Specifications

Proposal for 2013-01
LEON VALLEY PUBLIC LIBRARY
CHILDREN'S WING
6425 EVERS RD.
LEON VALLEY, TEXAS 78238

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Volume II

CHILDREN'S WING
LEON VALLEY PUBLIC LIBRARY
DIVISION 21-23 - MECHANICAL SPECIFICATIONS

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11/16/12

SECTION 22 11 16

DOMESTIC WATER PIPING AND APPURTENANCES

1.0 GENERAL

1.1 SCOPE

a. This Section provides requirements for furnishing and installing domestic hot and cold water piping.

1.2 RELATED WORK

a. Division 23, Mechanical.

(1) Earthwork.

(2) Access Doors.

(3) Valves, Strainers and Vents.

(4) Low Temperature Piping Insulation.

(5) High Temperature Piping Insulation.

(6) Pipe and Pipe Fittings - General.

1.3 STANDARDS

a. Perform work in accordance with applicable statutes, ordinances, codes, and regulations of governmental authorities having jurisdiction.

b. Resolve any code violation discovered in contract documents with the Engineer prior to award of the Contract. After award of the Contract, make any correction or additions necessary for compliance with applicable codes at no additional cost to Owner.

c. Obtain and pay for all permits and inspections.

2.0 PRODUCTS

2.1 PIPING AND FITTINGS

a. Provide pipe and pipe fittings of domestic manufacturers only and with labeling to comply with NSF 61.

b. Underground Piping.

(1) 2-1/2-inch and smaller, provide ASTM B-88, hard-drawn, Type K copper water tube with wrought copper fittings.

c. Underfloor Piping. Furnish ASTM B 88 cold drawn, Type K copper water tube. Run continuous with no joints under the floor slab to 12-inches above finished floor. Insulate all underfloor piping with 1-inch thick Armaflex AP pipe insulation to 6-inches above finished floor.

d. Above Ground Piping.

(1) 3-inches and smaller. Provide seamless ASTM B 88 harddrawn Type L or CDA alloy 194 heavy copper water tube with wrought copper fittings, ANSI B 16.22. Tape all bare copper piping located in CMU block walls with polyvinyl tape.

e. Solder. Use Harris "Stay-Safe-Bridgit", lead free, UPC and NSF approved, silver bearing solder with Harris "Stay-Clean" liquid solder flux. Apply per manufacturer's recommendations.

f. Unions. Provide Class-150, standard, 300-pound water-oil-gas service galvanized, malleable iron unions with ground joint and bronze seat. Flange joints larger than 2-inch. Provide dielectric isolating unions at all junctions or connections between metallic piping of dissimilar metal.

2.2 VALVES

a. Provide valves of one manufacturer only. Do not provide valves of more than one manufacturer throughout project.

b. Above Ground Gate Valves.

(1) 2-1/2-inches and smaller. Provide Class 150, ASTM B-62 cast bronze composition body and bonnet, ASTM B-371 alloy 694 Copper-silicon alloy stem, brass packing gland, Teflon-impregnated packing, rising stem, solid wedge, union bonnet, screwed end all bronze gate valves with malleable iron handwheel. Stockham B-120, Jenkins 47U, Walworth 11, Powell 2714 or Nibco T-134 modified for malleable iron handwheel.

c. Below Ground Gate Valves. Provide Class 200, WWP, AWWA, non-rising stem, IBBM, double disk with parallel seat, ASTM A-126 Class B cast body and bonnet, flanged end gate valves with 1-1/4-inch shaft and 2-inch operating nut. Stockham G-745-O, Kennedy 561X or Mueller A-2380-6.

(1) Provide an adjustable, extension type cast iron valve box with screw or locking slide adjustment, flared base and locking lid with 3/16-inch minimum wall thickness. Provide valve box for each valve. Use covers with appropriate identification marking cast on cover of type service. Western Iron Works Fig. 6-1.

d. Check Valves.

(1) 2-1/2-inches and smaller. Provide Class 125, ASTM B-62 cast bronze composition body and cap, screwed end all bronze check valves with brass or bronze swing type disc. Stockham B-319, Jenkins 4092, Walworth 3406 or Powell 578.

e. Ball Valves. (2-inches and smaller only) Provide 600 PSI, cast brass body, replaceable reinforced Teflon seats, conventional port, blowout proof stems, chrome plated brass ball and screwed ends. Stockham S-216-BR-RT, Apollo 70-100, Jenkins 901-A or Nibco T-580-BR.

3.0 EXECUTION

3.1 INSTALLATION

a. Make entire installation per local code requirements.

b. Keep the inside of the piping free from foreign matter.

c. Cut all piping neatly, using approved type mechanical cutters without damaging pipe. Use wheel cutters when applicable.

d. Ream all pipe connections and remove all burrs.

e. Properly flush all water lines adequately to remove all foreign matter from within plumbing systems prior to installation of fixtures.

f. For sets of fixtures installed on 4-inch walls or in concrete masonry unit (CMU) walls, provide a separate hot and cold water supply line for each fixture (do not interconnect in wall). Connect the water supply lines above the ceiling. Maintain structural and aesthetic integrity of walls.

g. Provide all valves, unions and appurtenances shown on floor plans, details, schematics and risers. Provide line-size shut-off valves for all groups of fixtures, each major equipment connection, each floor level and at all main branch connections to mains.

h. Provide access doors to provide access to all valves and to all appurtenances requiring service or maintenance.

i. Balancing valves shall be installed where shown on the drawings and where required to properly balance the hot water return system. Reference water heater specifications for other balancing requirements.

j. Provide all fittings and appurtenances required for a complete and working system.

3.2 MINIMUM COVER

a. For piping located below floors or finished grade, install piping in trench to the required depth to insure two feet minimum cover over pipe.

b. All underground piping shall be embedded in sand in accordance with Section VIA-1.13a of the "Standard Construction Specifications of the Water and Wastewater Department.

3.3 DRAINAGE

a. Install water piping systems with uniform horizontal grade of 1/8-inch per 10 feet, to low points to provide complete drainage of the system. Where constant pitch cannot be maintained for long runs, establish intermediate low points and rise to new level.

b. Grade branches to drain to mains or risers. Unless otherwise indicated, terminate low points of risers with drain valve piped to nearest hub or floor drain. Install a 2-inch drain for pipes 2-inches in diameter and larger. Install line size drain valves for pipes smaller than 2-inches. As drain valves, use gate valves as specified in this section. Route drains to floor drains with adequate air gap for cross connection protection.

3.4 STERILIZATION

a. Sterilize the main water system with solution containing not less than 50 parts per million available chlorine. Allow chlorinating solution to remain in system for period of 8 hours. Have valves and faucets opened and closed several times during the period. After sterilization, flush the solution from the system with clean water until residual chlorine content is less than 0.2 parts per million.

3.5 ROUGH-IN AND FINAL CONNECTIONS

a. Make rough-in and final connection of all services to all fixtures requiring plumbing connections. Contractor shall be responsible for installing fixtures at locations shown on the Architectural drawings and providing all service connections at required locations.

b. Provide service connections to all plumbing fixtures specified and to all equipment furnished by others. Reference Section 23 21 00 for rough-in requirements of equipment furnished by others.

3.6 COORDINATION

a. Making adjustments to field conditions is considered a part of the work required. Do not use contract drawings accompanying these specifications for rough-in locations but only for pipe sizing and general routing.

b. Contractor shall examine and familiarize himself with the Architectural, Structural, Electrical and Mechanical drawings to be knowledgeable of all plumbing connections required and space limitations.

c. The drawings are diagrammatic and are not intended to show all the fittings required. Contractor shall include in his bid, costs for items of material and labor which are not specifically called for in drawings or specifications, but which are required to make plumbing installation. Contractor shall make any necessary changes to avoid beams, footings, columns, piers, vents, ducts, equipment or other obstructions.

d. In any case where a pipe shown on a plan sheet differs from that shown on a riser, schematic or detail, use the larger of the two sizes shown.

e. Do not route any piping above electrical control panels and related electrical equipment. Prior to installation of any piping, determine the actual space requirements and the location of all electrical panels and related electrical equipment. Make all offsets and adjustments as required.

3.7 PIPE EXPANSION AND CONTRACTION

a. Provide expansion joints for all hot water piping having straight lengths of 100 feet and greater. Pipe anchors, guides and supports are specified in the section on pipe and pipe fittings general.

b. Provide swing joints to all branch connections and individual pipe connections from mains. Provide a minimum of 2-elbows from main connection for each branch or individual connection. Provide all offsets, changes in direction and swing joints required to compensate for expansion of pipe whether shown or not on the drawings.

c. Contractor shall install pipe with adequate spacing between the water lines and the building construction such that the expansion of the pipe (in length) is less than the space available. Protect all pipe from rupture or damage due to expansion.

3.8 TESTING

a. Test under a cold water hydrostatic pressure of 1-1/2 times operating pressure (150 psig minimum) and carefully check for leaks. Repair all leaks and retest system until system holds for at least 24 hours and proven watertight.

b. Testing shall be verified by Architect/Engineer or appointed Owner’s representative. At Architect's/Engineer's discretion, the General Contractor shall verify and document the test results. Test findings shall be documented and forwarded to the Architect.

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SECTION 22 11 19

VALVES, STRAINERS AND VENTS - GENERAL

1.0 GENERAL

a. This Section gives general requirements which apply to all Division 23, Mechanical, sections. Valve types for specific services are specified in the Section on that service.

2.0 PRODUCTS

2.1 VALVE DESIGN

a. Furnish valves designed for repacking under pressure when fully opened, equipped with packing suitable for intended service, equipped with gland followers, and having pressure/temperature rating not less than design criteria applicable to components of system. Perform shell and seat tests and stamp valve to show that tests have been successfully completed. Furnish valves conforming to following specifications:

Material	Specifications
Bronze - 150 psi maximum	ASTM B 62

2.2 VALVE OPERATORS

a. Furnish single lever operator for ball valves and butterfly valves and hand wheel operators for all others.

2.3 VALVE BOXES

a. Employ cast iron boxes, extension type with screw or locking slide adjustment, and flared base. Minimum thickness of metal shall be 3/16-inch. Install boxes over each underground valve. Use covers with appropriate cast-in identification of service.

2.4 VALVE TAGS

a. Furnish valves with 1-1/2-inch diameter brass valve tag with stamped and red-filled numbers. Service designations shall be 1/2-inch letters, and valve numbers shall be 1/2-inch letters. Service designations shall be approved by Engineer. Secure tags to valves by use of brass "S" hooks and brass chain. Secure chain to valve by use of copper or monel meter seals. Mount charts and drawings listing functions of each valve and its location in a metal frame and behind glass places as directed. In addition on the record drawings, mark the symbols and furnish a valve schedule properly identifying the valve number and service with the exact location, the material being piped, and the room

number of area that the valve services. This schedule shall be furnished on reproducible drafting paper or film suitable for reproduction on an Ozalid machine. The size of drafting paper shall be approved by the Owner.

2.5 STRAINERS

a. Unless specified or shown otherwise, furnish strainers ahead of tanks, traps, pumps, solenoid and control valves and other equipment indicated on drawings. Furnish "Y" or "T" pattern strainers. Arrange cap for easy removal of screen and provide with opening for blowout. Furnish strainer with blow-out nipple and plug valve of same size as blow-out connection, and pipe to nearest floor or hub drain.

3.0 EXECUTION

a. Install valves and stops in accessible locations; furnish and install where shown or as required to make systems complete and readily maintained. Install shutoff valves to each group of plumbing fixtures and in branch chilled and heating water piping systems, whether shown or not.

b. Install valves located behind access doors so the doors can be closed with the valve in either the open or closed position.

c. Install valves so their bonnets can be removed.

d. Install horizontally-mounted valves so the valve stem is inclined 30 degrees above horizontal.

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SECTION 22 13 00

DRAINS, HYDRANTS, CLEANOUTS AND APPURTENANCES

1.0 GENERAL

1.1 SCOPE

a. This Section provides requirements for furnishing and installing floor drains, cleanouts, hydrants, water hammer arresters and trap primers.

1.2 RELATED WORK

a. Division 23 - Mechanical.

(1) Access Doors.

(2) Pipe and Pipe Fittings – General.

(3) Domestic Water Piping.

(4) Soil, Waste and Sanitary Drain Piping, Vent Piping.

1.3 JOB REQUIREMENTS

a. Furnish drains, hydrants and cleanouts shown or specified with all necessary trimmings. Provide drains, drain bodies, hydrants, cleanouts and similar devices of one manufacturer.

b. Provide that all porcelain enameled surfaces be acid resistant.

1.4 STANDARDS

a. Perform work in accordance with applicable statutes, ordinances, codes, and regulations of governmental authorities having jurisdiction.

b. Resolve any code violation discovered in contract documents with the Engineer prior to award of the contract. After award of the contract, make any correction or additions necessary for compliance with applicable codes at no additional cost to Owner.

2.0 PRODUCTS

2.1 CLEANOUTS

a. Finished Floors and Concrete Floors, square top (FCO). Furnish a primer coated cast iron floor cleanout with combination cover and plug, threaded adjustable housing and ferrule, membrane flange, secured/vandal proof, square, heavy duty, satin finished nickel bronze or stainless steel scoriated top that adjusts to finished floor after concrete has set. Mifab C1100 C-5-3, Watts Drainage CO-200-S-6; Wade W-6030-XS-1-5-26-75 or approved equivalent.

b. Finished Walls (WCO). Furnish a primer coated cast iron cleanout tee with countersunk, taper thread bronze plug, No-Hub connections and round, smooth, stainless steel secured access cover with secured/vandal proof screw. Mifab C1460-RD-3, Watts Drainage CO-460-RD; Wade W-8460-NH-R6-5 (No-Hub connections) or approved equivalent.

2.2 HYDRANTS

a. Wall Hydrant, Non-Freeze, Exposed (WH-1). Provide an Line-Guard, Enviro/Guard, Ecolotrol exposed, anti-siphon, non-freeze wall hydrant with 3/4-inch IPS (threaded end) inlet (of length as required to fit wall construction), satin nickel bronze face, bronze casing, all bronze interior parts, non-turning operating rod with free-floating compression closure valve, integral ASSE 1011 and ASSE 1019 listed backflow preventer, hose connection and tee handle key. Provide to Owner one wall hydrant

operating key for each wall hydrant. Mifab HY-1000, Watts Drainage HY-420; Wade W-8620 or approved equivalent.

2.3 WATER HAMMER ARRESTERS

a. Type. Provide 250 psig, heavy-duty, balanced expansion, nesting bellows type hydraulic water hammer arresters contained in a permanently factory charged and sealed pressurized compression chamber. Chamber shall consist of a stabilized 18-8 stainless steel casing having sufficient displacement volume to dissipate the calculated kinetic energy generated in the piping system and sealed with fusion weld under an argon gas shield. Provide bellows precharged with clinically pure air or nitrogen, completely sealed and operating free of casing. Water hammer arresters shall be tested and certified in accordance with the Plumbing and Drainage Institute (PDI) "Standard P.D.I. WH-201" and the American Society of Sanitary Engineering Standard ASSE-1010. Mifab CLB series, Watts Drainage SS Series; Wade W-Shockstop series or approved equivalent. O-ring type water hammer arresters are not considered equals. Do not submit or install water hammer arresters that depend on O-rings for seals.

b. Size. Provide all arresters size and quantity as required and recommended by both the Plumbing and Drainage Institute Standard PDI-WH-201 and the manufacturer's sizing and placement recommendation data sheets.

(1) Contractor shall be responsible for obtaining and installing the proper number and size of water hammer arresters, including all arresters where special requirements occur. Where fixture unit counts/totals exceed the scheduled ratings, provide factory engineered, rechargeable water hammer arresters complete with pressure gauge and air valve.

(2) Water Hammer Arrester sizes shown on drawings are minimum size requirements only (quantities are partial requirements only). Water hammer arresters shall be of sufficient size and shall be installed throughout the water systems such that there will be no noise, movement in the piping system or damage to equipment due to water hammer. Adequately protect all equipment and fixtures requiring water hammer protection to all washing machines, kitchen sinks, dishwashers, tub and showers, and waterclosets.

(3) Access Doors. Provide a 10-inch (minimum) square access door for single arrester installations and a 14-inch square (minimum) door for two arrester installations in walls. Provide minimum 14-inch square access door for all arresters located above ceilings except for arresters located directly above lay-in-place acoustic tile ceilings.

2.4 TRAP PRIMERS

a. Provide UPC/IAPMO listed and approved, pressure actuated, automatic trap primers with integral air gap/vacuum breaker ports (near outlet opening) in conformance with ASSE 1018 or 1044. Provide a trap primer that automatically maintains a constant water seal in one to four drain traps and operates on the principle of differential pressure. The trap primer shall be made of corrosion resistant brass and shall not rely on springs or diaphragms for activation. Mifab trap primer or Precision Plumbing Products Inc. "PRIME-RITE".

(1) Equip primers with distribution units as required to provide an individual drain line to each hub drain or floor drain. Trap primers are required on all floor drains and hub drains.

(2) Provide a trap primer, water supply line (from nearest available domestic cold water supply line), ball valve, union, trap primer, distribution unit, connector fittings, drain line to floor or hub drain and access door (12-inch by 24-inch minimum) for each floor drain and hub drain whether or not shown on drawings.

(3) Unless otherwise noted, for each floor drain and hub drain provide a galvanized cast iron trap primer connector fitting with 1/2-inch or 3/4-inch female thread side inlet trap primer connection. Do not use threaded or No-Hub connections on trap primer connector fittings located below floors. Mifab M-500 series, Wade W-2430-39 series or approved equivalent.

(a) All galvanizing shall be factory applied and performed, field or shop galvanizing is not acceptable.

(b) Floor drains with trap primer connections may be provided in lieu of auxiliary inlet fittings (if available as an option on floor drains).

2.5 WATERPROOFING MEMBRANE

a. When a membrane is not provided in floor or roof construction, provide a membrane of size that extends a minimum of 12-inches on either side of floor drain, roof drain or cleanout.

b. Membrane shall be 4-pound per square foot sheet lead, Number 24 B & S gauge sheet copper or three layers of standard grade 15-pound asphalt impregnated roofing felt with each layer thoroughly hot mopped to ensure a completely watertight installation.

c. Coordinate waterproofing with appropriate trades.

3.0 EXECUTION

3.1 INSTALLATION

a. General.

(1) Install in accordance with manufacturer's recommendations and as shown on the drawings.

b. Floor Drains

(1) Coordinate flashing work with work of other trades. Coordinate with floor slab work to interface drains with concrete.

(2) Install floor drains at the low points of the surface areas to be drained. Set top of drains 1/2-inch below finished floor elevation unless otherwise shown on mechanical or structural drawings. Set floor drain grates such that top of grate is installed flush with surrounding floor elevation.

(3) Adequately grout around all floor drain tops. Fill in gaps between floor drain and floor with grout (or other rigid concrete based material) that matches the surrounding finished flooring in both color and texture.

(4) Install drain flashing collar of flange such that no leakage occurs between drain and adjoining flooring. Maintain watertight integrity of penetrated waterproof membranes.

(5) Position drains such that installed drains are accessible and easy to maintain.

(6) All floor drains and hub drains shall be individually vented to outside or nearest vent of adequate size. Provide a vent line for each floor drain and hub drain whether or not shown on drawings. Provide a 2-inch diameter (minimum) individual vent line.

c. Cleanouts.

(1) Location.

(a) Cleanouts shown on drawings are partial requirements only. Contractor shall provide and install all cleanouts shown on drawings, specified in this specification section as well as any additional cleanouts required by code authorities having jurisdiction.

(b) Provide cleanouts wherever necessary to make accessible all parts of the drainage soil or waste systems.

(c) Provide a line size cleanout on each horizontal drain line 5-feet or greater in length.

(d) Locate cleanouts in runs not more than 50-feet apart and provide all additional cleanouts required by local authority having jurisdiction. 50-foot spacing between cleanouts shall include length of vertical risers at cleanouts. All portions of the drain system shall be accessible to a 50-foot drain and sewer cleaning/rodding machine through cleanouts.

(e) Provide cleanouts where soil or waste lines change in direction of more than 90° as well as any other cleanouts required by local authority having jurisdiction.

(f) Provide cleanouts at the end of each continuous waste line and at the end or each battery of fixtures.

(g) Provide a line size wall cleanout at each sink and each urinal.

(h) Provide cleanouts at the base of each soil or waste stack.

(i) Provide a full size upper terminal cleanout at each run of piping which is more than 50-feet in total developed length or fraction thereof, except on horizontal drain lines less than five feet in length unless such line is serving sinks or urinals (cleanouts are required at all sinks and at all urinals).

(j) Provide a full size, cast iron, double, two-way cleanout with two exterior floor cleanouts extended to grade and casted into a 18-inch by 24-inch by 6-inch concrete pad for each drain line extending from building. Risers from double two way cleanout fitting to cleanouts shall be standard weight, cast iron, DWV, bell and spigot soil pipe and pipe fittings.

(2) Size. Install cleanouts the same size as the soil waste lines in which the cleanouts are placed; however, no cleanout should be larger than 4-inches in diameter.

(3) Installation.

(a) Set top of floor clean-outs such that top is flush with finished floor (including tile). Top of exterior floor cleanouts shall be installed flush with finished grade.

(b) Where cleanouts occur in pipe chases, bring the cleanouts through the walls and install covers. Wall cleanout plugs shall be installed within 3-inches (in depth) from access door and shall be centered in respect to access door opening for easy access.

(c) Install cleanout flashing collar of flange such that no leakage occur between cleanout and adjoining flooring. Maintain watertight integrity of penetrated waterproof membranes.

(d) Cleanouts shall be readily accessible and shall be located at a minimum of 18-inches from any wall, fixture, equipment or other obstruction.

(e) Adequately grout around all floor cleanout tops. Fill in gaps between cleanouts and floor with grout (or other rigid concrete based material) that matches the surrounding finished flooring in both color and texture.

(4) Waterproofing. Coordinate flashing work with work of other trades.

d. Hydrants.

(1) Unless otherwise noted, install all hose bibbs at 16-inches above finished floor and all wall hydrants at 16-inches above finished grade.

e. Water Hammer Arresters.

(1) Provide hydraulic water hammer arrestors in cold and hot water supply lines to each fixture, if single fixture, and to each battery of fixtures; and at each automatic, solenoid-operated or quick-closing valve serving mechanical, kitchen or laundry equipment.

(2) Hammer Arresters shown on drawings are partial requirements only. Water hammer arresters shall be installed throughout the water systems such that there will be no noise, movement in the piping system or damage to equipment due to water hammer. Adequately protect all equipment and fixtures requiring water hammer protection.

(3) All water hammer arresters shall be installed directly behind such access doors and shall be readily accessible for easy replacement.

f. Trap Primers.

(1) Trap primers are required on all floor drains and hub drains. Install a trap primer, water supply line, ball valve, union, trap primer distribution unit, connector fittings, 1/2-inch copper drain line to floor or hub drain and access door (12-inch by 24-inch minimum) for each floor drain and hub drain whether or not shown on drawings.

(2) Trap primers may be omitted on floor drains located in toilet rooms if first approved by authorities having jurisdiction.

(3) Trap primers, trap primer drain lines and distribution units to floor drains or hub drains located in mechanical rooms may be installed exposed above the finished floor level. Auxiliary inlet fittings and access doors may be deleted. Provide a minimum 1-inch air gap between floor drain or hub drain and trap primer drain line.

(4) Equip primers with distribution units as required to provide an individual drain line to each hub drain or floor drain.

3.2 PROTECTION OF FINISH

a. All floor drains, cleanouts and wall hydrants shall be adequately protected from physical damage during construction. Grates, covers and tops that have been marred or damaged shall be replaced with new or equivalent design, material and finish at no cost to the Owner. Grates, covers and tops shall have a new and unmarred look at time of construction end.

3.3 COORDINATION

a. Making adjustments to field conditions is considered a part of the work required. Do not use contract drawings accompanying these specifications for rough-in locations but only for pipe sizing and general routing.

b. Contractor shall examine and familiarize himself with the Architectural, Structural, Electrical and Mechanical drawings to be knowledgeable of all plumbing connections required and space limitations.

c. The drawings are diagrammatic and are not intended to show all the fittings required. Contractor shall include in his bid, costs for items of material and labor which

are not specifically called for in drawings or specifications, but which are required to make plumbing installation. Contractor shall make any necessary changes to avoid beams, footings, columns, piers, vents, ducts, equipment or other obstructions.

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SECTION 22 13 16

SOIL, WASTE AND SANITARY PVC DRAIN PIPING, VENT PIPING AND APPURTENANCES

1.0 GENERAL

1.1 SCOPE

a. This Section provides requirements for furnishing and installing piping within buildings and underground laterals.

1.2 RELATED WORK

a. Division 02, Site Work.

(1) Sanitary Sewers.

(2) Section 23 07 19.53 – Low Temperature Piping Insulation.

b. Division 23, Mechanical.

(1) Pipe and Pipe Fittings.

(2) Plumbing Fixtures and Fixture Carriers.

(3) Drains, Hydrants and Cleanouts.

1.3 STANDARDS

a. Perform work in accordance with applicable statutes, ordinances, codes, and regulations of governmental authorities having jurisdiction.

b. Resolve any code violation discovered in contract documents with the Engineer prior to award of the Contract. After award of the Contract, make any correction or additions necessary for compliance with applicable codes at no additional cost to Owner.

c. Obtain and pay for all permits and inspections.

