operating mode according to manufacturer's written instructions.
6. Factory-authorized service representative shall prepare the "Fire Alarm System Record of Completion" in the "Documentation" Section of the "Fundamentals of Fire Alarm

Systems" Chapter in NFPA 72 and the "Inspection and Testing Form" in the "Records" Section of the "Inspection, Testing and Maintenance" Chapter in NFPA 72.

B. Reacceptance Testing: Perform reacceptance testing to verify the proper operation of added or replaced devices and appliances.

C. Fire-alarm system will be considered defective if it does not pass tests and inspections.

D. Prepare test and inspection reports.

E. Maintenance Test and Inspection: Perform tests and inspections listed for weekly, monthly, quarterly, and semiannual periods. Use forms developed for initial tests and inspections.

F. Annual Test and Inspection: One year after date of Substantial Completion, test fire-alarm system complying with visual and testing inspection requirements in NFPA 72. Use forms developed for initial tests and inspections.

END OF SECTION 283111