2.0 PRODUCTS

2.1 DRAIN AND VENT PIPE AND FITTINGS

a. Waste and vent pipe and pipe fittings shall be:

(1) Material. Schedule 40 ASTM D-1784, D-2665, D-3311, FHA UM-79, Federal Specification L-P-320a, IAPMO IS 9-75, PS 27-69, NSF Standard No. 14, cell classification 12454-B (Type I, Grade 1) polyvinyl chloride - drain waste and vent (PVC-DWV) pipe and fittings.

(2) PVC pipe and pipe fittings shall have design stresses of 2000 psi at 73°F and shall be listed, tested, and approved for conveying sanitary waste by the Plastic Pipe Institute (PPI) and the National Foundation Testing Laboratory (NSF).

(3) Fittings shall conform to ASTM D-2466 and NSF Standard No.14.

(4) Solvent cement joints shall be made in accordance with ASTM D-2564 using Purple Primer meeting requirements of ASTM F-656, listed for use on PVC.

(5) All piping system components shall be the products of one manufacturer and shall be installed in accordance with the manufacturer's recommendations. Piping shall not be threaded.

(6) Fittings and pipe shall be clearly marked in accordance with the requirements of ASTM standards.

3.0 EXECUTION

3.1 NOTICE AND FEES

a. Give proper notice and pay all fees and other costs for complete sewer service.

3.2 GRADE AND COVER

a. Give horizontal pipe a uniform grade of 1/4-inch per foot where possible, but not less than 1/8-inch per foot, unless otherwise shown. Verify all flowline elevations and pipe grades with local authorities for approval of all sanitary piping with grades less than 1/4-inch per foot. Field verify all flow lines shown on drawings.

b. Prior to installation of any portion of piping, determine the actual space requirements including the space required for proper slope of pipe. Do not install any

piping until such flow line elevations and offsets are determined to be acceptable within the limitations of these documents and local code requirements. Make all offsets and adjustments required for proper installation.

3.3 PIPE AND JOINT FABRICATION

a. Cut plastic pipe with pipe cutters using a cutting wheel specifically designed for plastic pipe.

b. Remove all burrs, chips, filings, etc. from both the I.D. and O.D. of the pipe before joining. Use a knife, deburring tool, or a half-pound coarse file to remove all burrs.

c. Bevel all pipe ends to minimize the chances of wiping the solvent cement from the I.D. of the fitting as the pipe is socketed. Use a beveling tool designed to bevel pipe at a 10° to 15° angle and a depth of 1/16" to 3/32".

d. Using a clean, dry, cotton rag, wipe away all loose dirt and moisture from the I.D. and O.D. of the pipe end and the I.D. of the fitting. Do not solvent weld wet surfaces.

e. Apply primer to the pipe surface in the same manner, making sure that the length of pipe evenly brushed is at least equal to the fitting socket depth.

f. For checking penetration, scratch or scrape away the primed surface until a few thousandths of an inch can be so removed. Repeat applications of primer to either or both surfaces as necessary. In cold weather, allow more time for proper penetration.

g. Cover the outer pipe surface literally with solvent cement for a length at least equal to that of the fitting socket depth.

h. Continue alternate application to the fitting socket with a medium layer of solvent cement. Avoid puddling in the socket. On belled end pipe, do not coat beyond the socket depth or allow cement to run beyond the bell.

i. Apply a second coat of cement to the pipe. Cement layers must be without voids and sufficient to fill any gaps in the joints.

j. Immediately upon finishing cement application and before it starts to set, insert the pipe to the full socket depth while rotating the pipe or fitting 1/4 turn to ensure complete and even distribution of the cement. Hold joint together for a minimum of 10 to 15 seconds to make sure that pipe does not move back out of the socket.

k. Immediately after joining and before joint is set, gently place joint onto a level surface, and wipe off all excess cement from the circumference of the joint.

l. Do not perform joining operations if ambient temperature is below 40°F. Allow a minimum of 72 hours of joint drying time before subjecting joints to any appreciable internal pressure.

3.4 DRAIN PIPE AND FITTINGS

a. Offsets and Fittings.

(1) Use reduction fittings to connect two pipes of different diameter.

(2) Change directions by appropriate use of 45-degree wyes, long-sweep quarter-bends, and sixth- , eighth-, and sixteenth-bends. Sanitary tees may be used on vertical stacks. Use long sweeps at the base of risers.

(3) Provide a separate trap at each fixture, unless a trap is built into the fixture. Provide a Deep Seal trap at each floor drain and hub drain. Place traps so that the discharge from any fixture will pass through only one trap before reaching a building drain.

(4) For sets of fixtures installed in 4-inch walls, provide a separate waste and vent line for each fixture (do not interconnect in wall). Connect the waste lines underfloor and the vent lines above the ceiling. Maintain structural and aesthetic integrity of walls.

(5) Do not route any piping above electrical control panels and related electrical equipment. Prior to installation of any piping, determine the actual space requirements and the location of all electrical panels and related electrical equipment. Make all offsets and adjustments as required.

b. Floor Drains. Provide all required floor drains complete with drain lines and vent lines as required by the section on Drains, Hydrants and Cleanouts.

c. Cleanouts.

(1) Provide drainage lines with properly specified cleanouts. Provide all as required by the section on drains, hydrants and cleanouts.

3.5 VENT PIPING

a. Make vent connections to vent stacks with inverted wye fittings. Extend full-size vents through the roof to at least 6-inches above the roof.

b. Coordinate location of vent penetrations with roofing trades; flashing to be done by roofer.

c. Offset all vents located near building edge such that no vent through roof piping is located within 5-feet from the building edge (measured from building line not building eave). Make offsets in roof structure space.

d. Terminate vent through roof not less than 15-feet away from any shaft, window or outside air intake openings.

e. All vent and vent branch pipes shall be graded and connected to drip back to sanitary waste piping by gravity.

3.6 ROUGH-IN AND FINAL CONNECTIONS

a. Make rough-in and final connection of all services to all fixtures requiring plumbing connections. Contractor shall be responsible for installing fixtures at locations shown on the Architectural drawings and providing all service connections at required locations.

b. Rough-in and final connection of services to all equipment shall be installed in accordance with the latest edition of the manufacturer's rough-in measurements manual. Contractor shall obtain all such documents.

c. Use threaded sanitary tapped tee pipe fittings for p-trap connections at walls.

d. Provide service connections to all plumbing fixtures specified and to all equipment furnished by others. Reference section 23 21 00 for rough-in requirements of equipment furnished by others where applicable.

e. Install all piping and associated equipment in accordance to manufacturer's recommendations using recommended tools.

f. Provide all fittings and appurtenances required for a complete and working system.

3.7 COORDINATION

a. Making adjustments to field conditions is considered a part of the work required. Do not use contract drawings accompanying these specifications for rough-in locations but only for pipe sizing and general routing.

b. Contractor shall examine and familiarize himself with the Architectural, Structural, Electrical and Mechanical Drawings to be knowledgeable of all plumbing connections required and space limitations.

c. The Drawings are diagrammatic and are not intended to show all the fittings required. Contractor shall include in his bid, costs for items of material and labor which are not specifically called for in drawings or specifications, but which are required to make plumbing installation. Contractor shall make any necessary changes to avoid beams, footings, columns, piers, vents, ducts, equipment or other obstructions.

d. In any case where a pipe shown on a plan sheet differs from that shown on a riser, schematic or detail, use the larger of the two sizes shown.

3.8 PVC PIPE IN RETURN AIR PLENUMS.

a. Insulate all waste and vent pipe located in return air plenums where pipes do not meet the flame/smoke rating of 25/50 requirements.

3.9 TESTING

a. Under Floor.

(1) Test pipe under floors before connecting to sewers.

(2) Maintain not less than 15-feet of hydrostatic head.

(3) Repair all leaks and repeat until system holds for 2-hours without a drop in water level.

b. System Test. After all the various sections of soil, waste and vent piping are installed, but before fixtures are connected, test the system by:

(1) Plugging all outlets.

(2) Filling the entire system with water and maintaining not less than 10-feet of hydrostatic head to any portion of the sanitary or vent piping system. Apply water tests to drainage, waste and vent systems either in its entirety or in sections. Provide extension pieces, wyes, supports, clamps, plugs and all other fittings and materials as required to facilitate plugging and testing.

(3) Repair all leaks and repeat until system holds for 6-hours without a drop in water level.

c. Furnish all equipment and labor required to conduct tests.

d. Contractor shall notify Architect/Engineer or appointed Owner's representative for visual inspection of test. At Architect's/Engineer's discretion, the General Contractor shall verify and document the test results. Test findings shall be documented and forwarded to the Architect/Engineer.

e. Prior to ceiling and wall cover-up, Contractor shall conduct smoke test of the entire waste and vent system to assure no leaks occur. Prior to test Contractor shall seal all vent through roofs, pump smoke in system. Once complete and accepted by the Architect/Engineer Team, Contractor shall unplug all vent through roofs. Contractor shall conduct a second smoke test when all plumbing fixtures are installed and introduce smoke in piping system as mentioned above. Both tests are to be witnessed and accepted by the Architect/Engineer Team prior to completion of the project.

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SECTION 22 33 00.26

ELECTRIC DOMESTIC WATER HEATERS (LESS THAN 10 KW)

1.0 GENERAL

1.1 SCOPE

a. This Section includes hot water heating systems complete as shown, including hot water heaters and pressure temperature relief valves as scheduled.

1.2 RELATED WORK

a. Division 23, Mechanical.

(1) Pipe and Pipe Fittings - General.

(2) High Temperature Piping Insulation.

(3) Domestic Water Piping and Appurtenances.

1.3 CERTIFICATION

a. Provide a water heater tested, listed and labeled by the Underwriters (U.L.) Laboratories for 150 psi standard working pressure and shall comply with the National Electrical Manufacturers Association (NEMA) standards.

2.0 PRODUCTS

2.1 CAPACITY

a. Water heaters shall have the storage capacity, efficiencies and gallons per hour recovery at 100°F rise as scheduled on drawings. Water heaters shall meet energy efficiency standards of ASHRAE 90A-1980.

2.2 TANK

a. Provide a glass-lined tank with an alkaline borosilicate composition that has been fused to steel by firing at a temperature range of 1400°F to 1600°F. Equip tank with extruded aluminum, sacrificial anode rods, required piping, piping connections, ASME and UL-174 rated temperature and pressure relief valve, drain valve, thermometers and all other required openings. Tank shall be rated for 150 psi working pressure.

2.3 INSULATION

a. Insulate the water heater with factory applied high density fiberglass (or similar product) and trim with a heavy-gauge, enameled steel jacket.

2.4 GUARANTEE

a. Provide a 1-year limited warranty on water heater as available from manufacturer.

2.5 INSTALLATION AND TESTING

a. Water heater shall be tested and installed according to the current installation instructions provided with the unit.

3.0 EXECUTION

3.1 INSTALLATION

a. Install a line size shut-off valve in the cold water supply close to each heater.

b. Provide approved dielectric couplings at all cold water and hot water connections to storage tank, and at pressure and temperature relief valve connection.

c. Check operation of safety controls and devices and proper settings of elements.

d. Have the authorized representative of the water heater available if requested.

e. Install according to manufacturer's specifications and pipe as shown.

3.2 DISCHARGE PIPING

a. Discharge piping from temperature and pressure relief valve shall be routed to nearest floor drain, hub drain or other approved point of safe discharge. Discharge piping shall be full size, in diameter, of relief opening of temperature and pressure relief valve.

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SECTION 22 40 00

PLUMBING FIXTURES

1.0 GENERAL

1.1 SCOPE

a. This Section provides requirements for furnishing and installing urinals, and electric drinking fountain.

1.2 APPLICABLE PROVISIONS

a. Refer to Section 23 00 00, Mechanical General Provisions.

1.3 JOB REQUIREMENTS

a. Furnish plumbing fixtures shown or specified with all necessary trimming. Furnish faucets, fittings, supply stops and similar devices of one manufacturer.

b. Unless otherwise specified, all sink faucets shall be washerless. Seats on faucets specified with renewable/replaceable seats shall be Monel.

c. Furnish chair carriers for all wall hung fixtures.

d. All porcelain enameled surfaces shall be acid resistant porcelain.

e. All plumbing fixtures shall be new and unused, free from imperfections, true as to line, angles, curves and color. Smooth, watertight and complete in every respect.

1.4 STANDARDS

a. Perform work in accordance with applicable statutes, ordinances, codes, and regulations of governmental authorities having jurisdiction.

b. Furnish and install required plumbing fixtures for use by handicapped as required by the latest edition of the Texas State Purchasing and General Services Commission Act or Elimination of Architectural Barriers and any other state or local code requirements.

c. Obtain and pay for all permits and inspections.

d. All fixtures shall comply with A112.19 and all subsections.

e. All faucets, valves, stops, etc. conveying water for human ingestion shall conform to NSF 61, Section 9.

2.0 PRODUCTS

2.1 WALL-HUNG URINALS (UR-1).

(1) Fixture. Furnish and install a white vitreous china, siphon jet flushing action, compact, space-saving, wall-hung, flush valve urinal fixture with 3/4 inch top spud. Urinal fixture shall measure a minimum of 14-inches from wall to front of flare and shall be designed to flush efficiently with a maximum of 0.5-gallon of water total per flush. American Standard No. 6550.005.

(2) Trim. Equip fixture with a sensor operated, self-cleaning piston, quiet flush, exposed urinal flush valve made of chrome plated brass and battery operated with override button, 1-inch IPS screw driver operated back check angle stop with protective cap, renewable main valve seat, adjustable threaded union tailpiece, vacuum breaker, 3/4-inch by 11-1/2 inch flush tube and connection with spud coupling for 3/4-inch top spud, spud securing nut, wall and spud flanges, one gallon flush regulator, solid ring pipe support all with polished chrome finish. American Standard No. 6063.051.002.

(3) Wall Sealing Ring. Furnish and install resilient sponge rubber urinal sealing rings. Do not use wax ring gaskets. Install per manufacturer's recommendations.

2.2 ELECTRIC DRINKING FOUNTAIN

a. Wall Hung Two Level Electric Drinking Fountain (EDF-1)

(1) Fixture. Furnish and install wall mounted one level ADA duel height electric water cooler with all stainless steel basin, 8 GPH capacity and combination self-closing stop and regulator. Furnish an air cooled unit and motor that is 1/5 HP, 115 volt, single phase, 60 HZ. Elkay No. EZ08L / LKAPR EZL or approved equivalent.

(2) Supplies. Furnish and install straight screwdriver stop with 1/2-inch IPS inlet and outlet. Elkay No. LK-2680 or approved equivalent.

(3) Trap. Furnish and install 1-1/4-inch adjustable cast brass "P" trap with tubing drain to wall, ground swivel joint, clean-out plug and cast brass escutcheon, all with polished chrome finish. McGuire No. 8872 or approved equivalent.

2.3 FIXTURE CARRIERS

a. Urinal Carriers. Furnish and install ZURN ZR-1221 or -1222 series, or approved equivalent, concealed carrier with bearing plate or approved equivalent.

b. Electric Drinking Fountain Carriers. Furnish and install a ZURN ZR-1225 series concealed drinking fountain carriers with adjustable support plates or approved equivalent.

2.4 FLOW RESTRICTORS AND TEMPERING VALVES

a. Furnish and install flow restrictors and tempering valves to all fixtures requiring water flow and/or temperature regulation as required to meet local code requirements and to regulate water flow for instantaneous water heaters. Furnish either in-line or faucet-end type flow restrictors (Use of either type is acceptable). Furnish access to all in-line flow restrictors located in walls or above ceilings.

2.5 CHROME FINISH

a. All exposed fixture trim, including (but not limited to) p-traps, supplies, riser supports, flex tube risers, etc. shall have a polished chrome finish. Furnish all polished chrome finished nipples, extension pieces, escutcheons, etc. required to meet this requirement.

2.6 ACCEPTABLE MANUFACTURERS

a. Plumbing Fixtures: American Standard, Kohler.

b. Drinking Fountains: Elkay, Halsey Taylor, Haws.

c. Flush Valves: Kohler.

3.0 EXECUTION

3.1 INSTALLATION

a. Set fixtures at heights as directed and approved by Architect.

b. Rigidly secure all water supply piping to wall structure. The piping in the wall shall be secured to wall such that flush valve or supply piping will not have any movement during valve activation or when jarred (typical for all plumbing fixtures).

c. Furnish and install adequate pipe supports in walls at all supply and drain lines extending through walls to rigidly secure all supply lines to all fixtures with special concentration on water closet and urinal supply lines. Contractor shall install additional pipe supports, metal framing, Unistrut, nuts, bolts, clamps and metal channels as required to adequately and rigidly secure all valves and supply piping in pipe chases and to prevent damage to plumbing fixtures. Movement of piping within wall due to valve activation or jarring will not be acceptable.

d. At each water supply stop serving lavatories and sinks, furnish and install a plastic support bracket as manufactured by P & M Company to adequately secure piping in wall. In lieu of such brackets, cast brass drop ear elbow fittings may be used when adequate blocking is installed in wall and brass elbow is rigidly secured to blocking in wall (secure to wall with brass screws or copper nails). In either case install an additional copper tubing strap located not more than 1-inch from elbow at supply stop and adequately secure to blocking in wall with brass screws or copper nails. Connect supply stop to elbow in wall using ASTM B 43-80, threaded, red brass pipe nipples. Conceal pipe nipples in wall. Where pipe nipples cannot be concealed, install polished chrome plated, threaded, red brass pipe nipples. Under no circumstances shall steel nipples be used.

e. All escutcheons shall be installed flush to wall (no gap between wall and escutcheon plate). Caulk all wall penetrations behind pipe escutcheons. Air tight with Dow-Corning No. 2000 Fire Stop Sealant or approved equivalent. Wall penetrations shall not be larger than the escutcheon installed. All escutcheons of same type service shall be of same physical size. Reference the section on Pipe and Pipe Fittings - General for additional requirements on pipe escutcheons.

f. All plumbing trim shall be installed in a neat and well organized manner with services running parallel with the primary lines of the building construction.

g. Install all appurtenances required for a complete and working system.

h. Install all fixtures and trim in accordance with the manufacturer's recommendations and as shown on drawings.

3.2 ROUGH-IN AND FINAL CONNECTIONS

a. Make rough-in and final connection of all services to all fixtures requiring plumbing connections. Contractor shall be responsible for installing fixtures at locations shown on the Architectural drawings and providing all service connections at required locations.

b. Rough-in and final connection of services to all equipment shall be installed in accordance with the latest edition of the manufacturer's rough-in measurements manual. Contractor shall obtain all such documents.

c. Install service connections to all plumbing fixtures specified and to all equipment furnished by others. Reference Section 23 21 00 for rough-in requirements of equipment furnished by others.

3.3 QUALITY AND PROTECTION

a. All plumbing fixtures shall be free from imperfections, true as to line, angles, curves and color, smooth, watertight and complete in every respect. Chipped, scratched, marred or disfigured fixtures shall be replaced with new fixtures. Contractor shall replace all fixtures found to be damaged or defective.

3.4 COORDINATION

a. Making adjustments to field conditions is considered a part of the work required. Do not use contract drawings accompanying these specifications for rough-in locations but only for pipe sizing and general routing.

b. Contractor shall examine and familiarize himself with the Architectural, Structural, Electrical and Mechanical drawings to be knowledgeable of all plumbing connections required and space limitations.

c. The Drawings are diagrammatic and are not intended to show all the fittings required. Contractor shall include in his bid, costs for items of material and labor which are not specifically called for in drawings or specifications, but which are required to make plumbing installation. Contractor shall make any necessary changes to avoid beams, footings, columns, piers, vents, ducts, equipment or other obstructions.

d. Contractor shall coordinate physical requirements of all countertop fixtures with all other trades. Prior to submittal on these fixtures, the contractor shall verify space limitations.

3.5 CLEANING AND ADJUSTING

a. Thoroughly clean and disinfect all plumbing fixtures, including all exposed trim. At work completion all plumbing fixtures and trim shall be clean and free from any stains, sediment, waterspouts, oils, factory shipping wrapping/protective covers, installation instruction stickers/labels, etc. Disinfect all plumbing fixtures using commercial disinfecting agents.

b. Properly flush all water systems, clean and service all strainers and plumbing connections to facilitate proper operation of fixture valves. Install servicing until all water systems and appurtenances prove to be clean, free of debris and operating properly.

c. Adjust all flush valves and self-closing valves for proper flushing or operation, but without excess use of water. Water closets shall not exceed 1.6-gallons per flush, urinals shall not exceed 1-gallon per flush and lavatory faucets shall remain open for a minimum of 10 seconds, and a maximum of 20 seconds. Demonstrate to the Architect (or representative) that the entire system and all components thereof are functioning properly.

d. Install such equipment and personnel as required to conduct tests and demonstrate the acceptability of the various plumbing systems.

e. Have the authorized representatives of the various manufacturers available if requested.

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SECTION 22 40 00.16

PIPING AND PIPING APPURTENANCES FOR COLD WATER MAKE-UP AND EQUIPMENT DRAINS

1.0 GENERAL

1.1 SCOPE

a. This Section provides for the furnishing and installation of piping and piping appurtenances to drain air handlers.

1.2 APPLICABLE PROVISIONS

a. Refer to Section 23 00 00, Mechanical General Provisions.

2.0 PRODUCTS

2.1 PIPE AND FITTINGS

a. Furnish seamless, hard-drawn, Type L, copper water tube conforming to ASTM B 88, and wrought copper fittings.

2.2 TRAPS

a. On each air handling unit condensate drain, furnish a trap deep enough to overcome pressure of the unit. All drain piping shall be Type L copper pipe.

3.0 EXECUTION

a. Install in strict and complete accordance with manufacturer's recommendations.

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SECTION 23 00 00

MECHANICAL GENERAL PROVISIONS

1.0 GENERAL

1.1 SCOPE OF WORK

a. The work covered by Division 23 includes the furnishing of all materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary and the complete installation of all mechanical work required in the Contract Documents and specified herein. The intent of the Contract Documents is to provide an installation complete in every respect. In the event that additional details or special construction may be required for the work indicated or specified in Division 23 or work specified in other Divisions of the Specifications, it is the responsibility of the Contractor to provide all material and labor which is usually furnished with such systems in order to make the installation complete and operational.

b. The Contractor is responsible for the coordination and proper relation of his work to the building structure and to the work of other trades. The Contractor shall visit the site and thoroughly familiarize himself with the existing conditions that affect the work and to verify all dimensions. The Contractor shall advise the Architect/Engineer of any discrepancy prior to bidding. The submission of a bid shall be deemed evidence of the Contractor's site visit, the coordination of all existing conditions, and the inclusion of all consideration for existing conditions.

1.2 CODES AND STANDARDS

a. All work shall comply with the latest edition or the adopted editions of the applicable standards, rules, and regulations of the ASTM, ASHRAE, ASME, UL, SMACNA, ANSI, AWWA, IBC, IMC, IPC, IFC, NEC, and Americans with Disabilities Act (ADA), as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provisions of this specification shall be construed as waiving any of the rules, local amendments, regulations, or requirements of these codes or authorities.

b. Materials which are specified by reference to Federal Specifications; ASTM, ASME, ANSI, or AWWA Specifications; Federal Standards; or other standard specifications must comply with latest editions, revisions, amendments or supplements in effect on date bids are received. Requirements in reference specifications and standards are minimum for all equipment, material, and work. In instances where capacities, size or other feature of equipment, devices or materials exceed these minimums, meet listed or shown capacities.

c. Material and equipment for electrical work shall bear approval label or be listed by Underwriters' Laboratories.

d. The Contractor shall resolve any code violation discovered in the Contract Documents with the Architect/Engineer prior to award of the contract. After award of the Contract, make any correction or additions necessary for compliance with applicable codes as part of this work.

e. In any instance where the Plans or Specifications call for materials of a better quality or larger size than required by the codes, those provisions of the Drawings or Specifications shall take precedence. The codes shall govern in case of direct conflict between the codes and the Drawings or Specifications.

1.3 RELATED DOCUMENTS

a. The Plans and Specifications, the General Conditions, Supplementary General Conditions and other requirements of Division 01, apply to the work specified in Division 23, and shall be complied with in every respect. The Contractor shall examine all of the documents, which make up the Contract Documents, and shall coordinate them with the mechanical work on the Mechanical plans and in Division 23 of these Specifications.

1.4 DRAWINGS AND SPECIFICATIONS

a. The Specifications are accompanied by Drawings for the project and details of the installations indicating the locations of equipment, piping, outlets, etc. The Drawings and Specifications are complementary to each other, and what is required by one shall be as binding as if required by both.

b. If any departures from the Contract Documents are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted in writing to the Architect/Engineer for review. No departures from the Contract Documents shall be made without prior written approval of the Architect/Engineer.

c. The interrelation of the Specifications, Drawings, and Schedules is as follows: The Specifications determine the nature and quality of the materials, the Drawings establish the quantities, dimensions and details, and the Schedules give the performance characteristics. Should the Drawings or Schedules disagree in themselves, or with the Specifications, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Architect/Engineer in writing, shall be performed or furnished. Figures indicated on Drawings govern scale measurements and large scale details govern small scale Drawings. In case of disagreement between Specifications and Drawings, see Division 01 of these Specifications for clarification.

d. Items specifically mentioned in the Specifications but not shown on the Contract Drawings and/or items shown on the Contract Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

1.5 PERMITS

a. Obtain and pay for all permits and inspections.

1.6 BUILDING CONSTRUCTION

a. It is the responsibility of the Contractor to review the Drawings and Specifications so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.

b. The mechanical drawings are diagrammatic in character and cannot show every connection in detail or every pipe or duct in its exact location. The Contractor shall carefully investigate structural and finish conditions and shall coordinate with all other trades in order to avoid interference between the various phases of work.

c. The approximate location of mechanical items is indicated on the mechanical drawings. These drawings are not intended to give complete and exact details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the job site and will in all cases be subject to the approval of the Architect/Engineer. The Architect/Engineer reserves the right to make any reasonable changes in the location indicated without additional cost.

1.7 BUILDING DEMOLITION

a. Unless noted otherwise, remove all mechanical materials and equipment from areas designated for demolition.

b. Remove all piping, ductwork, fixtures, valves, trim, air devices, hangers, supports, and other items of mechanical equipment not required to remain as a portion of the remodeled work. Remove any abandoned mechanical materials, equipment, etc. encountered during the demolition phase. Ensure that systems serving adjacent areas of the building, not part of the demolition and renovation, are kept in service.

c. Patch all wall, floor, or other openings created as a result of the demolition.

d. Remove any materials or equipment to be relocated and/or reinstalled as part of the renovations. Protect all such items from damage during the removal, storage, and reinstallation process. Clean all such items prior to reinstallation.

e. Work shall be executed and all materials installed to present a neat appearance when completed in accordance with the best practice of the trades in a thorough, substantial, workmanlike manner by competent workmen.

f. Wherever a new to existing mechanical connection is required, the Contractor shall provide all materials (e.g., piping, ductwork, fittings, and wiring connections) and labor required to make the connections.

1.8 CONTRACTOR QUALIFICATIONS

a. An acceptable Contractor for the work under this division shall be a specialist in this field and have the personal experience, training, skill and the organization to furnish a practical working system. If required, he shall be able to furnish acceptable evidence of having contracted for and installed not less than three systems of comparable size and type to this one, that have served their owners satisfactorily for not less than three years.

b. The foreman for this work shall have had experience in installing not less than three such systems and shall be approved before the work is begun. Adequate and competent supervision shall be provided to ensure first class workmanship and installation.

c. Work shall be executed and all materials installed in accordance with the best practice of the trades in a thorough, substantial, workmanlike manner by competent workmen, presenting a neat appearance when completed. Work shall be performed by mechanics skilled in the trade.

d. The Contractor shall be responsible for all construction techniques required for all mechanical systems specified and shown on the drawings.

1.9 OBSERVATION OF THE WORK

a. Architect/Engineer's and/or Owner's authorized representative shall have the right to observe the work at any time. The Contractor shall have a representative present when his work is being observed, and he shall give assistance, as may be required, to the Architect/Engineer's representative. Recommendations made by observer shall be promptly carried out, and all unsatisfactory material and/or workmanship shall be replaced to the satisfaction of the Architect/Engineer.

b. Periodic observation of the work by Engineer is only for the express purpose of verifying compliance with the Contract Documents. Observation by the Engineer shall not relieve Contractor, any Subcontractor, and/or Material Supplier of responsibility for deviation from requirements of Contract Documents nor for error or omissions in the performance of work.

1.10 SUBMITTALS

a. Comply with the requirements of Division 01, Submittals.

b. The submittals shall include a specification compliance analysis for review and approval before work shall begin. The compliance document shall address each paragraph of the specification by indicating COMPLY, EXCEED or EXCEPTION. Do not indicate COMPLY unless the proposed system exactly meets the paragraph requirement. If EXCEED or EXCEPTION is indicated, then provide a clear and concise explanation of the variance from the specifications and the net effect this would have on the specified system performance.

c. Review is only for general conformance with design concept of project and general compliance with the Contract Documents. Contractor is responsible for conforming and correlating equipment dimensions at job site; for information, which pertains to fabrication processes or construction techniques; and for coordination of work of all trades. Review of submittals shall not relieve Contractor, any Subcontractor and/or Material Supplier of responsibility for deviation from requirements of Contract Documents nor for errors or omissions in submittals, including failure to coordinate with work required by other trades. Any material provided by the Contractor, subcontractor, and/or material supplier without review constitutes the Contractor's, subcontractor's and/or material supplier's agreement to comply with the Architect/Engineer's intent whether specified, shown or implied.

d. **ORGANIZE DATA IN A 3-RING HARDCOVER BINDER WITH DIVIDERS TABBED AND INDEXED BY SPECIFICATION SECTION.** Show any revisions to equipment layouts required by use of selected equipment. Type of submittal data is listed in the individual sections of this Division.

e. Drawings.

(1) Submit coordination Fabrication Drawings (i.e. Shop Drawings) for all equipment and for all ductwork. Ductwork shall be at 1/4" = 1'-0" and all equipment rooms shall be at 3/8" = 1'-0". Drawings shall indicate all service clearances.

1.11 SUBSTITUTIONS AND PRODUCT OPTIONS

a. Products List. Within 30 days after Contract date, submit to Architect/Engineer a complete list of major products proposed to be used, with the name of the manufacturer and the installing subcontractor.

b. Contractor's Options.

(1) For products specified only by reference standard, select any product meeting that standard.

(2) For products specified by naming several products or manufacturers, select any one of the products or manufacturers named, which complies with the specifications.

(3) For products specified by naming one or more products or manufacturers and "or equivalent," Contractor must submit a request for substitutions for any product or manufacturer not specifically named.

(4) For products specified by naming only one product and manufacturer, there is no option.

c. Substitution Provisions. Manufacturers' names and catalog numbers specified under sections of Division 23 are used to establish standards of design, performance, quality and serviceability and not to limit competition, nor to discriminate against an "approved equivalent" product of another manufacturer. Equipment of equivalent design to that specified will be acceptable upon approval by the Architect/Engineer. The Architect/Engineer will **not** consider written requests for substitution of specified products, until the period beginning 30 calendar days and ending 60 calendar days after the date of the Notice to Proceed by the Owner. After that date, request for substitution will be considered only in cases of product unavailability or other conditions beyond control of the Contractor. It is the Contractor's responsibility to:

(1) Personally investigate the proposed substitute product to determine that it has all the same accessories and is equal or superior in all respects to that specified.

(2) Provide the same guarantee for the substitution that he would for that specified.

(3) Coordinate the installation of the equipment, which he proposes to substitute with all, trades and includes the costs for any changes required for the work to be complete in all respects. The Contractor will prepare shop drawings where required by the Architect/Engineer or where dimensions vary.

(4) Provide itemized cost breakdown including material and labor for the proposed product substitutions.

(5) Submit complete design and performance data.

d. The Architect/Engineer will review Requests for Substitutions with reasonable promptness, and notify the Contractor, in writing, of the decision to accept or reject the requested substitution.

1.12 PROJECT RECORD DOCUMENTS

a. Throughout progress of the work of this Contract, maintain an accurate record of all changes in the Contract Documents. Upon completion of the Work of this Contract, transfer the recorded changes to a set of reproducible Record Documents. Delegate the responsibility for maintenance of Record Documents to one person on the Contractor's staff. Thoroughly coordinate all changes within the Record Documents, making adequate and proper entries on each page of Specifications and each sheet of Drawings and other Documents where such entry is required to properly show the change. Accuracy of records shall be such that future search for items shown in the Contract Documents may reasonably rely on information obtained from the approved Record Documents. Make all entries within 24 hours after receipt of information.

b. The Contractor will mark all deviations on a daily basis. The Architect/Engineer will visit the site periodically and may request to see the "As-Built" documentation. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect/Engineer. Mark the drawings with a colored pencil. Record installed feeder conduits, dimensioning the exact location and elevation of the conduit.

c. Record Documents shall consist of the following:

(1) Job Set: Promptly following award of Contract, secure from the Architect/Engineer, one complete set of all documents comprising the Contract.

(2) Final Record Documents: At a time near the completion of the work, secure from the Architect/Engineer at the Contractor's expense, one complete set of reproducible mylar sepias of all Drawings included in the Contract. Following receipt of the mylar sepias described above, and prior to start of transfer of recorded data thereto, secure a review by the Architect/Engineer of all recorded data. Make all required revisions.

(3) Carefully transfer all change data shown on the job set of Record Drawings to the corresponding sepias, coordinating the changes as required, and clearly indicating at each affected detail and other drawing the full description of all changes made during construction and the actual location of items. Call attention to each entry by drawing a "cloud" around the area or areas affected. Make all change entries on the sepias neatly, consistently, and in ink or crisp black plastic lead pencil.

(4) Submit the completed total set of Record Documents to the Architect/Engineer as described above. Participate in review meeting or meetings as required by the Architect/Engineer, make all required changes in the Record Documents, and promptly deliver the final Record Documents to the Architect/Engineer. Upon completion of Work, the Contractor shall certify the "Record Drawings" for correctness by signing the following certification:

CERTIFIED CORRECT (3/8" high letters)

(Name of the Contractor)

By
Date

(Name of the Sub-Contractor)

By

Date

d. Deliver record drawings to the Architect/Engineer in the number and manner specified in Division 01 - General Requirements.

1.13 OPERATION AND MAINTENANCE DATA

a. Prepare and submit sets of product data, shop drawings, wiring diagrams, instructions and parts lists for operating and maintaining equipment and systems installed. Include in the instructions a description of normal adjustments and a list of items to be lubricated. Specify the type and frequency of lubrication required. Provide special servicing tools as required for this equipment. Deliver manuals and tools to the Architect/Engineer as a condition of final acceptance. Refer to Division 01 for other requirements. The manual shall include:

(1) Manufacturer's installation instruction brochures.

(2) Manufacturer's local representative and/or distributor's name and address.

(3) Manufacturer's operating and maintenance brochures.

(4) Manufacturer's internal wiring diagram.

(5) Contractor's installation wiring diagram.

(6) Control system installation drawings.

(7) Replacement part number listings and/or descriptions.

(8) Framed operating instructions when required.

(9) Manufacturer's warranties and guarantees.

(10) Training programs for systems provided under Division 23.

b. The manual shall include all of the above listed data bound into a permanent hard-back, three ring binder(s) identified on the cover as "Operating and Maintenance Manual" with additional cover display of the location of Building and the name, address and telephone number of the Owner, the Architect, the Engineer, the General Contractor, and the Subcontractors installing equipment represented in the brochure.

c. Contents of the manual shall be grouped in sections according to the various sections of Division 23, and shall be listed in a Table of Contents. Sections shall be organized as follows:

(1) Each "tab" in the brochure shall identify the grouping of all literature required for a single class of equipment; i.e., "air handling units", "plumbing fixtures", etc., for all types of equipment on the job.

(2) Contents under each "tab" shall refer to a single class of equipment, and shall be arranged in the following sequence: First, the manufacturer's installation brochure; second, the manufacturer's operating and maintenance brochure; third, the manufacturer's installation wiring diagram; fourth, the Contractor's field wiring diagram; if different, and fifth, the manufacturer's brochure listing replacement part numbers and description.

(3) Provide final tab "Warranties and Guarantees" behind which all such items will be located.

d. Upon completion of the work, instruct the Owner's operating personnel in operation and maintenance of mechanical equipment and systems furnished and installed under Division 23. The specified training shall be given at a time and location designated and provided by the Owner for personnel selected by the Owner, in addition to any necessary on-site orientation and training. A training program shall be submitted with materials, instructor qualifications and a proposed schedule, a minimum of 45 days prior to the proposed training for each mechanical system in the project. The Owner reserves the right of approval of each training course. A minimum of 12 (other quantity if appropriate) bound copies of training materials shall be provided at the time of training, with additional copies submitted at the time of Substantial Completion included with the O&M Manuals.

At the conclusion of the instruction, obtain the signatures of the people instructed on one copy of the program to signify that they have a proper understanding of the operation and maintenance of the system. Submit the signed program to the Architect/Engineer as a condition of final acceptance. Provide a minimum of 8 hours of general instruction in addition to any time specified in other sections of Division 23.

2.0 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

a. Furnish new and unused materials and equipment of Domestic Manufacturers meeting requirements of the paragraph specifying acceptable manufacturers. Where two or more units of same type or class of equipment are required, furnish units of a single manufacture.

2.2 STANDARD PRODUCTS

a. All materials and equipment shall be standard catalog products of domestic manufacturers regularly engaged in the manufacture of products conforming to these specifications. Materials and equipment shall have been in satisfactory use at least two years prior to bid opening. Where custom or special items are required, these shall be fully described by drawings and/or material list which detail the item proposed for use on this project.

2.3 MANUFACTURERS INSTRUCTIONS

a. The Contractor is fully responsible for furnishing the proper mechanical equipment and/or material and for seeing that it is installed as intended by the manufacturer's written instructions. If needed for proper installation, operation, or start up, the Contractor shall request advice and assistance from a representative of the specific manufacturer. The manufacturers' published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning all materials and equipment. The Contractor shall promptly notify the Architect/Engineer in writing of any conflict between the requirements of the contract documents and the manufacturer's directions and shall obtain the Architect/Engineer's instructions before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer's directions or instructions from the Architect/Engineer, he shall bear all costs arising in connection with correcting the deficiencies.

2.4 RUST PREVENTION

a. All metallic materials shall be protected against corrosion. Exposed metallic parts of outdoor apparatus shall be given a rust-inhibiting treatment and standard finish by the manufacturer. All parts such as boxes, bodies, fittings, guards, and miscellaneous parts

shall be protected by galvanizing, except where other equivalent protective treatment is specifically approved in writing.

2.5 DELIVERY AND STORAGE

a. The Contractor shall not deliver any equipment to the job site until the equipment is ready to be installed or until there is suitable space provided to properly protect equipment from weather, humidity, dust, and physical damage.

b. All equipment shall be protected in accordance with the manufacturer's recommendations.

c. All equipment injured or damaged in transit from factory, during delivery to premises, while in storage on premises, while being erected and installed, and while being tested, until time of final acceptance, shall be replaced by the Contractor.

2.6 CAPACITIES AND SPACE LIMITATIONS

a. The Contractor is responsible to verify that the equipment he proposes to provide will physically fit within the space indicated on the contract documents and that the required code clearances and maintenance access are maintained. Any space conflicts shall be noted in the submittals. Provide scale drawings to the Architect/Engineer indicating proposed solutions to any space conflict for the Architect/Engineer's review and approval.

2.7 NAMEPLATES

a. Each piece of equipment shall have a nameplate from the manufacturer with the following information: name, address, catalog number, voltage, phase, full load amperes or horsepower, and/or other pertinent information on a plate securely attached to the equipment. All data on nameplates shall be legible at the time of final inspection.

b. All equipment including but limited to air handling units, fan-coil units, condensing units, boilers, chillers, furnaces, etc., shall have an engraved Setonply Nameplate, black background, white letters, 1-1/2" x 4". Nameplate shall have equipment mark (same as indicated on drawings) in white. Plate shall be attached to equipment without using screws, per manufacturer's recommendations. All fans shall have an engraved aluminum plate with fan number, black background, white letters, 3/4" x 2-1/2". Fan nameplate shall also list rooms served by fan on one line and the service on the third line. Attach to fan per manufacturer's recommendations.

3.0 EXECUTION

3.1 PROTECTION

a. Protect all materials and equipment to be installed under this Division from physical and weather damage.

b. Furnish all hoisting and scaffolding equipment required for proper installation of equipment. Take full responsibility for the safety of the materials and equipment using such hoisting equipment and scaffolding.

c. Adequately protect work, equipment, fixtures, and materials. At work completion, make all work clean and in good, unblemished condition.

d. Remove, round, or protect with ¾-inch Armaflex insulation all sharp corners of pipe, duct, and equipment where such corners pose a hazard to occupants or maintenance personnel.

3.2 COORDINATION

a. Contract Documents are diagrammatic in showing certain physical relationships to other trades. Interface and coordination with other work including utilities and electrical work is the exclusive responsibility of the Contractor.

b. Contractor shall coordinate with Division 26 and other divisions as required. This is to include, but not be limited to, verification of power, voltage, phase and other characteristics as being compatible with that called for on the electrical drawings and Division 26 specifications, as well as that called for in Division 23 drawings and specifications or other divisions requiring electrical connections or interface with this division. Contractor shall perform this coordination prior to placing orders for equipment.

c. Arrange mechanical work in a neat, well-organized manner, with services running parallel to the primary lines of the building construction, and with the maximum overhead clearance possible.

d. Locate operating and control equipment properly to provide easy access. Arrange entire mechanical work with adequate access for operation and maintenance of all components requiring access. If any equipment or components are shown in such a position that proper access cannot be provided, resolve the problem by coordinating with General Contractor prior to installation. In the event access still cannot be provided, advise Architect/Engineer and request review of the situation.

e. Advise other trades in advance of the relevant construction of openings required in their work for the subsequent move-in of large units of mechanical work.

f. Verify exact locations of existing equipment and determine exact requirements for connections prior to routing services to equipment.

g. Contract drawings are diagrammatic only and do not give fully dimensioned locations of various elements of work or show all offsets or required fittings. Determine exact locations from field measurements. Making adjustments to field conditions is considered a part of the work required.

h. Prior to locating mechanical equipment, plumbing fixtures, water heaters, water coolers and other plumbing or mechanical items, obtain approval as to exact method and exact placement and location of equipment in the various areas shown on the drawings. In no case shall the locations be determined by scaling the drawings. Plumbing fixtures shall be mounted at the heights directed by the Architect and local code authorities. Relocate equipment and devices and pay all costs of modifying work of all trades necessitated by failure to comply with this requirement.

i. The drawings show diagrammatically the location of the various outlets and apparatus. Exact locations of these outlets and apparatus shall be determined by reference to the general drawings and to all detail drawings, equipment drawings, rough-in drawings, etc., by measurements at the building, and in cooperation with the other trades. The Owner reserves the right to make any reasonable change in location of any outlet or apparatus before installation, without additional cost to the Owner.

3.3 CONCEALED WORK

a. Where the word "concealed" is used in connection with insulating, painting, piping, ducts and the like, the word is understood to mean hidden from sight as in chases, furred spaces or suspended ceilings. "Exposed" is understood to mean open to view, including exposed in mechanical rooms.

3.4 OBSTRUCTIONS

a. The Drawings indicate certain information pertaining to surface and subsurface obstructions, which have been taken from available drawings. Such information is not guaranteed, however, as to accuracy of location or complete information.

b. Before any cutting or trenching operations are begun, verify with Owner's representative, utility company, municipalities, and other interested parties that all available information has been provided. Verify locations given.

c. Should obstruction be encountered, whether shown or not, alter routing of new work, reroute existing lines, remove obstruction where permitted, or otherwise perform whatever work is necessary to satisfy the purpose of the new work and leave existing services and structures in a satisfactory and serviceable condition.

d. Assume total responsibility for and repair any damage to existing utilities or construction, whether or not such existing facilities are shown.

3.5 OPENINGS

a. Framed, cast or masonry openings for piping or equipment is specified under other divisions. However, drawings and layout work for exact size and location of all such openings are included under this Division.

b. The Contractor shall be responsible for timely placement of all equipment and piping to avoid cutting new construction.

3.6 AIR FILTERS AND PIPE STRAINERS

a. Immediately prior to final acceptance of project, inspect, clean and service strainers. Replace disposable type air filters, clean permanent air filters. Contractor shall furnish filters for each air handler, fan coil unit, and any air moving piece of equipment requiring air filters during construction and a replacement set prior to final acceptance of project.

3.7 OPERATING TESTS

a. After all mechanical systems have been completed and put into operation, subject each system to an operating test under design conditions to ensure proper sequence and operation throughout the range of operation. Make adjustments as required to ensure proper functioning of all systems. Special tests on individual systems are specified under individual sections.

3.8 LUBRICATION, REFRIGERANT AND OIL

a. Furnish a complete charge of correct lubricant for each item of equipment requiring lubrication.

b. Furnish a complete and working charge of proper refrigerant, free of contaminants, into each refrigerant system. After each system has been in operation long enough to ensure completely balanced conditions, check the charge and modify it for proper operation as required.

c. Furnish locking refrigerant caps for service valves. Locking caps shall be corrosion resistant and color coded to indicate the refrigerant used in the system. Furnish labels as necessary to indicate the refrigerant. Locking caps shall have an integral neoprene O-ring that resists all oils. Locking caps shall be accessible only by use of a hand-held screwdriver type tool with a unique end. Locking caps and associated screwdriver type tool shall be equal to a Novent Locking Refrigerant Cap.

3.9 HOISTING, SCAFFOLDING, AND TRANSPORTATION

a. The Contractor shall provide his own hoisting, scaffolding and ladders as required to set his materials and equipment in place.

b. The Contractor shall provide all necessary transportation to facilitate the delivery of all materials, equipment, tools, and labor to the job.

3.10 CLEANING AND TOUCH-UP PAINTING

a. The Contractor shall, at all times, keep the premises free from accumulations of waste material or rubbish caused by him, his employees, or his work. Debris shall be removed, not only from the building, but also from the site and from any public area adjacent to the site.

b. At completion of the project, the Contractor shall remove all of his tools, scaffolding, and surplus materials.

c. Touch-up or repaint to match original color, any finished surfaces that have been scratched or discolored.

3.11 ELECTRICAL CONNECTIONS TO MOTORS AND EQUIPMENT

a. Contractor shall coordinate with Division 26 and other Divisions as required to verify all electrical requirements of Division 23 work. This is to include but not be limited to verification of power, voltage, phase and other characteristics as being compatible with that called for on the electrical drawings and Division 26 Specifications. This shall be done prior to placing orders for equipment or material, and prior to any rough-in, etc.

3.12 CUTTING AND PATCHING

a. The Contractor shall be responsible for timely placement of all equipment and piping to avoid cutting new construction.

b. When it becomes necessary to cut through any wall, floor, or ceiling to install any work under the Contract, or to repair any defects that may appear up to the expiration of the guarantee period, such cutting shall be done by the Contractor. The Contractor will not be permitted to cut or modify any structural members without the written permission of the Architect/Engineer.

c. Patching of all openings cut by the Contractor, or repairing of any damage to the work of other trades caused by cutting or by the failure of any part of the work installed under this Contract, shall be performed by the appropriate trade and shall be paid for by the Contractor.

d. Any openings cut through exterior walls or roofs shall be provided with suitable covers, while they are left open, to protect the property or materials involved. Any openings cut through walls below grade shall be properly protected to prevent entrance of water or other damaging elements. All openings shall be waterproofed upon completion of the work as specified by the Architect/Engineer. Any openings through fire rated walls or floors shall be sealed to maintain the minimum fire rating of wall or floor penetrated, using fire barrier penetration sealing, "3M" Fire Barrier Caulk Type CP-25, and type 303 Putty Fire-Stop Sealant and "3M" Fire Barrier Penetration Sealing Systems or approved equivalent.

3.13 CONTROLS

a. Provide and install all wiring, conduit and other devices required for a complete and working HVAC system, including all interlocks and stop/start wiring from time clock. This includes but is not limited to 120 volt and low voltage wiring. Materials and method of execution are specified in Division 26 - Electrical.

b. Provide a motorized low leakage volume damper for outside air to each unit. Volume damper shall close when air-unit is de-energized.

3.14 PIPE SLEEVES

a. Fit with sleeves all pipes passing through masonry and concrete construction. Fabricate sleeves of Schedule 40 galvanized steel pipe. Size sleeve for minimum clearance between pipe or insulation and sleeve.

b. Extend each sleeve through the floor or wall. Cut the sleeve flush with each surface, except that in exposed locations, extend floor sleeves 3-inches from finished wall or above finished floor line.

c. Caulk all sleeves water and airtight. Seal annular space between pipes and sleeves with fire stop material; see specification on fire stopping found elsewhere in this specification. Install per manufacturer's recommendation to meet or exceed fire rating of penetrated wall (minimum 1-1/2 hour). Reference architectural drawings for wall fire ratings.

d. Sleeve pipe through concrete foundations, below grade with Thunderline Link-Seal wall penetration seals. Equip seals with stainless steel nuts, bolts and pressure plate.

3.15 CONDENSATE DRAINS

a. All condensate piping shall be hard drawn copper tube Type L. Contractor shall furnish and install all condensate drain piping.

3.16 FIRESTOPPING

a. All piping, tubing, ductwork, conduit, etc. passing through fire rated floors and/or walls shall have the void area between the material passing through floor and/or wall sealed with an approved fire-stop material to maintain the fire rating of the floor and/or wall. Depending on the particular installation, the contractor shall use FS900 series fire stop caulk or FS500/600 series fire-stop components as manufactured by International Protective Coatings or approved equivalent.

b. All fire stop systems shall be installed as required by the manufacturer and U.L. requirements for each application.

c. The Contractor shall procure the services of an independent inspection service to review and provide a certified letter to the Contractor, Engineer and the authority having jurisdiction, stating all firestopping has been installed per U.L. listing and the manufacturer's recommendations. Independent service shall have experience in the inspection of firestopping materials and methods installed.

3.17 EXISTING FACILITIES

a. The Contractor is responsible for loss or damage to the existing facilities used by his workmen, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices and receive written permission from the Owner to enter existing areas. Before beginning work in existing areas, make the necessary arrangements and perform other services required for the care, protection, and in service maintenance of all electrical, communication, plumbing, heating, air conditioning, and ventilating services for existing facilities. The Contractor shall erect temporary barricades with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.

b. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

c. Where existing construction is removed to provide working and extensive access to existing utilities, the Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork, and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

d. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed and equipment located in these areas is required to remain in operation, the Contractor shall remove and reinstall all equipment required for the operation of the remaining mechanical systems.

3.18 OUTAGES

a. Outages of services as required by the project will be permitted but only at time approved by the Owner. The Contractor shall notify the Owner in writing three weeks in advance of the requested outage in order to schedule required outages. No outages shall be taken unless written approval has first been received from the Owner. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount.

3.19 VIBRATION ISOLATION

a. The Contractor shall furnish and install vibration isolation means for all equipment and materials furnished under the Contract to prevent the transmission of perceptible vibration, and structure borne or air borne noise to occupied areas.

b. Select equipment to operate with minimum noise and vibration. If objectionable noise or vibration is produced or transmitted to or through the building structure by equipment, piping, ducts or other parts of work, rectify such conditions as part of this work.

3.20 SUBSTITUTIONS REQUIRING CHANGES

a. Manufacturers and power requirements indicated on the mechanical and electrical drawings are the basis of design. If changes are required for the equipment submitted, such as changes in connection sizes and/or locations, supports, housekeeping pads, orientation, routing of piping and/or ductwork, conduit size, conductors, breakers, disconnects, etc., such changes shall be made as part of this work.

3.21 GUARANTEE

a. Guarantee work for 1 year from the date of final acceptance of the project and during that period make good any faults or imperfections that may arise due to defects or omissions in materials or workmanship.

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SECTION 23 00 02

EARTHWORK

1.0 GENERAL

a. This Section provides for the excavating and backfilling required for pipe trenches for underground piping, and miscellaneous excavation for structures installed as part of mechanical work.

2.0 PRODUCTS (NOT USED)

3.0 EXECUTION

3.1 EXCAVATION

a. Excavate trenching for underground piping to the required depth to ensure two feet minimum cover over the pipe.

b. Cut the bottom of the trench or excavation to uniform grade so that pipe or structure will bear on undisturbed soil. Install additional excavation at joints as required to allow full length of pipe to lay on undisturbed soil.

c. Should rock be encountered, excavate 6-inches below the bottom of the trench grade, fill with gravel and tamp well.

d. Carefully lay out alignment of pipe trenches to avoid obstructions.

3.2 BACKFILL

a. Place backfill only after the work has been inspected, tested and approved. Complete backfill to the surface of natural ground or to the lines and grades shown on drawings. Except where special materials are requested, use suitable soils from the excavation as backfill material. Do not use peat or other organic matter, silt, muck, debris or similar materials.

b. Compacting Backfill. Place material in uniform layers of prescribed maximum thickness and wet or dry the material to approximately optimum moisture content. Compact with power-driven hand tampers to the prescribed density. Place regular backfill in 8-inch maximum layers, loose measure. Compact to not less than 95 percent of maximum soil density as determined by AASHTO Method T-99 and ASTM D-698.

c. Restoration. Compact backfill where trenching or excavation is required in improved areas such as pavements, walks, and similar areas, to a condition equivalent to undisturbed earth, and restore surface of the area to the condition existing prior to trenching or excavating operation.

d. Provide 6" stabilized sand bed with 4" stabilized sand cover around each pipe.

3.3 DISPOSAL OF EXCESS MATERIAL

a. Remove excess excavation material or material unsuitable for backfill from site.

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SECTION 23 05 48

VIBRATION ISOLATION

1.0 GENERAL

1.1 SCOPE

a. This Section specifies furnishing, installing, and adjusting vibration isolation, including bases of structural steel and concrete, with steel pouring forms and reinforcing bars for concrete.

1.2 APPLICABLE PROVISIONS

a. Refer to Section 23 00 00, Mechanical General Provisions.

1.3 SUBMITTALS

a. Submit product data showing type, size, load, deflection and other information required. Include clearly outlined procedures for installing and adjusting isolators.

b. Completely detail concrete bases including the 6-inch-thick foundation pad.

1.4 ACCEPTABLE MANUFACTURERS

a. Amber-Booth

b. Mason

2.0 PRODUCTS

2.1 ISOLATOR DESIGN

a. Materials. Design and treat vibration isolators for resistance to corrosion. Furnish phosphatized steel components with industrial-grade, corrosion-resistant material. Coat components exposed to the weather with PVC coating or fabricate of galvanized steel. Furnish zinc electroplated nuts, bolts and washers. Clean steel bases thoroughly of welding slag and prime with zinc-chromate or metal etching primer.

b. Design.

(1) Unless equipment furnished is internally isolated, use spring-type vibration isolators for all equipment driven by motors of 3 horsepower and larger. The isolator manufacturer must calculate the amount of spring deflection

required for each isolator to achieve optimum performance and to prevent the transmission of objectionable vibration and noise. The following minimum spring deflections apply:

(a) Belt-Driven Equipment.

Motor Size Horsepower	Installation Above Grade	Installation At Grade or Below
3-10	3/4 inch	3/4 inch
15-30	1-1/2 inch	1 inch
40-75	2 inch	1-1/2 inch

(b) Direct-Driven Equipment.

Motor Size Horsepower	Installation Above Grade	Installation At Grade or Below
3-20	3/4 inch	3/4 inch
25-75	1 inch	3/4 inch

(2) All spring isolators must be completely stable in operation and must be designed for not less than 30 percent reserve deflection beyond actual operating condition.

(3) Isolate equipment driven by motors of 2 horsepower or less by means of Amber-Booth Type RVD elastomeric mounts or BRD elastomeric hangers. The elements shall be designed for approximately 1/2-inch deflection.

(4) Design isolators for equipment installed outdoors to provide adequate restraint due to normal wind conditions. The isolators must withstand wind loads of 30 pounds per square foot applied to any exposed surface of the isolated equipment.

(5) Air handling equipment subjected to excessive horizontal air thrust shall be furnished with isolated thrust resisters to limit displacement to 1/4-inch.

(6) Height saving brackets used with isolators having 2-1/2-inch deflection or greater shall be of the precompression type to limit exposed bolt length.

2.2 ISOLATOR TYPES

a. Isolator types listed in the section on applications are described below. All type names are Amber-Booth designations.

(1) Types XL and XLW. An aluminum-housed, adjustable, spring-mounting having telescoping top and bottom sections separated by resilient inserts of neoprene to limit horizontal motion. Steel or cast iron housings may be used if the housing is hot-dip galvanized after fabrication. A neoprene pad with a minimum thickness of 1/4 inch is bonded to the base plate.

(2) Type SW. An adjustable, freestanding, open-spring mounting with combination leveling bolt and equipment fastening bolt. The spring mounting to base plate and compression plate must be rigid. A neoprene pad with a minimum thickness of 1/4-inch is bonded to the base plate. A minimum horizontal-to-vertical spring rate of 1.0 is required.

(3) Type BS. A spring hanger consisting of a rectangular steel box, coil spring, spring retainers, neoprene-impregnated fabric washer, and steel washer.

(4) Type BSR. A combination spring and rubber hanger consisting of a rectangular steel box, coil spring, spring retainers, and an elastomeric mounting designed for 1/2-inch deflection.

(5) Type RSW. An adjustable spring isolator as described for Type SW with the addition of a fabricated steel housing suitable for recessing into a concrete inertia block. The housing has a side access.

(6) Type PBS. A spring hanger as described for Type BS with the addition of a load transfer plate to hold the equipment or piping at a fixed elevation during installation and to permit transferring the load to the spring after installation.

(7) Type PBSR. A combination spring and elastomeric hanger as described for Type BSR with the addition of a load transfer plate to hold the equipment or piping at a fixed elevation during installation and to permit transferring the load to the spring after installation.

(8) Type CT. An adjustable, open-spring isolator having one or more coil springs attached to a top compression plate and a base plate. A neoprene pad with a minimum thickness of 1/4-inch is bonded to the base plate. The spring assembly must fit within a welded steel enclosure consisting of a top plate and rigid lower housing, which serves as a blocking device during

installation. The isolator includes restraining bolts for connecting the top plate and lower housing to prevent the isolated equipment from rising when drained of water.

(9) Type SP-NRE. A pad-type mounting consisting of two layers of 3/8-inch-thick ribbed or waffled neoprene pads bonded to a 16-gauge, galvanized steel, separator plate. Size pads for approximately 20 to 40 psi load and a deflection of 0.12 to 0.16-inch.

(10) Type BR. An elastomeric hanger consisting of a rectangular steel box and an elastomeric isolation element of neoprene. A high quality synthetic rubber may be used if it contains antiozone and antioxidant additives. The elements are designed for approximately 1/2-inch deflection and loaded so that the deflection does not exceed 15 percent of the free height of the element.

(11) Type RT1R. Rail shall be a continuous assembly consisting of rails formed to fit curb and equipment with a flexible air and water seal incorporating Type SW spring isolators sized for 1-inch deflection.

2.3 ISOLATOR APPLICATIONS

	EQUIPMENT	ISOLATOR TYPE
a.	Air Handling Units.	
	Floor Mounted - Up to 15 HP	XL
	Floor Mounted - 20HP and Over	XLW
	Suspended - Up to 15 HP	BSR
	Suspended - 20 HP and Over	PBSR
	High Pressure Fan Sections	XLW
b.	Suspended fans and fan-coil units.	BR
c.	Centrifugal Fans.	
	Class I & II - Up to 54-1/4 inch Diameter	XL

3.0 EXECUTION

a. Stock Requirements. The isolation manufacturer's representative must maintain an adequate stock of springs and isolators of type used so that changes made during construction and installation can be made.

b. Factory Representation. After installation, furnish factory-trained representative of the isolation manufacturer to check various isolators and report measured versus anticipated deflection on all isolators. Have the representative certify that isolators have been installed in accordance with manufacturer's recommendations and approved submittals.

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SECTION 23 05 93

TESTING, ADJUSTING AND BALANCING

1.0 GENERAL

1.1 SCOPE

a. This Section covers final air balance operations after construction of the air and water systems.

b. Testing Agency. The Contractor shall secure the services of an independent air balance and testing agency to perform complete balance, adjustment and testing of air moving equipment and air distribution systems, including terminal units. Agency shall have on its staff at least one certified member of NEBB who has been a member in good standing for at least 3 years, and the balancing agency shall be NEBB certified for a period of at least three years; or agency shall be a member of AABC for at least 1 year.

c. Equipment. Instruments used shall be accurately calibrated and maintained in good working condition. Equipment shall be as listed by the Associated Air Balance Council (AABC) or NEBB for this type work.

d. The balancing AGENCY shall provide tests to demonstrate the specified capacities and operation of all equipment and materials comprising the systems. Such tests other than as described herein, which are deemed necessary by the Engineer to indicate the fulfillment of the contract, shall be made. The Balancing (HVAC) Agency shall then make available to the Engineer such instruments and technicians as are required for spot checks of the system.

e. The Drawings and Specifications indicate valves, dampers, sheaves and miscellaneous adjustment devices for the purpose of adjustment to obtain optimum operating conditions, and it will be the responsibility of the Mechanical Installer to install these devices in a manner that will leave them accessible and readily adjustable. The Balancing (HVAC) Agency may be consulted if there is a questionable arrangement of a control or adjustable device.

f. The Balancing Agency shall be responsible for inspecting, balancing, adjusting, testing and logging the data of the performance of fans, all dampers in the duct systems, all air distribution devices or heat exchangers and the flows of water through all coils. The General Contractor, the Mechanical Installer and the suppliers of the equipment installed shall all cooperate with the Balancing (HVAC) Agency to provide all necessary data on the design and proper application of the system components and shall furnish all labor and material required to eliminate any deficiencies or malperformance.

g. The Balancing (HVAC) Agency shall provide the following services:

(1) During construction, inspect the installation of heating and cooling pipe systems, sheet metal work, temperature controls and other component parts of the heating, air conditioning and ventilating systems. The inspection of the work will cover that part relating to proper arrangement and adequate provisions for the testing and balancing. The inspections shall be performed periodically as the work progresses. A minimum of two inspections are required as follows:

(a) When 60% of the piping is installed in each building.

(b) When 60% of ductwork is installed in each building.

(c) When 90% of ductwork is installed in each building.

(2) Submit brief written report of each inspection to Architect/Engineer, with copies to Contractor, Mechanical Engineer, Inspector, and Owner's Representative.

(3) Upon completion of the installation and start-up of the mechanical equipment by the Mechanical Installer, the Balancing (HVAC) Agency will balance, test and adjust the systemic components to obtain optimum conditions in each conditioned space in the building. If construction deficiencies are encountered which preclude obtaining optimum conditions, and the deficiencies cannot be corrected by the Contractor within a reasonable period of time, cease TAB services and advise the Architect in writing with an information copy to the Owner's Representative. The Balancing (HVAC) Agency is advised that deficiencies in HVAC construction are often encountered during final TAB services and he should include in his bid an amount he deems advisable to compensate for his time in identifying the deficiencies to the Mechanical Installer and awaiting their correction.

(4) Fourteen (14) days, or earlier, prior to the Owner's Final Inspection, as requested by the General Contractor, the TAB shall prepare seven (7) copies of the completed Balancing (HVAC) Test and Balance Report. The Report shall be complete with logs, data, and records as required herein and all logs, data, and records shall be typed, produced on white bond paper, and bound with plastic spiral. The Reports shall be certified accurate and complete by a principal Engineer of the Balancing (HVAC) Agency. Transmit one (1) copy direct to the Owner's Representative and the

remaining six (6) copies to the Architect. The Architect will, in coordination with the Engineer, review the report. Upon approval, two (2) copies will be submitted to the Owner's Representative and two (2) copies transmitted to the Contractor.

(5) The Report shall contain the following general data in a format selected by the TAB Agency for clarity and ease of reference.

(a) Project No.

(b) Contract No.

(c) Project Title:

(d) Project Location:

(e) Project Mechanical Engineer: (Name)

(f) TAB Field Test Engineer: (Name)

(g) TAB Testing Diagnosis and Analysis by: (Name)

(h) TAB Agency: (Firm name and address)

(i) Mechanical Installer: (Name and address)

(j) General Contractor: (Name and address)

(k) Inclusive dates tests were performed and date of Report

(l) Test Certification Number:

(m) Certification by principal engineer

(6) The TAB Report shall normally contain the following sections:

(a) Table of Contents

(b) General data and certification

(c) Brief Description of Tests and Test Procedures (including instruments used)

(d) Summary of Test Results (note deficiencies, if any, and action taken for correction)

(e) Logs, Data, and Records

1.2 APPLICABLE PROVISIONS

a. Refer to Section 23 00 00, Mechanical General Provisions.

1.3 PROCEDURES

a. Operating Tests. After all mechanical systems have been completed, and prior to air balance, subject each system to an operating test under design conditions to ensure proper sequence of operation in all operating modes. Make adjustments as required to ensure proper functioning of all systems.

b. Certified Data. The Contractor shall provide the balance and testing agency the certified data on fans, grilles, coils, filters and other equipment required for proper balancing of the system.

c. Adjustment. The balance and testing agency shall supervise or perform necessary adjustments to air flow dampers, fans, sheaves, extractors, splitters, and other controls as required to properly balance the system.

d. Balancing. The balance agency shall follow balancing and testing procedures published by the Associated Air Balance Council, or NEBB.

e. Reports. Compile the test data on report forms as listed in the "National Standards for Total System Balance". Include data on air volume at supply and return grilles and diffusers. Include exhaust air volume.

2.0 PRODUCTS

2.1 QUALIFIED TESTING AND BALANCING AGENCIES

a. Engineered Air Balance. Contact Gary Miller (210) 736-9494.

b. PHI. Contact Bruce Wermerskirchen (210) 229-9143.

c. T.S.I. Contact Wes Harvey (210) 492-8885.

d. Professional Test & Balance. Contact Bill Arnold (210) 889-4332.

e. TRM. Contact Tom McKeen (830) 981-9770.

f. Other Test and Balance Agencies must be submitted for review by the Engineer of Record 10 days prior to Bid Date for approval. Submittal shall include a minimum of:

(1) 5 references from Licensed MEP Engineering Companies.

(2) 5 references from Facility Owners.

(3) 5 references from HVAC Contractors.

(4) NEBB or ABB Certification.

(5) In lieu of membership stated above, the qualifications of other applicants will be considered for approval, provided documentation is submitted to show that the minimum published qualification standards for general membership in the listed organizations are met.

3.0 EXECUTION

3.1 AIR BALANCE (BY AIR BALANCE AGENCY)

a. General Requirements.

(1) Do all work required for complete testing and adjusting of all HVAC systems.

(2) Provide all instruments and equipment required to accomplish necessary testing, adjusting, and as required by the engineer to verify performance. All instruments shall be in accurate calibration and shall be calibrated in ranges that will be expected.

(3) Prior to final observation, submit to the owner a letter certifying:

(a) That all balancing is complete.

(b) That all controls are calibrated and functioning properly.

(c) That all parts of the various systems are complete and ready to be turned over to the Owner for continuous operation. Submit with letter a report tabulating data requested by the Engineer.

b. Design Conditions. The HVAC systems have been designed to maintain the inside conditions indicated below when operating with the outside conditions stated. Install, test

and adjust the systems so that they will produce the inside conditions for design; however, contractor must be prepared to provide a suitable test to prove that equipment is producing capacities scheduled.

(1) Inside Conditions.

(a) Summer: 75°F D.B.50% R.H.

(b) Winter: 72°F D.B. (Typical)

(2) Outside Conditions.

(a) Summer: 99°F D.B. (Typical) 78°F W.B. (Typical)

(b) Winter: 25°F D.B. (Typical)

c. Adjust all air system dampers and volume controllers to obtain proper air balance throughout the conditioned area. The air quantities shown on the drawings for individual outlets may be changed to obtain uniform temperature within each zone, but the total air quantity shown for each zone must be obtained. Maximum temperature variation within a zone to be 2°F.

d. Adjust all blower drives to obtain proper total amounts of air. Change drive if necessary to accomplish proper air flow.

e. Calibrate, set and adjust all automatic temperature controls.

f. After balancing is complete and before calling for final observation, record, and submit for record, following data:

(1) For each air unit:

(a) Suction and discharge static pressure, and total static.

(b) Fan rpm, measured by tachometer; verify rotation.

(c) Motor nameplate F.L.A., actual amps, voltage.

(d) Measured cfm for total supply, return and outside air.

(e) Entering and leaving air temperature for each coil.

(2) Each condenser unit:

(a) Ambient air temperature, condenser discharge temperature.

(b) Motor nameplate F.L.A., actual amp, voltage.

(c) Suction and discharge pressures, temperature.

(3) Fans:

(a) Suction and discharge pressure.

(b) CFM.

(c) Fan RPM.

(d) Fan motor amps.

(4) Occupied space:

(a) Supply CFM.

(b) Return CFM.

(c) Exhaust CFM.

(5) Other reports and forms to be completed and submitted. Provide instrument list, air moving test sheet, exhaust fan data sheet, static pressure profile, return air/outside air data, fan and motor pulley, duct traverse readings, duct traverse zone totals, air distribution test sheet, air cooled condensers, cooling coil data, heating coil data, duct leak test. All forms shall be as listed in the 2002 "National Standards for Total System Balance", or shall be similar, but must note same information.

g. After Owner Occupancy. After Owner has occupied and is using the building, make three additional inspections of the system (at 1 month intervals) to:

(1) Correct any Owner observed temperature imbalances.

(2) Check correct operation of equipment and verify by letter to the Engineer on each trip. List in the letter corrections made.

h. At Time of Job Completion.

(1) Provide such tools, equipment and personnel as required to conduct tests and demonstrate the acceptability of the various systems.

(2) Have the authorized representatives of the various manufacturers available if requested.

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SECTION 23 07 13

EXTERNAL DUCT INSULATION

1.0 GENERAL

1.1 WORK INCLUDED

a. This Section provides for the furnishing and installation of external insulation on low-velocity supply, return and outside air ducts, all VAV box hot water coil housings and tube bends, and all round low-velocity supply ductwork.

b. External insulation of concealed and exposed ducts is included in this section. Internal acoustic duct linings are specified under Ductwork and not included in this section.

c. External fire rated wrapping for ductwork is included in this section.

1.2 RELATED WORK

a. Division 23 - Mechanical. Insulation - General.

1.3 DEFINITIONS

a. Exposed – All duct visible to public and all duct in Mechanical Rooms below 7'-0".

b. Concealed – All duct above ceilings.

2.0 PRODUCTS

2.1 INSULATION

a. Concealed Duct, Round, Flat Oval, or Rectangular. Provide flexible glass fiber insulation with factory-applied, reinforced Foil-Kraft facing. A minimum thermal resistance of 6.0 (sq. ft. x degrees F x hrs. per BTU) at 75°F is required, after installation (not in bag). Provide minimum 1-pound density insulation, which complies with specification H-B-100B. Insulation shall meet ASTM-E-84 and ASTM-C411 requirements.

b. Exposed Round and Flat Oval Duct. Provide flexible fiberglass insulation with glass cloth vapor barrier. A minimum thermal resistance of 6.0 (sq. ft. x degrees F x hrs. BTU) at 75°F is required. Insulation shall meet ASTM-E-84 and ASTM-C411 requirements.

c. Exposed Rectangular Duct. Provide rigid board duct insulation of 1-1/2-inch thick fiberglass. A density of three pounds per cubic foot is required. Provide an integral, UL labeled, reinforced Foil-Kraft facing on the outside surface. Insulation shall meet ASTM-E-84 and ASTM-C411 requirements.

d. Standing Seams. Insulate standing seams and stiffeners that protrude through the insulation with 0.6-pound-per-cubic-foot density, 1-1/2-inch thick, unfaced, flexible blanket insulation. As a vapor seal, use 8-ounce canvas with vapor barrier coating. Insulation should not prevent adjustment of damper operators.

2.2 COATING AND ADHESIVE

a. Vapor Barrier Coating. Provide Benjamin Foster 30-80, Childers CP 30 or approved equivalent.

b. Adhesive. Provide Benjamin Foster 85-60, Childers CP 127, or approved equivalent.

3.0 EXECUTION

3.1 FIRE SAFETY REQUIREMENTS

a. Do not extend duct coverings through walls or floors required to be firestopped or required to have a fire resistance rating. Interrupt duct coverings in the immediate vicinity of heat sources, such as electric resistance or fuel-burning heaters.

3.2 CONCEALED DUCT, ROUND, FLAT OVAL OR RECTANGULAR

a. Insulation shall be wrapped tightly on the ductwork with all circumferential joints butted and longitudinal joints overlapped a minimum of 2-inches. In addition, secure insulation to the bottom of rectangular ductwork over 24-inches wide by the use of mechanical fasteners at no more than 18 inches on center.

b. On circumferential joints, the 2-inch flange on the facing shall be stapled with 9/16-inch flare-door staples on 6-inch centers, and taped with a minimum 3-inch-wide strip of glass fabric and coating, or a 3-inch-wide strip of 8-ounce canvas adhered with adhesive. Cover all seams, joints, pin penetrations and other breaks with coating reinforced with glass fabric.

c. On circumferential joints, the 2-inch flange on the facing shall be stapled with 9/16-inch flare-door staples on 6-inch centers, and taped with a minimum 3-inch-wide strip of glass fabric and coating, or a 3-inch-wide strip of 8-ounce canvas adhered with adhesive. Adhesive systems employing release paper will not be acceptable.

3.3 EXPOSED ROUND AND FLAT OVAL DUCT

a. Apply insulation to dry duct. Firmly butt all joints together. Seal longitudinal laps of factory-applied vapor barrier jacket with adhesive. Cover butt joints with a 3-inch-wide strip of factory-supplied vapor barrier jacket adhered with adhesive. Adhesive systems employing release paper will not be acceptable.

3.4 EXPOSED RECTANGULAR DUCT

a. Fill and point up all joints, perforations and exposed edges with coating reinforced with glass fabric or a 3-inch-wide strip of 8-ounce canvas adhered with adhesive. Securely fasten insulation to metal surface with adhesive and mechanical fasteners on 12-inch centers. Sheet metal screws and discs or other approved fasteners may be used.

3.5 RECTANGULAR DUCTWORK EXPOSED TO WEATHER

a. Insulate the ductwork with high density rigid insulation, 2" thick, with sloped top (minimum 1/2" per foot) coated with continuous glass fab, Benjamin Foster exterior white mastic similar to Sealfas GPM 35-00,

b. Aluminum Protective Coating. Provide final covering of 0.024-inch thick aluminum jacketing, with seams on bottom of duct, and all joints sealed weather tight per manufacturer's recommendations. Aluminum jacketing to be self-fastening, Type 3003-H14 aluminum alloy.

c. Field Applied or Pre-Applied Jacket

(1) At Contractor's option, all insulated ductwork and equipment requiring aluminum jacketing can have a field-applied or pre-applied protective finish and/or vapor seal, operating within the range of -30°F (-34°C) and 300°F (149°C), and will be jacketed with laminated, flexible self-adhering, protective jacketing, vapor barrier and weather proofing membrane, having a high performance acrylic adhesive capable of installation with no additional mechanical attachment. Material is to be equal to VentureClad 1579CW (13 ply) natural aluminum finish. Jacketing material is to be E84 test, a .0000 vapor permeance rating per ASTM E-96, and mold inhibitors incorporated. All products shall be UV stable.

(2) Fabrication and installation conform to the manufacturer's installation instructions.

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SECTION 23 07 19.53

LOW TEMPERATURE PIPING INSULATION

1.0 GENERAL

1.1 SCOPE

a. This Section provides for furnishing and installing low temperature piping insulation of fiberglass or Armaflex AP as noted below. The insulation will be used for low temperature application including refrigerant, domestic cold water, PVC waste and vent piping located in return air plenums, condensate drains, and horizontal portions of waste lines above grade which receive condensate from air handling units or evaporators.

1.2 APPLICABLE PROVISIONS

a. Refer to Section 23 00 00, Mechanical General Provisions.

2.0 PRODUCTS

2.1 LOW TEMPERATURE PIPE INSULATION

a. Premolded fiberglass pipe insulation, permanent K factor of 0.23 at 75ºF (R-4.3/inch) mean temperature, with factory-applied, all service reinforced vapor barrier jacket having integral laminated aluminum vapor barrier. Insulation systems using self-sealing laps and butt joints are not allowed. Supply in thickness as shown, and in accordance with ASHRAE 90.1. Insulation shall conform to ASTM-E-84.

b. Premolded flexible, elastomeric, thermal insulation (Armaflex AP), K factor of 0.27 at 75ºF. Insulation systems using self-sealing laps and joints are not allowed. Supply thickness as shown and in accordance with ASHRAE 90.1. Insulation shall conform to ASTM-E-84.

Insulated Unit	**Thickness (Inches)**	**Type**
Refrigerant Suction Piping	1	Armaflex AP
Condensate Drain Lines	1/2	Armaflex AP
Domestic Cold Water Piping (All)	1/2	Fiberglass
All PVC Pipe in Return Air Plenums	1/2	Fiberglass

2.2 VALVE AND FITTING INSULATION

a. Furnish molded PVC or mitered covers for flanges, valves and fittings.

2.3 INSULATION SHIELD

a. Field Fabricated. Use sections of high density cellular glass or phenolic foam insulation that will support the bearing area at hangers and supports. Further support insulation at hangers and supports with a shield of galvanized metal extending not less than 6-inches on either side of the support bearing area, covering at least half of the pipe circumference, and conforming to the schedule below. When pipe is guided at top and bottom, metal shields shall cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide with respect to insulation.

Pipe Diameter	**Insulated Section Length in Inches**	**Minimum U.S. Standard Gauge of Metal Shield**
3" and Smaller	12	18

b. At Contractor's option, factory-made insulation shields may be furnished and installed as made by Pipe Shields, Inc., or equivalent. Insulation should extend at least 1-inch beyond metal. Select proper shield for service and pipe span.

2.4 SEALANT, ADHESIVE AND FINISH

a. Sealant. Use Benjamin Foster 95-44 at valve covers.

b. Adhesive. Furnish Benjamin Foster 85-20 to seal longitudinal laps of the vapor barrier jacket and to adhere butt joint covers. Self-sealing laps and butt strips are not allowed.

c. Finish. Use Benjamin Foster 30-35 with glass fabric reinforcement.

d. Finish Armaflex AP insulation with minimum 2-coats of Armstrong Finish per manufacturer's recommendations.

2.5 ALUMINUM JACKETING

a. Apply aluminum jacketing to all insulated pipe located outdoors and pipe in Mechanical Rooms below 7'-0".

(1) Piping. Furnish for finishing insulated pipe, a self-fastening jacket of type 3003-H14 aluminum alloy, 0.016-inch thick.

(2) Valves, Fittings and Flanges. For finishing all valves, fittings and flanges, and smaller installations, furnish formed aluminum covers, 0.024-inches thick, Type 3003-H14 aluminum alloy.

(3) Straps and seals. Where required by manufacturer, furnish aluminum strapping seals for jackets and covers installed according to manufacturer's recommendations.

(4) Acceptable manufacturers. Jacketing as manufactured by Preformed Metal Products Company, Childers or Johns-Manville will be acceptable.

(5) All longitudinal seams must be installed on bottom of horizontal piping.

3.0 EXECUTION

3.1 PIPE

a. Apply insulation to clean, dry pipes. Butt insulation joints firmly together. Seal longitudinal laps and butt strips with sealant.

b. Where piping is interrupted by fittings, flanges, valves or hangers and at intervals not to exceed 25 feet on straight runs, form an isolating seal between the vapor barrier jacket and the bare pipe by liberal application of the adhesive to the exposed joint faces carried continuously down to and along 4 inches of pipe and up to and along 2-inches of the jacket. This shall be furnished and installed only for chilled water service.

3.2 VALVES, FLANGES AND FITTINGS

a. Insulate all valves, flanges and fittings with factory molded or mitered fitting covers secured with wire. Thickness of insulation shall be equivalent to that of adjoining piping. Mitered covers for pipe 2" and smaller shall be minimum 3-piece to the side, and pipe 2-1/2" and larger shall be minimum 6-pieces to the side. The fitting shall then be rasped or otherwise formed to have a smooth appearance.

b. Finish with 1/4-inch layer of Benjamin Foster 30-35 reinforced with glass fabric.

3.3 CONTROL VALVE COVERS

a. Fabricate special covers, complete with troweled-on vapor seal, shaped to accommodate the valve stem. Insulation thickness shall be same thickness as adjoining pipe.

b. Seal covers to valve insulation proper with adhesive so that the seal may be broken with a knife blade without damage to either part. Arrange so that cover can be removed and replaced as necessary for operation of the valve. Finish valve cover with glass cloth and two coats of finish.

3.4 SHIELDS AND HANGERS

a. When the insulation is jacketed in aluminum, install a length of 40-pound roofing felt 1/2 inch longer than the insulation shield between shield and jacket.

b. Refer to Section 23 21 00 for support hangers.

3.5 PVC PIPING IN RETURN AIR PLENUM

a. Apply insulation to all PVC piping located in return air plenums. Contractor shall coordinate and verify location and size of return air plenum areas with Construction Documents.

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SECTION 23 07 19.54
HIGH TEMPERATURE PIPING INSULATION (FIBERGLASS)

1.0 GENERAL

1.1 SCOPE

a. This Section provides for furnishing and installing high temperature piping insulation, including domestic hot water piping.

1.2 APPLICABLE PROVISIONS

a. Refer to Section 23 00 00, Mechanical General Provisions.

2.0 PRODUCTS

2.1 INSULATION

a. Use premolded fiberglass pipe insulation, K value of .35 at 200°F mean temperature, with a factory-applied, all service reinforced jacket conforming to ASTM-E-84 and ASTMC 1136 Type I, having integral laminated aluminum vapor barrier. Furnish insulation thickness as listed and in accordance with ASHRAE 90.1-2004. Insulation systems using self sealing laps and butt joints is not acceptable.

Insulating Unit	Thickness (Inches)
Domestic Hot Water Piping, 1-1/2" and smaller	1
Domestic Hot Water Piping, 2" and greater	1-1/2
Domestic Tempered Water Piping, 1-1/2" and smaller	1
Domestic Tempered Water Piping, 2" and greater	1-1/2

2.2 INSULATION SHIELD

a. Field Fabricated. Use sections of high density fiberglass insulation that will support the bearing area at hangers and supports. Further support insulation at hangers and supports with a shield of galvanized metal extending not less than 4-inches on either side of the support bearing area, covering at least half of the pipe circumference, and conforming to the schedule below. When pipe is guided at top and bottom, metal shields shall cover the whole pipe circumference. Adhere metal shield to insulation so that metal will not slide in respect to insulation.

Pipe Diameter	Insulated Section Length in Inches	Minimum U.S. Standard Gauge of Metal Shield
3" and smaller	12	18

b. At Contractor's option, factory-made shields as manufactured by Pipe Shields, Inc., or equivalent may be furnished and installed. Select proper shield for service and span.

2.3 ADHESIVE, FINISH AND CEMENT

a. Adhesive. Furnish Benjamin Foster 85-20 to seal longitudinal laps of vapor barrier jacket and to adhere joint butt covers.

b. Finish. Use Benjamin Foster 30-35 coating with glass fabric reinforcement.

c. Cement. Furnish Johns-Manville No. 460 on insulated fittings, flanges and valves.

3.0 EXECUTION

3.1 PIPE

a. Apply insulation to clean, dry pipes. Butt insulation joints firmly together. Utilize staples at 4" centers with adhesive before the glass cloth wrap and sealant are applied. Seal longitudinal laps and butt strips with adhesive. Insulation using self sealing laps and butt strips is not acceptable. In exposed areas, finish with glass cloth and coating.

3.2 VALVES, FITTINGS AND FLANGES

a. Concealed piping.

(1) Insulate fittings and valves 2-1/2-inches IPS and larger, with factory molded or mitered fitting covers. Mitered covers shall be minimum 6-pieces to the side. The fitting shall then be rasped or otherwise formed to have a smooth appearance. Thickness of insulation shall be equivalent to that of adjoining pipe. Finish with coating reinforced with white 20" by 20" glass fabric.

(2) Insulate fittings and valves 2-inches IPS and smaller with mineral wool and insulating cement to a thickness equivalent to or greater than adjoining straight pipe. At Contractor's option, install molded or mitered fittings, finished with coating reinforced with glass fabric. Mitered covers for pipe 2" and smaller shall be minimum 3-piece to the side. The fitting shall then be rasped or otherwise formed to have a smooth appearance.

b. In exposed areas, insulate all fittings, flanges and valves with factory molded or mitered fitting covers. Thickness of insulation shall be equivalent to that of adjoining pipe. Mitered covers for pipe 2" and smaller shall be minimum 3-piece to the side, and pipe 2-1/2" and larger shall be minimum 6-pieces to the side. The fitting shall then be rasped or otherwise formed to have a smooth appearance. Finish with coating reinforced with white glass fabric.

c. Finish with 1/4-inch layer of Benjamin Foster 30-35 reinforced with glass fabric.

3.3 SHIELDS AND HANGERS

a. When the insulation is jacketed in aluminum, install a length of 40-pound roofing felt 1/2 inch longer than the insulation shield between shield and jacket.

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SECTION 23 21 00

PIPE AND PIPE FITTINGS - GENERAL

1.0 GENERAL

1.1 WORK INCLUDED

a. This Section specifies pipe and pipe fittings for all piping systems. The Section applies to all Sections of Division 23 - Mechanical, which employ pipe and pipe fittings.

1.2 RELATED WORK

a. Division 23 - Mechanical.

(1) Earthwork.

(2) Valves, Strainers, and Vents.

(3) Vibration Isolation.

(4) Painting.

(5) Insulation.

2.0 PRODUCTS

2.1 PIPE AND FITTINGS

a. The particular type of pipe and fittings for each system is specified in the section on that system. All pipe and pipe fittings shall be domestically manufactured (foreign pipe will not be acceptable).

2.2 JOINTS

a. Screwed. Make screwed joints using machine cut USASI taper pipe threads. Apply a suitable joint compound to the male threads only. Ream the pipe to full inside diameter after cutting. All-thread nipples are not permitted.

b. Dissimilar Metals. Make joints between copper and steel pipe and equipment using insulating unions such as Crane Company No. 1259; EPCO as manufactured by EPCO Sales, Inc.; or an approved equal.

c. Solder Joints.

(1) Prior to making joints, cut pipe square and ream to full diameter. Clean exterior of pipe and socket. Apply a thin coat of suitable fluxing compound to both pipe and socket, and fit parts together immediately.

(2) Heat assembled joint only as required to cause the solder to flow. Run the joint full, slightly on the outside, and wipe to remove excess solder.

(3) Use silver brazing alloy or Sil-Fos on refrigerant piping. Use 95.5 solder on all other copper piping, except domestic water piping.

(4) For domestic water piping, use Harris "Stay-Safe-Bridgit", lead free, UPC and NSF approved, silver bearing solder with Harris "Stay-Clean" liquid solder flux. Apply per manufacturer's recommendations.

2.3 UNIONS

a. Use Class-150 standard (300-pound WOG) malleable iron, ground joint unions with bronze seat. Provide flanged union joints on piping larger than 2-1/2-inches.

2.4 BRANCH CONNECTIONS

a. For Pipe 2-1/2-Inches and Smaller. For threaded piping, use straight size of reducing tee. When branch is smaller than header, a nipple and reducing coupling or swaged nipple may be used.

b. For 3-Inches and larger. For welding piping, when branch size is the same as header size, use welding tee. Use Weldolet when branch is smaller than header. For threaded branch connections, use 3000-pound full coupling welded to header.

3.0 EXECUTION

3.1 PIPE FABRICATION AND INSTALLATION

(1) Make piping layout and installation in the most advantageous manner possible with respect to headroom, valve access, opening and equipment clearance, and clearance for other work.

(2) Give particular attention to piping in the vicinity of equipment. Preserve the maximum access to various equipment parts for maintenance.

(3) Do not cut or weaken any structural member.

(4) Cut all pipes accurately to measurement determined at the site. After cutting pipe, ream it to remove burrs.

(5) Install piping neatly, free from unnecessary traps and pockets. Work into place without springing or forcing. Use fittings to make all changes in direction. Field bending and mitering are prohibited. Make all connections to equipment using flanged joints or unions. Make reducing connections with reducing fittings only.

3.2 OFFSETS AND FITTINGS

a. Because of the small scale of drawings, the indication of all offsets and fittings is not possible. Carefully investigate the structural and finish conditions affecting the work and take such steps as may be required to meet such conditions.

b. Install all piping close to walls, ceilings and columns so piping will occupy the minimum space. Provide proper space for covering and removal of pipe, special clearances, and for offsets and fittings.

3.3 SECURING AND SUPPORTING

a. Support piping adequately to maintain line and grade, with due provision for expansion and contraction. Use approved, clevis-type, split-ring or trapeze-type hangers properly connected to structural members of the building. On insulated pipe, provide hangers that are large enough in diameter to accommodate the insulation (Do not use line size hangers). Do not support piping from other piping.

b. Use copper hangers with copper pipe.

c. Where insulation occurs, design hangers to protect insulation from damage. Pipe saddles and insulation shields, where required, are specified in the appropriate insulation section.

d. Perforated bar hangers, straps, wires or chains are not permitted. Plastic support brackets as manufactured by P & M Company may be used in accordance with the manufacturer's recommendations.

3.4 ANCHORS

a. Provide anchors as indicated or required. Use pipe anchors consisting of heavy steel collars with lugs and bolts for clamping to pipe and attaching anchor braces. Install anchor braces in the most effective manner to secure desired results. Do not install supports, anchors or similar devices where they will damage construction during installation or because of the weight or the expansion of the pipe.

3.5 PIPE GUIDES

a. Provide ADSCO, FRS or FRC pipe alignment guides as indicated or required. Use ADSCO 178 for cold lines.

b. Guide expansion joints with two guides on the side opposite the anchor.

c. Guide pipe installed and supported by Unistrut supports using a duplicate set of pipe rolls on the top of the pipe.

d. Guide piping in vertical chases at a maximum guide spacing of 15 feet.

3.6 ISOLATION VALVES

a. Provide piping systems with line size shutoff valves located at the risers, at main branch connections to mains for all equipment, and at other locations as indicated and required.

3.7 DRAIN VALVES

a. Install drain valves at all low points of water piping systems so that these systems can be entirely drained. Install a 2-inch drain for 2-inch pipes and larger. Install a line size drain valve for pipes smaller than 2-inches.

3.8 PIPE MARKERS

a. Identify all exposed piping and piping in accessible chases or plenums with Brady Perma-Code Pipe Markers, System 2, consisting of pipe marker, arrows, and 1-1/2-inch wide banding tape. Use Brady B-350 material, 35 ounces per inch, for all indoor applications and Brady B-946G, 35 ounces per inch, for all outdoor applications. Background colors of markers, arrows and tape shall be the same.

b. Use a pipe marker at every point of pipe entry or exit through a wall, roof or floor. Apply markers at intervals not exceeding 50 feet on straight runs. Apply marker where view is unobstructed.

c. Pipe Marker Listing. Use pipe markers conforming to ANSI "Scheme for Identification of Piping Systems."

d. Surface Preparation. Pressure sensitive adhesives perform best on smooth, clean, dry surfaces. Use these guidelines for preparing surfaces for application:

(1) If surface is contaminated with oil or grease, clean it with an evaporative solvent such as methyl ethyl ketone.

(2) If surface is dirty, clean it with #600 emery cloth or 0000 steel wool, followed by solvent cleaning as above.

(3) Rough surfaces can be smoothed with sandpaper, then with steel wool, and solvent cleaned to remove residual dirt.

(4) A final cleaning with a dry, lint-free cloth is advised to remove any solvent film.

e. Wrap bands of arrow tape around pipe on each end of the marker. Make sure to overlap the marker 1/4 to 1/2 inch with the arrow tape. Also make sure to wrap the arrow tape all the way around the pipe and secure it back to itself with approximately a 2-inch overlap.

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SECTION 23 23 00

REFRIGERANT PIPING AND APPURTENANCES

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of copper tubing, valves, strainers and sight glass for refrigerant piping.

1.2 APPLICABLE PROVISIONS

a. Refer to Section 23 00 00, Mechanical General Provisions.

2.0 PRODUCTS

2.1 PIPE AND FITTINGS

a. Furnish refrigerant piping of Type L-ACR, hard-drawn copper tubing with sweat-type, wrought copper fittings. Cast fittings are not permitted.

b. Refrigerant piping shall comply with ASTM-B-88 and fittings shall comply with ASME-B16.18.

2.2 SERVICE VALVES

a. Furnish angle or globe service valves, with sweat connections. Use packed-type valves with gasketed seal cap and back seat feature. Valves must be wrench operated. Furnish valves especially designed for refrigerant service, in conformance with the ARI code.

b. Place service valves at the inlet and outlet of each compressor, on both sides of each strainer and solenoid valve, and as otherwise shown and specified.

2.3 SOLENOID VALVES (If required by manufacturer)

a. Furnish pilot-operated, floating piston solenoid valves suitable for operation with refrigerant.

b. Use valves with a bronze body and sweat-type connections.

c. Furnish stainless steel stem and plunger assembly, and a stainless steel piston.

d. Furnish solenoid coils which are sealed and moisture proof.

e. Use electrical characteristics of 115-volt, 60 hertz.

2.4 SIGHT GLASSES

a. Furnish suitable double-window sight glass in the liquid line leaving the condenser or receiver.

2.5 STRAINERS

a. Furnish Y-pattern or angle-type strainers especially designed for operation with refrigerant specified.

b. Furnish strainers constructed to permit the removal of the filter element without removing the strainer from the line.

3.0 EXECUTION

3.1 PRESSURE TEST

a. After all refrigerant equipment and piping are installed, charge the system with the proper refrigerant and dry nitrogen to 300 psig.

b. Test all joints with a Halide torch or an electronic leak detector.

c. Repair all leaks and retest each system until proved absolutely tight.

3.2 EVACUATION AND DRYING

a. After refrigerant system has been pressure tested, connect a suitable vacuum pump, and evacuate piping system, including all lines and equipment.

b. Maintain a vacuum down to 4 microns long enough to evaporate all the moisture in the system (at least 48 hours).

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SECTION 23 30 00

AIR DEVICES

1.0 GENERAL

1.1 SCOPE

a. This Section provides for the furnishing and installation of air distribution devices, including grilles, diffusers, registers, dampers, extractors, terminal boxes and sound attenuators.

1.2 APPLICABLE PROVISIONS

a. Refer to Section 23 00 00, Mechanical General Provisions.

1.3 COOPERATION WITH OTHER TRADES

a. Coordinate this work with work under Division 26, Electrical, to ensure that intended functions of lighting and air systems are achieved.

1.4 SUBMITTALS

a. Submit product data for outlets, grilles, registers, control devices, terminal boxes, sound attenuators, and similar equipment.

1.5 FINISHES

a. Paint devices with factory standard white enamel finish.

2.0 PRODUCTS

2.1 DIFFUSERS

a. Louvered. Furnish louvered, fixed-pattern, multiple cone diffusers with removable center cone, frames and white factory finish.

(1) Select faces and necks that are circular, rectangular or square, of the size and configuration indicated.

(2) Construct diffusers and frames of aluminum, or aluminized steel.

(3) Use a frame compatible with the type of ceiling in which the diffuser is installed.

b. Dampers. For inaccessible ceilings furnish an opposed-blade damper easily adjustable through the outlet for all diffusers. Furnish operating rod extensions as required for damper adjustment.

2.2 GRILLES

a. Supply. Use double-deflection supply grilles made of aluminum.

(1) Furnish vertical face blades and horizontal rear blades. Furnish solid, extruded aluminum blades which are individually adjustable. Space at not more than 3/4-inch centers for rear blades and 1/2-inch centers for face blades and not less than 5/8-inch deep.

(2) Employ grille frames of extruded aluminum with welded and mitered corners and mounting gaskets.

b. Return.

(1) For ceiling return, furnish perforated-face or louvered type, with white factory finish. Use construction and frame styles as specified for ceiling diffusers, but without pattern controllers. Use neck sizes as shown.

(2) For wall return, furnish a fixed-blade, aluminum grille, essentially sightproof, having curved or angular break, inclined blades. Space the blades at 1/2-inch centers to achieve sightproof feature. Furnish hemmed or fully rounded leading edges. Furnish extruded aluminum grille frames with welded and mitered corners. Include mounting gaskets.

c. Door Grilles. Furnish sightproof door grilles of aluminum construction for core only. Finish with prime coat suitable for field painting.

2.3 REGISTERS

a. Supply. Furnish double-deflection supply registers with aluminum, vertical face blades and horizontal rear blades. Use an integral, key-operated, opposed blade damper.

(1) Furnish solid, extruded aluminum blades which are individually adjustable. Space not more than 3/4-inch centers for rear blades and 1/2-inch centers for face blades and not less than 5/8-inch deep.

(2) Employ grille frames of extruded aluminum with welded and mitered corners and mounting gaskets.

b. Return and Exhaust. Furnish return and exhaust registers identical to return grilles except for the addition of an integral key-operated, opposed-blade damper.

2.4 ACCESSORIES

a. Supply Grille Extractors. Furnish each supply grille with an air control device capable of positively regulating the volume of air extracted from the supply duct.

b. Mounting Frames. Furnish a companion, all-purpose mounting frame constructed like a grille frame for each grille or register not equipped with a removable core to facilitate installation and removal of the grille or register without marring adjacent mounting surfaces.

(1) Furnish frames with 1/2-inch-thick sponge rubber gasket to prevent air leakage.

(2) Furnish a frame that neatly fits the grille. Mounting frames will not be required for grilles or registers mounted directly on exposed ductwork.

2.5 ACCEPTABLE MANUFACTURERS

a. Krueger, Metalaire, Titus, Price.

3.0 EXECUTION

3.1 INSPECTION

a. Do not install ceilings adjacent to fixtures until installation of fixtures, air supply assemblies, return air blank-off strips and flexible duct have been properly approved. Remove and reinstall any part of the installation found incorrect.

3.2 INSTALLATION

a. Diffusers. Louvered diffuser outlets mount tight against the ceiling. Fasten outlets securely to ductwork with sheet metal screws. For diffusers, attach the frame assembly by a concealed hinge assembly to an outer frame compatible with the type of ceiling on which the diffuser is installed.

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SECTION 23 30 00.40

DUCTWORK, FLUES AND LOUVERS

1.0 GENERAL

1.1 WORK INCLUDED

a. This Section provides for furnishing and installing low velocity and high velocity ductwork and includes duct construction and accessories.

1.2 APPLICABLE PROVISIONS

a. Refer to Section 23 00 00, Mechanical General Provisions.

1.3 GUARANTEE

a. Guarantee all ductwork for one year from the date of final acceptance. The guarantee will cover workmanship, noise, chatter, whistling, and vibration. Ductwork must be free from pulsation under all conditions of operation.

1.4 CONTRACTOR COORDINATION

a. Erect all ducts in the general locations shown, but conform to all structural and finish conditions of the building. Before fabricating any ductwork, check the physical conditions at the job site and make all necessary changes in cross sections, offsets, and similar items, whether they are specifically indicated or not.

1.5 STANDARDS AND CODES

a. Except as otherwise indicated, sheet metal ductwork material and installation shall comply with the latest edition of SMACNA Low Pressure Duct Construction Standards. Fiberglass ductwork material and installation shall comply with the latest edition of SMACNA Fibrous Glass Duct Construction Standards and NFPA Bulletin 90A. Medium and high pressure sheet metal ductwork shall comply with the latest edition of SMACNA High Pressure Duct Construction Standards. All air distribution devices (such as dampers) included in this specification shall comply with the latest applicable SMACNA manual and NFPA 90A.

b. All duct dimensions shown on drawings are clear inside dimensions.

2.0 PRODUCTS

2.1 DUCT MATERIAL

a. Except for the special ducts specified elsewhere, use prime galvanized steel sheets or coils up to 60-inches wide. Stencil each sheet with proper gauge and manufacturer's name. Stencil coils of sheet steel throughout on 10-foot centers with gauge and manufacturer's name. Contractor is cautioned that Engineer may random check duct and strap gauges with a micrometer to verify compliance with the specifications.

2.2 SEALING OF SEAMS AND JOINTS

a. The entire duct system shall be sealed. The seams and joints shall be sealed by use of United McGill water based duct sealer or equal. Thoroughly clean the duct areas to be sealed prior to application of sealer. Color shall be gray or green.

2.3 LOW PRESSURE DUCTWORK (LESS THAN 2 INCHES STATIC PRESSURE)

a. Rectangular. Furnish rectangular low pressure ducts constructed of sheet metal in the following minimum gauges:

Largest Dimension	U.S. Gauge
12" and less	No. 26
13" to 30"	No. 24
31" to 54"	No. 22
55" to 84"	No. 20
85" and above	No. 18

b. Round. Furnish round, low-pressure ducts which are spiral wound, such as manufactured by United McGill Corporation or equal, or shop fabricated round ducts with Pittsburgh lock longitudinal seams. Use the following gauges for shop fabricated ducts:

Diameter	U.S. Gauge
12" and less	No. 26
13" to 30"	No. 24
31" to 42"	No. 22

43" to 60" No. 20

c. Low Pressure Insulated Flexible Duct. Furnish factory-fabricated, flexible duct for connections between low velocity trunk ducts and supply air diffusers. Furnish flexible duct with an airtight inner liner, insulation and outer jacket. Construct the inner liner of chlorinated polyethylene (CPE) steel helix and fabric substantially bonded together to prevent the duct from collapsing or kinking in short radius bends. Furnish fiberglass insulation with minimum R Value of 6 around the inner liner. Sheath the entire assembly with reinforced aluminum foil kraft. Maximum length of flexible duct is 6 feet. Use a supply duct rated at a minimum positive working pressure of 10 inches of water. Exhaust ducts must withstand a negative pressure of 1.5 inches of water. Furnish duct UL-181 listed with a flame spread rate of not over 25 and smoke developed rate of not over 50, and complying with NFPA Standard 90A, paragraph 113a. Acceptable products include Thermaflex type M-KE or Flexmaster type 8M.

2.4 FIRE AND SMOKE DAMPERS

a. Quality standards: Furnish and install dampers according to the manufacturer's instructions and in compliance with the latest edition of the SMACNA Duct Manual and NFPA
Standards (90, 92A and 92B). All fire dampers and fire/smoke dampers shall comply with U.L. 555 and/or 555S.

b. Furnish an access door for each fire damper or fire/smoke damper. Stencil each door "Fire Damper Access" or "Fire/Smoke Damper Access" as appropriate for the damper installed.

c. Curtain style, dynamic fire damper. Furnish and install a fire damper suitable for dynamic systems. Dampers shall be marked with a U.L. Classified Fire Protection Rating, and marked "For Use in Dynamic Systems". Furnish a 165°F fusible link. Blades shall be out of the airstream. Damper frame shall be minimum 20-gauge. Damper blades shall be minimum 24 gauge. Provide factory mounted sleeve and retaining angles. Ruskin Model DIBD or approved equivalent.

d. Combination fire/smoke damper. Furnish and install a fire/smoke damper where shown on the drawings. Provide Class II leakage rating. Dampers shall be marked with a U.L. Classified fire rating. Damper blades shall be airfoil shaped, single piece construction, with blade seals mechanically locked into blade edge. (Adhesive clip-on seals are not acceptable). Provide stainless steel jamb seals and bearings. Damper frame shall be minimum 16-gauge.
Damper blades shall be minimum 14-gauge. Provide factory mounted sleeve and retaining angles.

e. Each combination fire/smoke damper shall be equipped with "Controlled Closure" heat actuated release device, designed to close from 7 to 15 seconds. Instantaneous damper closure is unacceptable. Damper shall have local reset button, and shall be remote resettable after test, smoke detection or power failure. Damper shall close upon loss of power. Provide 120-volt actuator. Ruskin Model FSD-60 or approved equivalent.

2.5 DUCT-MOUNTED SMOKE DETECTORS.

a. Wherever required by applicable codes and not shown on the Electrical drawings, furnish and install duct-mounted smoke detectors and coordinate with electrical to provide shutdown of air units as applicable. This includes but is not limited to the supply and return of all air units with a scheduled air quantity of 2,000 cfm or more. If multiple air units serve a common area and their total air quantity is 2,000 cfm or more, each unit must have a smoke detector.

b. Connect the duct smoke detectors to the building Fire Alarm System. If no Fire Alarm System exists, provide a visible and audible alarm device that signals upon smoke detection. Locate and identify the alarm device per the IMC.

c. Combination fire/smoke dampers not controlled thru a full coverage smoke detection system shall be furnished with a factory mounted pre-wired smoke detector.

2.6 WALL LOUVERS

a. Furnish and install a 5" deep rain proof louver, with 0.081" extruded aluminum frame, and extruded aluminum blades. Aluminum shall be 6063-T5. Blades shall be horizontal. Louver shall have 44% free area minimum. Ruskin Model EME520DD or equivalent.

b. Performance Test results shall be as follows:

(1) Wind velocity: 29 mph.

(2) Rainfall - 3 in./hr.

(3) Airflow thru free area - 1139 fpm.

(4) Pressure drop - 0.25".

(5) Water penetration - less than 0.01 oz./hr.

c. Provide 1/4" x 1/4" aluminum screen. Provide baked enamel (50% Kynar) finish, color to be selected by the Architect. Provide 20 year warranty on finish.

2.7 LOW PRESSURE DUCT TAPS SIDE TAKE-OFF FITTINGS

a. Fittings may be used for duct taps and shall include quadrant dampers with 2" stand-off bracket on all lines to air devices (diffusers and grilles) even if a volume damper is specified for the air device. Fittings shall be sealed at the duct tap with a gasket, or compression fit, or sealed with sealant. The location of fittings in the ducts shall be determined after the location of the light fixtures is known so as to minimize flexible duct lengths and sharp bends.

b. Each shall be provided with minimum 24-gauge damper plate with locking quadrant operator and sealed end bearings. Damper blade shall be securely attached to 3/8" square shaft to prevent damper from rotating around shaft. Shaft shall have nylon bushing seals.

c. Provide flange and gasket with adhesive peel-back paper for ease of application. The fitting shall be further secured by sheet metal screws spaced evenly at no more than 4-inches on-center with a minimum of four screws per fittings.

d. The fitting shall be equivalent to Flexmaster STO with B03 damper assembly.

3.0 EXECUTION

3.1 INSTALLATION

a. Construction Standards. Use construction methods which follow the requirements outlined in paragraph 1.5, as well as SMACNA Balancing and Adjusting publications, unless otherwise indicated in these specifications or accompanying drawings.

b. Reinforcement. Reinforce ducts having one side equal to 25-inches or more in accordance with recommended construction practice of SMACNA.

c. Plenum Construction. Construct Plenum chambers of not less than No. 20 U.S. gauge metal reinforced with galvanized structural angles.

d. Cross Breaking or Beading. Cross break or bead sheet metal for rigidity, except ducts which are 12 inches or less in the longest dimension.

e. Wall Penetrations. Where ducts pass through walls in exposed areas, install suitable escutcheons made of sheet metal angles as closers. At all locations where ductwork passes through floors, furnish watertight sleeves projecting 3-inches above finished floor and flush with bottom of floor slab. Fabricate sleeves of 1/8-inch thick steel, galvanized after fabrication. Anchor into adjacent floor slab as required. Sleeves are

required inside as well as outside chases. Support ducts where passing through floors with steel structural angles of adequate bearing surface, galvanized after fabrication and resting on top of the sleeve.

f. Interior Painting. Interior painting of metal ductwork exposed to view through grilles, registers, and other openings is specified in the section on painting. Do not install grilles, registers, or similar items until painting is complete.

g. Duct Cleanliness. During construction, provide temporary closures of taped polyethylene on open ductwork to prevent construction dust from entering ductwork system. Clean interior of all dust and debris prior to end of construction. Do not run air handlers or exhaust fans until all interior cleaning and painting is complete. The cleaning of fouled coils or fan assemblies due to paint or construction debris is to be the responsibility of the HVAC Contractor.

3.2 LOW PRESSURE DUCTWORK

a. Volume Dampers. Furnish opposed-blade volume dampers with an appropriate control device in each supply air, return air, outside air and exhaust branch duct, in exhaust connections to hoods or equipment, in each zone at multizone unit discharge, and where otherwise indicated, in accordance with SMACNA Duct Manual. Furnish multiblade dampers when blade width exceeds 12-inches.

b. Elbows.

(1) Rectangular. Where square elbows are shown, or are required for good air flow, furnish and install 4" radius, single thickness turning vanes space on 3-1/4" centers. Furnish vanes fabricated for the same angle as the duct offset. Use radius elbows with a center line radius of not less than 1-1/2 times the duct width. Radius elbows may be furnished in lieu of vaned elbows where space and air flow requirements permit.

(2) Round and Oval Duct. Furnish elbows with a centerline radius of 1-1/2 times the duct diameter or duct width. For round ducts, furnish smooth elbows or 5-piece, 90 degree elbows and 3-piece, 45 degree elbows.

c. Remote Cable Operated Dampers. Furnish and install remote cable operated dampers in areas with inaccessible ceilings and where otherwise indicated on drawings. Dampers shall be adjustable with a flat-head screwdriver and concealed in a powder coated steel cover box. Coordinate the location of cover box with Architect and Engineer. Damper with worm gear assembly, cable and all associated appurtenances shall be by the damper manufacturer. Damper shall be either rectangular or round as required. Cable length shall be determined by Contractor, as required for each application. Damper shall be Rototwist Model RT-200 (square) or RT-250 (round).

(1) At the Contractor's option, concealed cable system may be installed in lieu of worm gear, ceiling cup and cover plate assembly. Damper shall be installed with cable routed inside ductwork to neck of air device. Cable shall be adjustable through face of air device and secured as required to air device or associated upstream ductwork. Provide Rototwist Model RT-100 (square) or RT-150 (round). Contact Texas Air Products at (210) 495-8100.

d. Obstruction. Install streamline deflectors at any point where dividing a sheet metal duct around piping or where other such obstruction is permitted. Where such obstructions occur in insulated ducts, fill space inside streamliner and around obstructions with glass fiber insulation.

e. Remote Operated Dampers. Furnish factory-fabricated volume dampers for remote, manual volume control. Use opposed-blade, balanced type, pivoted in bronze bearings and mounted in a channel frame. Operate damper through a flexible-drive cable.

f. Low Pressure Insulated Flexible Duct. Do not exceed 6 feet in length with any flexible duct. Support duct independently of lights, ceiling and piping. Support duct with metal strap or hanger rod. Fiberglass strap supports are not acceptable.

g. Low Pressure Duct Supports.

(1) Horizontal Ducts Up To 40 Inch. Support horizontal ducts up to and including 40 inches in their greater dimension by means of No. 18 U.S. gauge band iron hangers attached to the ducts by means of screws, rivets or clamps, and fastened to inserts with toggle bolts, beamclamps or other approved means. Place supports on 8'-0" centers, maximum. Use clamps to fasten hangers to reinforcing on sealed ducts.

(2) Horizontal Ducts Larger Than 40-Inch. Support horizontal ducts larger than 40 inches in their greatest dimension by means of hanger rods bolted to angle iron trapeze hangers. Place supports on 8'-0" centers maximum according to the following:

Angle Length	Angle	Rod Diameter
4'-0"	1-1/2" x 1-1/2" x 1/8"	1/4"
6'-0"	1-1/2" x 1-1/2" X 1/4"	1/4"
8'-0"	2" X 2" X 1/4"	5/16"
10'-0"	3" X 3" X 1/4"	3/8"

(3) Vertical Ducts. Support vertical ducts where they pass through the floor lines with 1-1/2" x 1-1/2" x 1/4" angles for ducts up to-60 inches. Above 60-inches the angles must be increased in strength and sized on and individual basis considering space requirements.

(4) Structural steel shapes (i.e., Uni-Strut or Kindorf) that have equivalent load bearing properties of the SMACNA recommended support angles may be used as alternative support means.

3.3 FLEXIBLE CONNECTIONS

a. Where ducts connect to fans or air handling units, make flexible airtight connections using "Ventglas" fabric. The fabric must be fire-resistant, waterproof and mildew resistant with a weight of approximately 30 ounces per square yard. Furnish a minimum of 1/2-inch slack in the connections, and a minimum of 2-1/2-inches distance between the edges of the ducts. Also furnish a minimum of 1-inch slack for each inch of static pressure on the fan system. Securely fasten fabric to apparatus and to adjacent ductwork by means of galvanized flats or draw bands. Where rectangular connections are made in outdoor locations, seal fabric to metal with mastic. For connections to belted vent sets outdoors, furnish Duall fan connector, Koroseal, black with UV inhibitors. Secure with stainless steel bands.

3.4 ACCESS DOORS

a. Install ductwork access doors in structural angle frames and furnish with sash locks and hinges arranged for convenient access. Construct doors which occur in insulated ducts with an insulation filler. Install access doors for grease duct and grease duct enclosures for maintenance and cleanout per IMC and NFPA 96 requirements. Install an access door upstream of any duct-mounted coil.

3.5 FLASHING

a. Where ducts pass through roofs or exterior walls, furnish suitable flashing to prevent rain or air currents from entering the building. Furnish flashing not less than No. 26 gauge stainless steel or 16-ounce copper.

3.6 DUCT LINING

a. Install glass fiber acoustical lining in all rectangular supply and return ductwork for first fifteen feet upstream and downstream of air unit, and in return air sound traps. Furnish 1-1/2-inch thick, 1-1/2 pound density, flexible lining coated on the air stream side to reduce attenuation. Lining shall be provided in addition to external duct insulation required per Section 23 07 13. Secure to duct surfaces with Benjamin Foster 85-25 adhesive and sheet metal fasteners on 12-inch centers. Omit lining as necessary to

permit satisfactory operation of air control devices. Coat all exposed edges and leading edges of cross joints with adhesive. Use liner such as Johns-Manville Permacote Lina-Coustic, or equal which meets requirements of NFPA 90-A for rectangular duct. Use 1" thick Johns-Manville Spiracoustic Plus round liner board for round duct.

3.7 TESTS

a. Allowable Leakage. Test ductwork for leaks before concealing. Maximum allowable leakage is 1 percent of total flow at 2-inches W.C. for low pressure duct and 6-inches for medium and high pressure duct.

b. Equipment. Furnish equipment necessary for performing tests, including rotary blower, orifice section and U-tube gauge board complete with cocks and rubber tubing.

c. Risers and Branch. Test duct riser or branch duct including flexible duct runouts in accordance with SMACNA manual.

d. Mains. Test mains after risers and branches are tied in and all equipment set. Close runout connections and place fan in operation. Furnish pressure in mains above design pressure. Visually inspect joints. Repair leaks detected by sound or touch. Release mains for completion after joints are tight.

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SECTION 23 34 16

FANS

1.0 GENERAL

1.1 SCOPE

a. This Section provides for the furnishing and installation of fans, including centrifugal, axial and propeller types, with all supplemental equipment.

1.2 APPLICABLE PROVISIONS

a. Refer to Section 23 00 00, Mechanical General Provisions.

1.3 PERFORMANCE

a. Provide fan type, arrangement, rotation, capacity, size, motor horsepower, and motor voltage as shown. Fan capacities and characteristics are scheduled on the drawings.

b. Rate fans according to appropriate Air Moving and Conditioning Association, Inc. (AMCA), approved test codes and procedures. Supply fans with sound ratings below the maximums permitted by AMCA standards. All fans provided must be licensed to bear the Certified Ratings Seal.

c. Statically and dynamically balance all fans.

1.4 SUBMITTALS

a. Submit product data on all fans, including cut sheets, fan curve, sound data, performance data and accessories provided.

b. On products required to have a paint finish, submit a detailed cutsheet of paint properties.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

a. Centrifugal & Propeller Fans.

(1) Loren Cook

(2) Greenheck

(3) Twin City

2.2 SUPPLEMENTAL EQUIPMENT

a. Motor Covers. Furnish weatherproof motor covers for installation outdoors. Apply the same finish as used on the fan.

b. Belt Drives.

(1) Unless otherwise specified for belt-driven fans, equip the fan motors with variable pitch sheaves. Select the sheave size for the approximate midpoint of adjustment and to provide not less than 20 percent speed variation from full open to full closed size drives for 150-percent of rated horsepower. Key the fan sheave to the fan shaft.

(2) Nonadjustable motor sheaves may be used for motor sizes over 15 horsepower, at the Contractor's option. However, if changing a nonadjustable sheave becomes necessary to produce the specified capacity, the change must be made at no additional cost.

(3) Furnish belt guards and apply the same finish as used for the fan.

c. Safety Disconnect Switch. Furnish a factory-wired, safety disconnect switch on each unit equipped with a 115/1/60 motor.

d. Relief Vents and Air Inlets. Furnish vents and inlets with aluminum frames, 1/2-inch mesh galvanized bird screens, and dampers.

e. Prefabricated Roof Curbs. Furnish prefabricated roof curbs with built in cant strips and lined with glass fiber insulation. Curbs may be made of No. 18 U.S. standard gage galvanized steel or 0.063-inch aluminum. The minimum height is 18-inches. Include on each roof curb a resilient pad for equipment mounting on the top flange.

f. Sound Attenuating Bases. Construct sound attenuating bases of No. 18 U.S. standard gage galvanized steel or 0.063-inch aluminum. Include a built-in cant strip for curb mounting and a resilient pad for equipment mounting on the top flange. Line the base with 2-inches of glass fiber insulation and fit internally with glass fiber acoustical baffles.

2.3 CEILING MOUNTED CABINET EXHAUST FAN

a. Fan shall be ceiling mounted, direct driven, centrifugal exhaust fans.

b. Fan shall be listed by Underwriters Laboratories (UL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.

c. The fan wheel housing and integral outlet duct shall be either injection molded from a specially engineered resin (exceeding UL requirements for smoke and heat generation) or 20 gauge galvanized steel with a 1/2" acoustical liner. The outlet duct shall have provision for an aluminum backdraft damper with continuous aluminum hinge rod. The inlet box shall be minimum 22-gauge galvanized steel. Motor shall be isolation mounted to a one piece galvanized stamped steel integral motor mount/inlet. A field wiring compartment with a receptacle shall be standard. To accommodate different ceiling thickness, an adjustable prepunched mounting bracket shall be provided.

d. Wheel shall be centrifugal forward curved type, either injection molded of polypropylene resin or galvanized steel. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

e. Motor shall be open drip proof type with permanently lubricated sealed bearings and include impedance or thermal overload protection and disconnect plug. Motor shall be furnished at the specified voltage and phase.

f. Accessories:

(1) Ceiling Grille: White Aluminum.

(2) Unit mounted fan speed controller.

(3) Wall cap (for through-the-wall installations).

(4) Roof cap (for roof exhaust installations).

2.4 SQUARE IN-LINE CENTRIFUGAL FANS

a. Fan shall be duct mounted, direct drive or belt driven centrifugal square inline. Fan shall be listed by Underwriters Laboratories (UL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.

b. The fan shall be of bolted construction utilizing corrosion resistant fasteners. Housing shall be minimum 18-gauge steel with integral duct collars. Bolted access doors shall be provided on three sides, sealed with closed cell neoprene gasketing. Pivoting motor plate shall utilize threaded L-bolt design for positive belt tensioning. Housing shall be pre-drilled to accommodate universal mounting feet for vertical or horizontal installation. Unit shall bear an engraved aluminum nameplate with manufacture's data.

c. Wheel shall be centrifugal backward inclined, non-overloading flat blade type, constructed of 100% aluminum, including a cast aluminum hub. Wheel hub shall be keyed and securely attached to the fan shaft. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

d. All steel fan components shall be coated with a minimum 2-mil thick baked powder finish. Paint must exceed 1,000 hour salt spray under ASTM B117 test method.

e. Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.

f. Bearings shall be designed and tested specifically for use in air handling applications. Construction shall be regreasable ball type in a cast iron pillow block housing selected for an average L50 life in excess of 200,000 hours at maximum cataloged operating speed.

g. Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

h. Accessories: Provide the following accessories and those indicated on the schedule

(1) Inlet or outlet safety screens for non-ducted applications.

(2) Standard belt guard.

(3) Motor cover.

(4) Backdraft damper.

(5) Insulated housing.

2.5 ROOFTOP CENTRIFUGAL FANS

a. Fan shall be a spun aluminum, roof mounted, direct drive or belt driven, downblast centrifugal exhaust ventilator. Fan shall be listed by Underwriters Laboratories (UL 705). Fan shall bear the AMCA certified ratings seal for sound and air performance.

b. The fan shall be of bolted and welded construction utilizing corrosion resistant fasteners. The spun aluminum structural components shall be constructed of minimum 16-gauge marine alloy aluminum, bolted to a rigid aluminum support structure. The aluminum base shall have continuously welded curb cap corners for maximum leak

protection. The discharge baffle shall have a rolled bead for added strength. An integral conduit chase shall be provided through the curb cap and into the motor compartment to facilitate wiring connections. Bearings and drives shall be mounted on a minimum 14-gauge steel power assembly, isolated from the unit structure with rubber vibration isolators. These components shall be enclosed in a weather-tight compartment, separated from the exhaust air stream. Unit shall bear an engraved aluminum nameplate with manufacturer's data.

c. Wheel shall be centrifugal backward inclined, constructed of 100% aluminum, including a precision machined cast aluminum hub. Wheel inlet shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency. Wheel shall be balanced in accordance with AMCA Standard 204-96, Balance Quality and Vibration Levels for Fans.

d. Motor shall be heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase and enclosure.

e. Bearings shall be designed and individually tested specifically for use in air handling applications. Construction shall be heavy duty regreasable ball type in a cast iron housing selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.

f. Belts shall be oil and heat resistant, non-static type. Drives shall be precision machined cast iron type, keyed and securely attached to the wheel and motor shafts. Drives shall be sized for 150% of the installed motor horsepower. The variable pitch motor drive must be factory set to the specified fan RPM.

g. Accessories: Provide the following accessories and those indicated on the schedule.

(1) All aluminum construction.

(2) Stainless steel hardware [for corrosion protection typically used along the coast].

(3) 18 inch roof curb.

(4) Backdraft damper.

3.0 EXECUTION

a. Install fans according to the manufacturer's instructions and in the locations shown on the drawings.

b. Provide flexible connection at inlet for fans.

c. Roof mounted fans shall be installed on roof curbs provided by the fan manufacturer.

d. Propeller wall fans shall be mounted in collars provided by the fan manufacturer. Carefully coordinate exact collar dimensions.

e. On roof mounted fans, electrical wiring and/or conduit shall not interfere with backdraft damper.

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SECTION 23 81 26
AIR COOLED CONDENSING UNITS

1.0 GENERAL

1.1 RELATED DOCUMENTS

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

1.2 SUMMARY

a. This Section includes air cooled condensing units.

1.3 SUBMITTALS

a. Product Data. For each condensing unit, include rated capacities, operating characteristics, furnished specialties, and accessories. Include equipment dimensions, weights and structural loads, required clearances, method of field assembly, components, power requirements, wiring diagrams, and location and size of each field connection. Provide matching system fan coil/air handler selection at ARI conditions for each condensing unit.

b. Coordination Drawings. Plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved.

(1) Structural members to which condensing units will be attached (if required).

(2) Liquid and suction pipe sizes.

(3) Refrigerant specialties.

(4) Piping including connections and service valves.

c. Field quality-control test reports.

d. Operation and Maintenance Data. For condensing units to include in emergency, operation, and maintenance manuals.

e. Warranty. Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

a. Product Options. Drawings indicate size, profiles, and dimensional requirements of condensing units and are based on the specific system indicated.

b. Electrical Components, Devices, and Accessories. Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

c. Fabricate and label refrigeration system according to ASHRAE 15, "Safety Code for Mechanical Refrigeration."

(1) Units shall be designed to operate with HCFC-free refrigerants.

1.5 COORDINATION

a. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases.

b. Coordinate installation of roof curbs, equipment supports, and roof penetrations.

c. Coordinate location of piping and electrical rough-ins.

1.6 WARRANTY

a. Special Warranty. Manufacturer's standard form in which manufacturer agrees to repair or replace components of condensing units that fail in materials or workmanship within specified warranty period.

(1) Failures include, but are not limited to, the following:

(a) Compressor failure.

(b) Condenser coil leak.

(2) Warranty Period. Five (5) years from date of Substantial Completion.

PART 2 – PRODUCTS

2.1 MANUFACTURERS

a. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:

(1) Available Manufacturers. Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, manufacturers specified.

(2) Manufacturers. Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 CONDENSING UNITS, AIR COOLED, 1 TO 5 TONS

a. Available Manufacturers.

(1) Aaon.

(2) Carrier Corporation; Carrier Air Conditioning Div.

(3) Lennox Industries, Inc.

(4) Trane Co.

(5) York International Corp.

(6) McQuay

b. Description. Factory assembled and tested, consisting of compressor, condenser coil, fan, motors, refrigerant reservoir, and operating controls.

c. Compressor. Scroll, hermetically sealed, with rubber vibration isolators.

(1) Motor. Single speed, and includes thermal – and current-sensitive overload devices, start capacitor, relay, and contractor.

(2) Compressor. Automatic-reset, low-pressure switch.

(3) Refrigerant Type. HCFC-free.

d. Condenser Coil. Seamless copper-tube, aluminum-fin coil; circuited for integral liquid subcooler, and brass service valves with service ports.

(1) Condenser coil hail guard. (PVC-Coated Steel).

e. Condenser Fan. Direct-drive, aluminum propeller fan; with permanently lubricated ball bearings, totally enclosed fan motor with thermal-overload protection.

f. Accessories.

(1) Crankcase heater.

(2) Cycle Protector. Automatic-reset timer to prevent rapid compressor cycling.

(3) Electronic 7-day programmable low-voltage thermostat and sub-base to control condensing unit and evaporator fan.

(4) Low Pressure Switch. Automatic-reset switch cycles compressor off on low refrigerant pressure.

(5) Time-Delay Relay. Continues operation of evaporator fan after compressor shuts off.

g. Unit Casing. Galvanized steel, finished with baked enamel; with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Mount service valves, fittings, and gage ports on exterior of casing.

2.3 CONDENSING UNITS, AIR COOLED, 6 TO 120 TONS

a. Available Manufacturers.

(1) Aaon.

(2) Carrier Corporation; Carrier Air Conditioning Div.

(3) Lennox Industries, Inc.

(4) McQuay International.

(5) Trane Co.

(6) York International Corp.

b. Description. Factory assembled and tested, air cooled; consisting of casing, compressors, condenser coils, condenser and motors, and unit controls.

c. Compressor. Hermetic digital scroll compressor designed for service with crankcase sight glass, crankcase heater, and backseating service access valves on suction and discharge ports.

(1) Capacity Steps. Re: Schedule.

(2) Refrigerant Type. HCFC-free.

d. Condenser Coil. Seamless copper-tube, aluminum-fin coil, including subcooling circuit and backseating liquid-line service access valve. Factory pressure test coils, then dehydrate by drawing a vacuum and fill with a holding charge of nitrogen or refrigerant.

(1) Condenser coil hail guards. (PVC-coated steel).

e. Condenser Fans. Propeller-type vertical discharge; direct driven. Include the following:

(1) Permanently lubricated ball-bearing motors.

(2) Separately motor for each fan.

(3) Dynamically and statically balanced fan assemblies.

f. Operating and safety controls include the following:

(1) Manual-reset, high-pressure cutout switches.

(2) Automatic-reset, low-pressure cutout switches.

(3) Low oil pressure cutout switch.

(4) Compressor-winding thermostat cutout switch.

(5) Three-leg, compressor-overload protection.

(6) Control transformer.

(7) Magnetic contactors for compressor and condenser fan motors.

(8) Time to prevent excessive compressor cycling.

(9) Liquid and suction line shutoff valve(s).

(10) Suction line accumulator.

(11) Liquid line receiver.

g. Accessories

(1) Electronic 7-day programmable low-voltage thermostat and sub-base to control condensing unit and evaporator fan.

(2) Low Ambient Controller. Cycles condenser fan to permit operation down to 20 deg. F with time-delay relay to bypass low-pressure switch.

h. Unit Casings. Designed for outdoor installation with weather protection for components and controls and with removable panels for required access to compressors, controls, condenser fans, motors, and drives. Additional features include the following:

(1) Galvanized for exposed casing surfaces; treated and finished with baked enamel powder finish.

(2) Perimeter base rail with forklift slots and lifting holes to facilitate rigging.

(3) Gasketed control panel door.

2.4 SOURCE QUALITY CONTROL

a. Verification of Performance. Rate condensing unit according to 365.

(1) Coefficient of Performance. Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buidlings."

(2) Energy-Efficient Ratio. Equal to or greater than prescribed by ASHRAE/IESNA 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

b. Testing Requirements. Factory test sound-power level ratings according to ARI 270.

PART 3 – EXECUTION

3.1 EXAMINATION

a. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerance and other conditions affecting performance of condensing units.

b. Examine roughing-in for refrigerant piping systems to verify actual locations of piping connections before equipment installation.

c. Examine walls, floors, and roofs for suitable conditions where condensing units will be installed.

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

3.2 INSTALLATION

a. Install units level and plumb, firmly anchored in locations indicated; maintain manufacturer's recommended clearances.

b. Contractor to verify and comply with manufacturers recommended clearances with project conditions prior to installation.

c. Install condensing units on concrete base.

(1) Vibration Isolation. Mount condensing units on rubber pads with a minimum deflection of 1/4-inch.

d. Install roof-mounting units on equipment supports.

e. Vibration Isolation. Mount condensing units on rubber pads with a minimum deflection of 1/4-inch.

f. Maintain manufacturer's recommended clearances for service and maintenance.

g. Loose components. Install electrical components, devices, and accessories that are not factory mounted.

3.3 CONNECTIONS

a. Piping installation requirements are specified in other Mechanical Sections. Drawings indicate general arrangement of piping, fittings, and specialties.

b. Install pipe adjacent to machine to allow service and maintenance.

c. Connect refrigerant piping to air-cooled condensing units; maintain required access to unit. Install furnished field-mounted accessories. Refrigerant piping and specialties are specified in Specification Section "Refrigerant Piping".

3.4 FIELD QUALITY CONTROL

a. Perform the following field tests and inspections and prepare test reports.

(1) Perform electrical test and visual and mechanical inspection.

(2) Leak Test. After installation, charge systems with refrigerant and oil and test for leaks. Repair leaks, replace lost refrigerant and oil, and retest until no leaks exist.

(3) Operational Test. After electrical circuitry has been energized, start units to confirm proper operation, product capability, and compliance with requirements.

(4) Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

b. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

c. Remove and replace malfunctioning condensing units and retest as specified above.

3.5 STARTUP SERVICE

a. Complete installation and startup checks according to manufacturer's written instructions and perform the following:

(1) Inspect for physical damage to unit casing or condenser coil.

(2) Verify that access doors move freely and are weathertight.

(3) Clean units and inspect for construction debris.

(4) Verify that all bolts and screws are tight.

(5) Adjust vibration isolation and flexible connections.

(6) Verify that controls are connected and operational

b. Verify that fan wheel is rotating in the correct direction and is not vibrating or binding.

c. Start unit according to manufacturer's written instructions and complete manufacturer's startup checklist.

d. Verify that vibration isolation and flexible connections properly dampen vibration transmission to structure.

3.6 DEMONSTRATION

a. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain condensing units. Refer to Specification Section "Closeout Procedures or Demonstration and Training".

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SECTION 23 82 19.70

DX FAN COIL UNITS

1.0 GENERAL

1.1 WORK INCLUDED

a. This Section specifies heat pump fan coil units for indoor installation, matched with heat pump outdoor units specified in another section.

1.2 RELATED WORK

a. Division 23 - Mechanical.

(1) Refrigerant Piping.

(2) Condensing Units.

1.3 ACCEPTABLE MANUFACTURERS

a. Carrier, Trane, York, Aaon, McQuay.

1.4 PERFORMANCE

a. Provide units which meet or exceed the performance criteria scheduled on the Drawings.

1.5 APPROVALS

a. Rate coils and matching outdoor units in accordance with ARI Standard 210/240 latest edition.

b. Rate electric heater in accordance with DOE test procedures and FTC labeling regulations.

c. Meet UL and NEC standards for grounding units.

2.0 PRODUCTS

2.1 CABINET

a. Provide a unit suitable for vertical, floor-mounted or horizontal suspended installation as shown on the drawings.

b. Provide units complete with coils, motors and drives.

c. Furnish minimum 18-gauge steel insulated cabinets which are corrosion-resistant treated before final finish is added.

d. Provide removable access panels to all parts requiring service.

e. Provide electrical knockouts on both sides of unit. Make provision for duct connections at each end of the fan coil unit.

2.2 COILS

a. Provide seamless copper tubes with aluminum fins.

b. Factory test coil to ensure leakproof construction.

2.3 ELECTRIC HEAT

a. Furnish nichrome bare heating elements exposed to the air stream.

b. Provide high temperature limit control with automatic reset.

c. Provide thermal cutoff safety fuses mounted external to the element faceplate for easy replacement.

d. Furnish thermal sequencer relay to bring the elements on and off line, in sequence and in equal increments, with a time delay between each element. Sequencer also initiates and terminated blower operation.

e. Provide heater control relays.

f. Provide factory wired circuit breakers for overload and short circuit protection, manually reset.

g. Factory mount controls in heavy gauge galvanized steel box, requiring only plug-in field connections.

2.4 FANS

a. Provide belt drive blower, statically and dynamically balanced as an assembly before it is mounted in the unit.

2.5 MOTORS

a. Provide motors of the permanent, split capacitor type wired for multiple speeds.

b. Control the motors with easily accessible, multispeed switches located within the fan coil unit housing.

c. Provide built-in thermal overload and short circuit protection, accessible external to the cabinet, manually reset.

2.6 DRAIN PAN

a. Provide heavy-duty, rust-inhibited drain pans extending under coils, valves and pipe connection assembly within units, with primary and secondary drain connections.

2.7 CONTROLS

a. Provide control transformer and terminal strip, factory installed in the unit control box.

2.8 THERMOSTAT

a. Provide electronic programmable 7-day thermostat, suitable for the control of all stages of the unit. Include as a minimum two on and two off cycles per day, fan on/auto control, temperature override with lockout capability and auto changeover.

2.9 FILTERS

a. Provide 2", pleated, throwaway filter with 30% efficiency. Furnish two sets.

3.0 EXECUTION

a. Install the unit and make refrigerant and control connections in accordance with the manufacturer's recommendations.

b. On each unit condensate drain, furnish a trap deep enough to overcome pressure of unit. All condensate drain piping shall be hard drawn Type L copper pipe. For units on a mechanical mezzanine or if concealed above a ceiling, install a secondary drain pan. Route auxiliary drain line to an approved point of discharge. If auxiliary drain line is not possible, provide a float switch wired to unit so that system shutdown occurs upon water detection.

c. Upon completion of system installation, test the unit for proper operation in all normal modes. Verify that all safeties function properly.

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STATE OF TEXAS
ALBERTO E. MARTINEZ
102236
PROFESSIONAL LICENSED ENGINEER

11/16/12

SECTION 26 00 00

ELECTRICAL GENERAL PROVISIONS

1.0 GENERAL

1.1 SCOPE OF WORK

a. The work covered by Division 26 includes the furnishing of all materials, labor, transportation, tools, permits, fees, utilities, and incidentals necessary and the complete installation of all electrical work required in the Contract Documents and specified herein. The intent of the Contract Documents is to provide an installation complete in every respect. In the event that additional details or special construction may be required for the work indicated or specified in Division 26 or work specified in other Divisions of the Specifications, it is the responsibility of the Contractor to provide all material and labor which is usually furnished with such systems in order to make the installation complete and operational.

b. The Contractor is responsible for the coordination and proper relation of his work to the building structure and to the work of other trades. The Contractor shall visit the site and thoroughly familiarize himself with the existing conditions that affect the work and to verify all dimensions. The Contractor shall advise the Architect/Engineer of any discrepancy prior to bidding. The submission of a bid shall be deemed evidence of the Contractor's site visit, the coordination of all existing conditions, and the inclusion of all consideration for existing conditions.

1.2 CODES AND STANDARDS

a. All work shall comply with the latest edition of the applicable rules and regulations of the National Electrical Code (NEC), the National Electrical Safety Code (NESC), the National Fire Protection Association (NFPA), International Fire Code (IFC), Americans with Disabilities Act (ADA), the terms and conditions of service of the electrical utility, as well as any other authorities that may have lawful jurisdiction pertaining to the work specified. None of the terms or provisions of this specification shall be construed as waiving any of the rules, regulations, or requirements of these codes or authorities.

b. The Contractor shall resolve any code violation discovered in the Contract Documents with the Architect/Engineer prior to award of the contract.

c. In any instance where the Plans or Specifications call for materials of a better quality or larger size than required by the codes, those provisions of the Drawings or Specifications shall take precedence. The codes shall govern in case of direct conflict between the codes and the Drawings or Specifications.

1.3 RELATED DOCUMENTS

a. The Plans and Specifications, the General Conditions, Supplementary General Conditions and other requirements of Division 01, apply to the work specified in Division 26, and shall be complied with in every respect. The Contractor shall examine all of the documents, which make up the Contract Documents, and shall coordinate them with the electrical work on the Electrical plans and in Division 26 of these Specifications.

1.4 DRAWINGS AND SPECIFICATIONS

a. The Specifications are accompanied by Drawings for the project and details of the installations indicating the locations of equipment, piping, ductwork, outlets, lighting fixtures, switches, controls, receptacles, etc. The Drawings and Specifications are complementary to each other, and what is required by one shall be as binding as if required by both. Phase, neutral and switch leg indications are shown only where it is considered that clarification is required to indicate typical wiring methods required.

b. If any departures from the Contract Documents are deemed necessary by the Contractor, details of such departures and the reasons therefore shall be submitted in writing to the Architect/Engineer for review. No departures from the Contract Documents shall be made without prior written approval of the Architect/Engineer.

c. The interrelation of the Specifications, Drawings, and Schedules is as follows: The Specifications determine the nature and quality of the materials, the Drawings establish the quantities, dimensions and details, and the Schedules give the performance characteristics. Should the Drawings disagree in themselves, or with the Specifications, the better quality or greater quantity of work or materials shall be estimated upon, and unless otherwise directed by the Architect/Engineer in writing, shall be performed or furnished. In case the Specifications should not fully agree with the Schedules, the latter shall govern. Figures indicated on Drawings govern scale measurements and large scale details govern small scale Drawings. In case of disagreement between Specifications and Drawings, see Division 01 of these Specifications for clarification.

d. Items specifically mentioned in the Specifications but not shown on the Contract Drawings and/or items shown on the Contract Drawings but not specifically mentioned in the Specifications shall be installed by the Contractor under the appropriate section of work as if they were both specified and shown.

1.5 ELECTRICAL AND COMMUNICATION UTILITIES

a. The Contract Documents reflect the general location, voltage, ampacity, size and manner of routing for all electrical and communication utilities known to be required on this project. It is the responsibility of the Contractor to visit the site, meet with the local

Electrical Company personnel in order to coordinate and confirm the exact requirements for all electrical utilities. The bid submitted by the Contractor shall include costs for all such coordination work as well as any and all utility company charges and/or fees. See Section 26 00 20 for additional data.

1.6 TEMPORARY SERVICES

a. At present, electrical service exists on this site which may be used for temporary construction power. It is the responsibility of the Contractor to furnish and install a complete system for temporary construction power and lighting. Temporary services shall be installed in accordance with requirements of the National Electrical Code (NEC), the National Electrical Safety Code (NESC), and the Occupational Safety and Health Act (OSHA).

b. The Contractor shall pay for the cost of the temporary construction power and lighting systems throughout the entire construction period.

c. Remove all temporary services upon completion of the work.

1.7 BUILDING CONSTRUCTION

a. It is the responsibility of the Contractor to review the Drawings and Specifications so as to thoroughly familiarize himself with the type and quality of construction to be provided on this project.

b. The electrical drawings are diagrammatic in character and cannot show every connection in detail or every line or conduit in its exact location. The Contractor shall carefully investigate structural and finish conditions and shall coordinate with all other trades in order to avoid interference between the various phases of work. Work shall be organized and laid out so that it will be concealed in furred chases and above suspended ceilings, etc. in finished portions of the building unless specially noted to be exposed. All work shall be installed parallel or perpendicular to the lines of the building, including inside cabinets and under counters, in an aesthetic, inconspicuous manner unless otherwise noted.

c. The approximate location of electrical items is indicated on the electrical drawings. These drawings are not intended to give complete and exact details in regard to location of outlets, apparatus, etc. Exact locations are to be determined by actual measurements at the job site and will in all cases be subject to the approval of the Architect/Engineer. The Architect/Engineer reserves the right to make any reasonable changes in the location indicated without additional cost. Remove and relocate outlets placed in unsuitable location, when so requested by the Architect/Engineer.

1.8 BUILDING DEMOLITION

a. Unless noted otherwise, remove all electrical materials and equipment from areas designated for demolition.

b. Where electrical equipment is indicated for removal, the Contractor shall remove all associated wiring back to the last active outlet or to the panelboard. If all electrical equipment on the circuit is scheduled for removal, the Contractor shall remove the associated conduit system where run exposed or above accessible ceilings. Where conduit is concealed in walls, floors or ceilings the exposed portion of the conduit shall be cut off flush with the building surface and the concealed portion shall be capped and abandoned in place. All voids left by the removal of electrical equipment shall be filled with grout and finished to match existing adjacent surfaces. Removal of any electrical equipment shall be performed in such a way not to interfere with ongoing daily building operations.

c. All salvage shall remain the property of the Owner and be delivered to a location, on site, as designated by the Owner. In the event the Owner does not desire to retain the salvage material, the material becomes the property of the Contractor and shall be properly disposed of by the Contractor. Confirm with Owner the following salvage material: lighting fixtures, panelboards, transformers, fire alarm devices, disconnect switches and controllers.

d. Existing electrical services and controls to items being removed under other sections must be disconnected as a requirement of this section.

e. Wherever a new to existing electrical connection is required, the Contractor shall provide all materials (e.g., junction boxes, conduit, fittings, wiring and wiring connections) and labor required to make the connections.

f. The Contractor is responsible for maintaining all branch circuits, in an operational condition, in all areas not included under this contract that may be affected during the demolition.

g. All concrete slab penetrations shall be coordinated and approved by the Structural Engineer. Where required the Contractor shall X-ray the proposed slab penetration area prior to performing any work, to ensure that there are no existing conduit systems, concrete load bearing structural members, etc., that may otherwise be damaged by core drilling the concrete slab.

h. The Contractor shall field verify power connection points of devices not scheduled for removal, by means of circuit tracing, prior to any rewiring. Equipment and devices not scheduled for removal and their associated branch circuitry shall remain in their original operating condition.

i. The Contractor shall provide new wiring for all branch circuits and feeders scheduled for disconnection and reconnection. Splicing new wiring to old wiring is not acceptable. Existing conduit system may be reused and extended as required unless visible conduit damage is noted, in which case the existing conduit system shall be replaced with a new conduit system.

j. All existing abandoned conduit, cables, etc. above existing ceiling shall be removed.

k. Prior to removal of existing fire alarm equipment for relocation, test existing systems and provide a detailed list of deficiencies including any devices that are not functioning properly. Submit list to A/E and Owner prior to demolition with estimated probable cost for any required repair. The fire alarm system may not be disabled without approval of the authority having jurisdiction.

l. In all areas where the existing ceiling will be exposed for the demolition and/or new work, provide proper support for existing j-boxes and conduits as required before new ceilings are installed. Provide and install covers and "knock-out" closures for all enclosures, j-boxes that do not have them.

1.9 CONTRACTOR QUALIFICATIONS

a. An acceptable Contractor for the work under this Division shall be a specialist in this field and have the personal experience, training, skill and the organization to provide a practical working system. If required, he shall be able to furnish acceptable evidence of having contracted for and installed not less than three systems of comparable size and type to this one, that have served their owners satisfactorily for not less than three years.

b. The foreman or superintendent for this work shall have had experience in installing not less than three such systems and shall be approved by the Architect/Engineer before the work is begun. Adequate and competent supervision shall be provided to ensure first class workmanship and installation.

c. Work shall be executed and all materials installed to present a neat appearance when completed in accordance with the best practice of the trades in a thorough, substantial, workmanlike manner by competent workmen.

d. The Contractor is responsible for all construction techniques required for all systems specified and shown on the drawings.

1.10 OBSERVATION OF THE WORK

a. Architect/Engineer's and/or Owner's authorized representative shall have the right to observe the work at any time. The Contractor shall have a representative present

when his work is being observed, and he shall give assistance, as may be required, to the Architect/Engineer's representative. Recommendations made by observer shall be promptly carried out, and all unsatisfactory material and/or workmanship shall be replaced to the satisfaction of the Architect/Engineer.

b. Periodic observation of the work by Architect/Engineer is only for the express purpose of verifying compliance with the Contract Documents. Observation by the Architect/Engineer shall not relieve Contractor, any Subcontractor, and/or Material Supplier of responsibility for deviation from requirements of Contract Documents nor for error or omissions in the performance of work.

1.11 SUBMITTALS

a. Submit shop drawings and product data as specified in Division 01 - General Requirements. Submittal data shall indicate the manufacturer's name, published performance, ratings and/or capacity data, detailed equipment drawings for fabricated items, wiring diagrams, installation instructions and other pertinent data. Where literature is submitted covering a group or series of similar items, the applicable items must be clearly indicated. Submittals shall be clearly marked highlighting all proposed equipment and devices to be used in this project. Submittals that do not comply with this requirement will be returned without review. Shop drawings shall note all deviations from contract documents.

b. Review is only for general conformance with design concept of project and general compliance with the Contract Documents. Contractor is responsible for conforming and correlating equipment dimensions at job site; for information which pertains to fabrication processes or construction techniques; and for coordination of work of all trades. Review of submittals shall not relieve Contractor, any Subcontractor and/or Material Supplier of responsibility for deviation from requirements of Contract Documents nor for errors or omissions in submittals.

c. Submittal of shop drawings, product data and samples will be accepted only when they are submitted by the Contractor. Each submittal shall indicate by signed stamp that the submittals have been checked and that they are in accordance with Contract Documents and that dimensions and relationship with work of other trades have been checked. Submittals that have not been checked and signed by the Contractor will be returned for checking before being reviewed.

d. Architect/Engineer review of submittals constitutes an acknowledgment only and in no way relieves the Contractor of full responsibility for providing all materials and systems in accordance with the intent of the Contract Documents. Any material provided by the Contractor without Architect/Engineer's review constitutes the Contractor's agreement to comply with the Architect/Engineer's intent whether specified, shown or implied.

e. **ORGANIZE DATA IN A 3-RING HARDCOVER BINDER WITH DIVIDERS TABBED AND INDEXED BY SPECIFICATION SECTION**. Show any revisions to equipment layouts required by use of selected equipment. Type of submittal data is listed in the individual sections of this Division.

1.12 SUBSTITUTIONS AND PRODUCT OPTIONS

a. Products List. Within 30 days after contract date, submit to Architect/Engineer a complete list of major products proposed to be used, with the name of the manufacturer and the installing subcontractor. Equipment provided under the switchgear sections of Division 26 shall be provided by the same manufacturer unless otherwise indicated.

b. Contractor's Options.

(1) For products specified only by reference standard, select any product meeting that standard.

(2) For products specified by naming several products or manufacturers, select any one of the products or manufacturers named, which complies with the specifications.

(3) For products specified by naming one or more products or manufacturers and "or equivalent," Contractor must submit a request for substitutions for any product or manufacturer not specifically named.

(4) For products specified by naming only one product and manufacturer, there is no option.

c. Substitution Provisions. Manufacturers' names and catalog numbers specified under sections of Division 26 are used to establish standards of design, performance, quality and serviceability and not to limit competition, nor to discriminate against an "approved equivalent" product of another manufacturer. Equipment of equivalent design to that specified, will be acceptable upon approval by the Architect/Engineer. The Architect/Engineer will not consider written requests for substitution of specified products, until the period beginning 30 calendar days and ending 60 calendar days after the date of the Notice to Proceed by the Owner. After that date, request for substitution will be considered only in cases of product unavailability or other conditions beyond control of the Contractor. It is the Contractor's responsibility to:

(1) Personally investigate the proposed substitute product to determine that it has all the same accessories and is equal or superior in all respects to that specified.

(2) Provide the same guarantee for the substitution that he would for that specified.

(3) Coordinate the installation of the equipment which he proposes to substitute with all trades and includes the costs for any changes required for the work to be complete in all respects. The Contractor will prepare shop drawings where required by the Architect/Engineer or where dimensions vary.

(4) Provide itemized cost breakdown including material and labor for the proposed product substitutions.

(5) Submit complete design and performance data.

d. The Architect/Engineer will review Requests for Substitutions with reasonable promptness, and notify the Contractor, in writing, of the decision to accept or reject the requested substitution.

1.13 PROJECT RECORD DOCUMENTS

a. Throughout progress of the work of this Contract, maintain an accurate record of all changes in the Contract Documents. Upon completion of the Work of this Contract, transfer the recorded changes to a set of reproducible Record Documents. Delegate the responsibility for maintenance of Record Documents to one person on the Contractor's staff. Thoroughly coordinate all changes within the Record Documents, making adequate and proper entries on each page of Specifications and each sheet of Drawings and other Documents where such entry is required to properly show the change. Accuracy of records shall be such that future search for items shown in the Contract Documents may reasonably rely on information obtained from the approved Record Documents. Make all entries within 24 hours after receipt of information.

b. The Contractor will mark all deviations on a daily basis. The Architect/Engineer will visit the site periodically and may request to see the "As-Built" documentation. If the Contractor does not keep an accurate set of as-built drawings, the pay request may be altered or delayed at the request of the Architect/Engineer. Mark the drawings with a colored pencil. Record installed feeder conduits, dimensioning the exact location and elevation of the conduit.

c. Record Documents shall consist of the following:

(1) Job Set: Promptly following award of Contract, secure from the Architect/Engineer, one complete set of all documents comprising the Contract.

(2) Submit the completed total set of Record Documents to the Architect/Engineer as described above. Participate in review meeting or meetings as required by the Architect/Engineer, make all required changes in the Record Documents, and promptly deliver the final Record Documents

to the Architect/Engineer. Upon completion of Work, the Contractor shall certify the "Record Drawings" for correctness by signing the following certification:

CERTIFIED CORRECT (3/8" high letters)

(Name of the Contractor)

By

Date

(Name of the Sub-Contractor)

By

Date

d. Deliver record drawings to the Architect/Engineer in the number and manner specified in Division 01 - General Requirements.

1.14 OPERATION AND MAINTENANCE DATA

a. Prepare and submit sets of product data, shop drawings, wiring diagrams, instructions and parts lists for operating and maintaining equipment and systems installed. Include in the instructions a description of normal adjustments and a list of items to be lubricated. Specify the type and frequency of lubrication required. Provide special servicing tools as required for this equipment. Deliver manuals and tools to the Architect/Engineer as a condition of final acceptance. Refer to Division 01 for other requirements. The manual shall include:

(1) Manufacturer's installation instruction brochures.

(2) Manufacturer's local representative and/or distributor's name and address.

(3) Manufacturer's operating and maintenance brochures.

(4) Manufacturer's internal wiring diagram.

(5) Contractor's installation wiring diagram.

(6) Control system installation drawings.

(7) Replacement part number listings and/or descriptions.

(8) Framed operating instructions when required.

(9) Manufacturer's warranties and guarantees.

(10) Training programs for systems provided under Division 26.

b. The manual shall include all of the above listed data bound into a permanent hard-back, three ring binder(s) identified on the cover as "Operating and Maintenance Manual" with additional cover display of the location of Building and the name, address and telephone number of the Owner, the Architect, the Engineer, the General Contractor, and the Subcontractors installing equipment represented in the brochure.

c. Contents of the manual shall be grouped in sections according to the various sections of Division 26, and shall be listed in a Table of Contents. Sections shall be organized as follows:

(1) Each "tab" in the brochure shall identify the grouping of all literature required for a single class of equipment; i.e., "transformers", "lighting fixtures", "switchgear", etc., for all types of equipment on the job.

(2) Contents under each "tab" shall refer to a single class of equipment, and shall be arranged in the following sequence: First, the manufacturer's installation brochure; second, the manufacturer's operating and maintenance brochure; third, the manufacturer's installation wiring diagram; fourth, the Contractor's field wiring diagram; if different, and fifth, the manufacturer's brochure listing replacement part numbers and description.

(3) Provide final tab "Warranties and Guarantees" behind which all such items will be located.

d. Upon completion of the work, instruct the Owner's operating personnel in operation and maintenance of electrical equipment and systems furnished and installed under Division 26. The specified training shall be given at a time and location designated and provided by the Owner for personnel selected by the Owner, in addition to any necessary on-site orientation and training. Provide a minimum of 8 hours of general instruction in addition to any time specified in other sections of Division 26.

2.0 PRODUCTS

2.1 CONSTRUCTION MATERIALS

a. All materials shall be new and shall conform to the requirements of the National Electrical Code and/or the Standards Organizations regulating those products and shall be listed or labeled by Underwriters Laboratories. The listing or labeling by Underwriters

Laboratories will be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of a UL listing, the Contractor may submit a statement from a nationally recognized, adequately equipped independent testing agency, indicating that the items have been tested in accordance with required procedures, and that the materials and equipment comply with all contract requirements.

2.2 STANDARD PRODUCTS

a. All materials and equipment shall be standard catalog products of domestic manufacturers regularly engaged in the manufacture of products conforming to these specifications. Materials and equipment shall have been in satisfactory use at least two years prior to bid opening. Where custom or special items are required, these shall be fully described by drawings and/or material list which detail the item proposed for use on this project.

2.3 MANUFACTURERS INSTRUCTIONS

a. The Contractor is fully responsible for furnishing the proper electrical equipment and/or material and for seeing that it is installed as intended by the manufacturer's written instructions. If needed for proper installation, operation, or start up, the Contractor shall request advice and assistance from a representative of the specific manufacturer. The manufacturer's published instructions shall be followed for preparing, assembling, installing, erecting, and cleaning all materials and equipment. The Contractor shall promptly notify the Architect/Engineer in writing of any conflict between the requirements of the Contract Documents and the manufacturer's directions and shall obtain the Architect/Engineer's instructions before proceeding with the work. Should the Contractor perform any work that does not comply with the manufacturer directions or instructions from the Architect/Engineer, he shall bear all costs arising in connection with correcting the deficiencies.

2.4 RUST PREVENTION

a. All metallic materials shall be protected against corrosion. Exposed metallic parts of outdoor apparatus shall be given a rust-inhibiting treatment and standard finish by the manufacturer. All parts such as boxes, bodies, fittings, guards, and miscellaneous parts shall be protected by galvanizing, except where other equivalent protective treatment is specifically approved in writing.

2.5 DELIVERY AND STORAGE

a. The Contractor shall not deliver any equipment to the job site until the equipment is ready to be installed or until there is suitable space provided to properly protect equipment from weather, humidity, dust, and physical damage.

b. All equipment shall be protected in accordance with the manufacturer's recommendations and the requirements of NFPA 70B, Annex M (2010), titled "Equipment Storage and Maintenance During Construction".

c. All equipment injured or damaged in transit from factory, during delivery to premises, while in storage on premises, while being erected and installed, and while being tested, until time of final acceptance, shall be replaced by the Contractor with new equipment.

2.6 CAPACITIES AND SPACE LIMITATIONS

a. Capacities shall be not less than those indicated but shall be such that no component or system becomes inoperative or is damaged because of start-up or other overload conditions. Where equipment offered as a substitute is accepted and requires electrical power other than that indicated in the contract documents for the specified equipment, the Contractor is responsible for adjusting protective devices, starter sizes, conductors, conduits, etc., to accommodate the approved device electrically at no change in the contract price.

b. The Contractor is responsible to verify that the equipment he proposes to provide will physically fit within the space indicated on the Contract Documents and that the required code clearances and maintenance access are maintained. Any space conflicts shall be noted in the submittals. Provide scale drawings to the Architect/Engineer indicating proposed solutions to any space conflict for the Architect/Engineer's review and approval.

2.7 NAMEPLATES

a. Each piece of equipment shall have a nameplate from the manufacturer with the following information: name, address, catalog number, voltage, phase, full load amperes or horsepower, and/or other pertinent information on a plate securely attached to the equipment. All data on nameplates shall be legible at the time of final inspection.

3.0 EXECUTION

3.1 PROTECTION OF EQUIPMENT

a. Moisture. During construction, protect switchgear, transformers, motors, control equipment, and other items from insulation moisture absorption and metallic component corrosion by appropriate use of strip heaters, lamps or other suitable means. Apply protection immediately on receiving the products and maintain continuously.

b. Clean. Keep products clean by elevating above ground or floor and by using suitable coverings.

c. Damage. Take such precautions as are necessary to protect apparatus and materials from damage. Failure to protect materials is sufficient cause for rejection of the apparatus or material in question.

d. Finish. Protect factory finish from damage during construction operations and until acceptance of the project. Satisfactorily restore any finishes that become marred or damaged.

3.2 INSTALLATION

a. Cooperation with Other Trades. Cooperation with trades of adjacent, related or affected materials or operations, and of trades performing continuations of this work under subsequent contracts, is considered a part of this work. The Contractor is responsible to coordinate with other trades in order to effect timely and accurate placing of work and to bring together, in proper and correct sequence, the work of such trades. Provide coordination drawings showing exact size and location of sleeves, openings or inserts for electrical equipment in slabs, walls, partitions and chases.

b. Concrete Equipment Pads. Install 3-1/2-inch thick concrete housekeeping pads for indoor floor-mounted equipment, except where direct floor mounting is required. Exterior housekeeping pads shall be a minimum of 2-inches above finished grade and shall have 48 inches of pad space in front of the equipment for maintenance access. Pour indoor pads on roughened floor slabs, sized so that outer edges extend a minimum of 3-inches beyond equipment. Trowel pads smooth and chamfer edges to a 1-inch bevel. Secure equipment to pads as recommended by the manufacturer.

c. Setting of Equipment. All equipment shall be installed level and plumb. Sheet metal enclosures shall be separated from walls a minimum 1/4-inch by installing corrosion-resistant spacers. Provide corrosion-resistant bolts, nuts and washers to anchor equipment.

d. Sealing of Equipment. Permanently seal outdoor equipment at the base using concrete grout. Seal or screen openings into equipment to prevent entrance of animals, birds and insects. Use galvanized steel or copper mesh with openings not larger than 1/16-inch for screened openings. Seal small cracks and openings from the inside with a silicone sealing compound.

e. Concealed Work. Conceal electrical work in walls, floors, chases, under floors, underground and above ceilings except:

(1) Where shown or specified to be exposed. Exposed is understood to mean open to view.

(2) Where exposure is necessary to the proper function.

(3) Where size of materials and equipment preclude concealment.

f. Access. All equipment shall be installed in a manner to permit access to parts requiring service. All electrical equipment shall be installed in such a manner as to allow removal for service without disassembly of other equipment.

g. Clearance. Install all electrical equipment so that clearances are adhered to as required by the latest version of the National Electrical Code.

h. Anchoring. Fastening and anchoring shall be to the under side of floor slab above and sides of beams and joists. **Do not** attach to bottom of beams or pan joists.

3.3 HOISTING, SCAFFOLDING, AND TRANSPORTATION

a. The Contractor shall provide his own hoisting, scaffolding and ladders as required to set his materials and equipment in place.

b. The Contractor shall provide all necessary transportation to facilitate the delivery of all materials, equipment, tools, and labor to the job.

3.4 CLEANING

a. The Contractor shall, at all times, keep the premises free from accumulations of waste material or rubbish caused by him, his employees, or his work. Debris shall be removed, not only from the building, but also from the site and from any public area adjacent to the site.

b. At completion of the project, the Contractor shall remove all of his tools, scaffolding, and surplus materials.

3.5 CONDUIT SLEEVES AND PENETRATION SEALS

a. Where conduits pass through concrete/masonry walls or floors not on fill, galvanized sheet metal sleeves shall be used. In walls, they shall be flush with each finished surface. In floor slabs, sleeves shall extend 1-1/2" above floor slab and be cemented in a water tight manner. Size of sleeves shall be at least 1/2" greater than outside diameter of the conduit.

b. For conduits passing through outside walls, furnish and install galvanized steel sleeves having an inside diameter at least 1" greater than the outside diameter of contained conduit. Where sleeves occur in walls having a waterproof coating applied, the sleeves shall have flanges welded onto them to build into the waterproofing. After

conduits are installed, the annular space between the conduit and sleeve shall be effectively sealed with an approved mastic sealer as directed by the Architect/Engineer.

c. Pipe and duct sleeves, pitch pockets, and flashings compatible with the roofing installation shall be provided for roof penetrations. All roof penetrations shall be reviewed and approved by the Architect/Engineer.

d. The Contractor shall plug all conduits and sleeves entering the building or between floors after cabling has been installed with intumescent re-enterable flame retardant sealant.

3.6 FIREPROOFING

a. All conduits, cables, cable tray, etc. passing through fire rated floors and/or walls shall have the void area between the material passing through floor and/or wall sealed with an approved fire-stop material to maintain the fire rating of the floor and/or wall. Provide sealant in accordance with Division 07 requirements.

3.7 ELECTRICAL CONNECTIONS TO MOTORS AND EQUIPMENT

a. Contractor shall coordinate with Division 23 and other Divisions as required to verify all electrical requirements of those Divisions. This is to include but not be limited to verification of power, voltage, phase and other characteristics as being compatible with that called for on the electrical drawings and Division 26 Specifications, as well as that called for in Division 23 Drawings and Specifications or other Divisions requiring electrical connections. This shall be done prior to placing orders for equipment or material, and prior to any rough-in, etc. Making adjustments to field conditions is considered a part of the work required.

b. Motors are specified in other Divisions of the Specifications. Electrical work includes the electrical connection of all motors, except those which are wired as a part of equipment. Connection of motors specified in other Divisions of the Specifications, but not reflected on electrical drawings shall be included in Division 26 scope of work. Generally, motors 1/2-horsepower and smaller will be 115-volt, single phase and motors 3/4-horsepower and larger will be 460-volts, three phase unless otherwise indicated.

c. Terminate at proper points as indicated on detailed equipment shop drawings. Do not use Contract Drawings for rough-in locations, but only for general routing of circuiting.

3.8 CUTTING AND PATCHING

a. When it becomes necessary to cut through any wall, floor, or ceiling to install any work under the Contract, or to repair any defects that may appear up to the expiration of the guarantee period, such cutting shall be done by the Contractor. The Contractor will

not be permitted to cut or modify any structural members without the written permission of the Architect/Engineer. All core drilling shall be done in accordance with Division 03.

b. Patching of all openings cut by the Contractor, or repairing of any damage to the work of other trades caused by cutting or by the failure of any part of the work installed under this Contract, shall be performed by the appropriate trade and shall be paid for by the Contractor.

c. Any openings cut through exterior walls or roofs shall be provided with suitable covers, while they are left open, to protect the property or materials involved. Any openings cut through walls below grade shall be properly protected to prevent entrance of water or other damaging elements. All openings shall be waterproofed upon completion of the work as specified by the Architect/Engineer. Any openings through fire rated walls or floors shall be sealed to maintain the minimum fire rating of wall or floor penetrated.

3.9 EXISTING FACILITIES

a. The Contractor is responsible for loss or damage to the existing facilities used by his workmen, and shall be responsible for repairing or replacing such loss or damage. The Contractor shall send proper notices and receive written permission from the Owner to enter existing areas. Before beginning work in existing areas, make the necessary arrangements and perform other services required for the care, protection, and in service maintenance of all electrical, communication, plumbing, heating, air conditioning, and ventilating services for existing facilities. The Contractor shall erect temporary barricades with necessary safety devices, as required to protect personnel from injury, removing all such temporary protection upon completion of the work.

b. The Contractor shall provide temporary or new services to all existing facilities as required to maintain their proper operation when normal services are disrupted as a result of the work being accomplished under this project.

c. Where existing construction is removed to provide working and extension access to existing utilities, the Contractor shall remove doors, piping, conduit, outlet boxes, wiring, light fixtures, air conditioning ductwork, and equipment, etc., to provide this access and shall reinstall same upon completion of work in the areas affected.

d. Where partitions, walls, floors, or ceilings of existing construction are indicated to be removed and equipment located in these areas is required to remain in operation, the Contractor shall remove and reinstall all equipment required for the operation of the remaining electrical systems.

3.10 OUTAGES

a. Outages of services as required by the project will be permitted but only at time approved by the Owner. The Contractor shall notify the Owner in writing two weeks in advance of the requested outage in order to schedule required outages. No outages shall be taken unless written approval has first been received from the Owner. The time allowed for outages will not be during normal working hours unless otherwise approved by the Owner. All costs of outages, including overtime charges, shall be included in the contract amount. See Section 26 00 20 for additional information.

3.11 VIBRATION ISOLATION

a. The Contractor shall furnish and install vibration isolation means for all equipment and materials furnished under the Contract to prevent the transmission of perceptible vibration, and structure borne or air borne noise to occupied areas. Raceway systems shall be isolated from all rotating or reciprocating machinery. Install 12-inches of liquid-tight flexible metal conduit per 1-inch of conduit diameter. The minimum length of liquid-tight flexible conduit used for isolation shall be 12-inches and the maximum length shall not exceed 36 inches.

3.12 TESTING

a. Tests to be completed by the Contractor shall be of two types. During construction, system testing shall be accomplished to determine whether systems are suitably wired, or if systems operated as prescribed. Later, demonstration testing shall be accomplished for the purpose of showing that the systems operate as designed.

(1) Following each system test, a certified record of each test shall be made and submitted to the Architect/Engineer for review, giving the results of the test, and the persons conducting and/or witnessing the test.

(2) When performing demonstration testing, the Contractor shall make a similar certificate of the test, but this test shall be witnessed by the Architect/Engineer or his representative. These certificates will require being signed by the person conducting and witnessing the test. Demonstration tests will not be considered completed unless such a signed certificate is provided on each item herein after mentioned. Other items may be added by the Architect/Engineer depending on the items being installed.

(3) The Contractor shall furnish all test equipment, instrument, tools, ladders scaffolds, temporary wiring, labor, etc., required to perform testing.

b. System Tests

(1) After conductors and cables are in place, but before being connected to devices and equipment, test the system for shorts, opens, intentional and unintentional grounds by means of a "Megger". Replace or clear all conductors or cables that are shorted or unintentionally grounded.

(2) Test the insulation resistance of all motor windings to ground with a "Megger" before applying line voltage to the motors. If these values are less than 1 megohm, the Contractor furnishing the motor shall be responsible for correcting the deficiency.

(3) With the system energized, make line-to-line voltage and line current measurements at all motors under full load conditions. Should measured values deviate +/- 5% from the nameplate ratings, the condition shall be corrected.

(4) Any wiring device, lighting fixture or electrical apparatus if grounded or shorted in an integral "line" part, shall be removed and the trouble corrected or device replaced.

(5) Systems such as computerized EMC, fire alarm, security and special access systems shall be tested by the system supplier. Following the test, provide an affidavit that the system has been tested by him, and that the system is complete and operating in accordance with the contract documents.

(6) System voltages shall be measured and recorded under maximum load conditions available during construction. Incoming service voltage, as well as transformer secondary voltages shall be checked and adjusted to be equal to the voltage rating, or not exceeding 2-1/2% above the voltage rating. Line-to-line voltages should be adjusted between 460 and 480 volts, or 208 and 213 volts. A record of each final test along with time of day, date, and conditions of loading should be recorded for each test location.

(7) Test for load division between all conductors in parallel feeders. Division of currents shall not exceed 10% of feeder current. Record of test for each parallel feeder shall be made. Records shall be complete with amperage, voltage, and feeder identification. Where corrective measures are taken, before and after test conditions shall be provided. All tests shall be signed by the tester and the witness of the test.

(8) Submit three copies of all tests, certified by the Contractor, for review. Test data shall include the name of the building, driven equipment, and nameplate data of all integral horsepower motors.

(9) Do not subject Ground Fault Interrupter (GFCI) type breakers or receptacles to megger tests.

c. Demonstration Test of Completed Systems. Demonstrate the essential features of the following systems provided as part of the work under Division 26:

(1) Lighting Fixtures and Equipment:

(a) Exit lighting fixtures.

(b) Indoor and outdoor lighting fixtures.

(2) Switchgear:

(a) Branch circuit panelboards.

(b) Distribution panelboards.

(c) Safety switches.

(d) Motor control equipment.

(3) Wiring Devices:

(a) Coverplates.

(b) Outlets.

(c) Switches.

(4) Communications Systems:

(a) Fire alarm system.

(5) Standby Electrical Service Equipment:

(a) Battery packs for egress lighting fixtures.

d. Each system shall be demonstrated only once, after completion of satisfactory testing and acceptance.

e. The demonstration shall be held upon completion and acceptance of all systems at a date to be agreed upon in writing by the Architect/Engineer.

f. The demonstration shall be held by the Contractor or his representative in the presence of the Architect/Engineer or his representative and the manufacturer representative.

g. Demonstrate the functions and location (in the structure) of each system, and indicate its relationship to the riser diagrams and drawings.

h. Demonstrate by "start-stop operation" how to work the controls, how to reset protective devices, how to replace fuses, and what to do in case of emergency.

i. The Contractor shall test all receptacles for power polarity and ground to assure that all receptacles are operating properly, correctly wired and suitably grounded. Furnish a statement to the effect that this work has been accomplished, when and by whom performed.

j. Check rotation of all equipment and correct if necessary.

3.13 CONDITIONS OF EQUIPMENT AT FINAL ACCEPTANCE

a. At time of acceptance, the Contractor shall have inspected all installed systems to assure the following has been completed:

(1) Fixtures are operating, lamps, lenses and reflectors are free of dust, debris, and fingerprints.

(2) Panelboards have all conductors neatly formed, laced and made-up tight. Enclosures shall be vacuum cleaned, surfaces clean of stray paint, dust, grease and fingerprints. All circuit directories to be neatly typed and in place.

(3) Wall plates and exposed switch and receptacle parts to be clean, free of paint, plaster, etc.

(4) Disconnect switches and motor starters shall be vacuum cleaned, surfaces clean of stray paint, dust, grease and fingerprints.

(5) Switchgear, transformers and system devices shall be cleaned internally and externally and have all surfaces restored to initial surface conditions.

(6) Touch-up all scratched surfaces using paint matching the existing equipment paint. Where paint cannot be matched, the entire surface shall be repainted in a color and manner approved by the Architect/Engineer.

(7) All electrical equipment shall be labeled as specified under this section.

3.14 WARRANTIES

a. The Contractor shall guarantee all materials and workmanship for a period of twelve (12) months after the substantial completion of work. The Contractor shall correct any faults or imperfections that arise due to defects or omissions in materials or workmanship during this twelve (12) month period.

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SECTION 26 00 20

ELECTRICAL AND COMMUNICATION SERVICES

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of materials and equipment and making arrangements for the connection of electrical service and telephone service for the project.

1.2 REFERENCE STANDARDS

a. Comply with all service installation standards of the serving utility companies.

1.3 APPLICABLE PROVISIONS

a. Refer to Section 26 00 10 - Electrical General Provisions.

1.4 SUBMITTALS

a. None required.

2.0 ELECTRICAL SERVICE REQUIREMENTS

2.1 SOURCES

a. Electrical service to the addition shall be provided from CPS Energy System. The source characteristics are 240/120 volts, single phase, three wire, sixty hertz. Service to the project will be run via underground conduit.

b. Telephone service will be provided from the existing MDF. Service to the project will be via above ceiling conduit sleeves/plenum cables.

2.2 MATERIALS AND EQUIPMENT

a. Furnish materials and equipment required by the serving utility to connect the project service to the utility system.

b. Materials.

(1) Raceways shall be in accordance with Section 26 05 33.

(2) Boxes shall be in accordance with Section 26 05 33.13.

2.3 OUTAGES

a. Schedule utility outages to avoid interference with the Owner's activities. Obtain approval from Owner at least 14 days prior to the requested outage. If required by the Owner, provide a schedule showing sequence and duration of all activities during the requested outage.

3.0 EXECUTION

3.1 INSTALLATION

a. The location of each service entrance shall be coordinated with the local utility company.

b. Secure approval from the Owner for the final location of all telephone outlets, especially those located in floor slabs.

c. Provide 3/4-inch minimum conduit from each telephone outlet to a termination point above an accessible location in the ceiling plenum, or provide conduit back to terminal board in I/T closet (MDF/IDF). Provide insulated bushings at each end of conduit.

d. If communication cables are not installed under this work, provide pulling line in each raceway.

e. Install each utility service as required by the Contract Documents. Demonstrate that the utility systems are operational.

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SECTION 26 05 19

600 VOLT INSULATED CONDUCTORS

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of 600 volt insulated conductors.

1.2 REFERENCE STANDARDS

a. ANSI/UL 4 - Armored Cable.

b. ANSI/UL 83 - Thermoplastic-Insulated Wires.

c. ICEA S-61-402 (NEMA WC 5) - Thermoplastic-Insulated Wire and Cable for the Transmission and Distribution of Electrical Energy.

d. UL 486A - Standard for Safety Wire Connectors and Soldering Lugs for Use with Copper Conductors.

1.3 APPLICABLE PROVISIONS

a. Refer to Section 26 00 00 - Electrical General Provisions.

1.4 SUBMITTALS

a. Submit manufacturer's technical product data on conductors and connectors. Include data substantiating that materials comply with the requirements of this section.

1.5 DELIVERY, STORAGE AND HANDLING

a. Deliver conductors properly packaged in factory-fabricated containers, or wound on NEMA-standard type wire and cable reels.

b. Store conductors in a clean dry space in original containers. Protect products from weather, damaging fumes, construction debris and traffic.

c. Handle conductors carefully to avoid abrading, puncturing and tearing wire and cable insulation and sheathing. Ensure that dielectric resistance integrity of conductors is maintained.

2.0 PRODUCTS

2.1 600-VOLT INSULATED CONDUCTORS

a. Conductors shall be soft-drawn annealed copper with conductivity of not less than 98% at 20°C (68°F).

b. Minimum wire size shall be No. 12 AWG unless otherwise noted on the drawings.

c. Conductors No. 10 AWG and smaller may be stranded or solid and conductors No. 8 AWG and larger shall be stranded.

d. Conductors shall be permanently marked to indicate voltage, insulation type and temperature rating and size in accordance with NEC Article 310.11.

e. Insulation Identification:

(1) Ungrounded Conductors: Furnish factory colored insulation for conductors No. 10 AWG and smaller. Color code No. 8 AWG and larger insulated conductors with a field applied tape.

(2) Grounded and Grounding Conductors: Furnish factory colored insulation for conductors No. 6 and smaller. Color code No. 4 AWG and larger insulated conductors with field applied tape.

f. Insulation shall be as follows:

(1) Type THW: For dry and wet locations; maximum operating temperature 75°C. Flame-retardant moisture and heat resistant thermoplastic.

(2) Type THHN or THWN: For dry and wet locations; maximum operating temperature 75°C (THWN) or 90°C (THHN). Flame-retardant, heat and/or moisture and/or oil-resistant thermoplastic insulation with nylon outer jacket.

2.2 METAL CLAD (MC) CABLE

a. Conductors shall be soft-drawn annealed copper with conductivity of not less than 98% at 20°C (68°F), including internal ground wire. Armor shall be galvanized steel or aluminum.

b. Minimum wire size shall be No. 12 AWG unless otherwise noted on the drawings.

c. Conductors No. 10 AWG and smaller may be stranded or solid and conductors No. 8 AWG and larger shall be stranded.

d. Conductors shall be permanently marked to indicate voltage, insulation type and temperature rating and size in accordance with NEC Article 310.11.

e. Insulation Identification:

(1) Ungrounded Conductors: Furnish factory colored insulation for conductors No. 10 AWG and smaller. Color code No. 8 AWG and larger insulated conductors with a field applied tape.

(2) Grounded and Grounding Conductors: Furnish factory colored insulation for conductors No. 6 and smaller. Color code No. 4 AWG and larger insulated conductors with field applied tape.

f. Insulation shall be as follows:

(1) Type THHN: For dry locations; maximum operating temperature 90°C. Flame-retardant, heat resistant thermoplastic insulation with nylon outer jacket.

g. Use of these cables must be authorized by the Authority Having Jurisdiction (AHJ). Contractor shall confirm the use of the cables with AHJ.

h. The sheath shall not be used as a current carrying conductor.

3.0 EXECUTION

3.1 INSTALLATION

a. Mechanically protect conductors by installing in raceways. Do not install the conductors until raceway system is complete and properly cleaned. Use an approved wire-pulling compound when pulling large conductors. Wiring pulling compound shall be UL listed and as recommended by the conductor manufacturer. Do not bend any conductor either permanently or temporarily during installation to radii less than four times the outer diameter of the insulated conductors. Do not exceed manufacturer's recommended values for maximum pulling tension.

b. Pull conductors simultaneously where more than one conductor is being installed in the same raceway.

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

d. Tighten electrical connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A.

e. Neatly and securely bundle all conductors in enclosures using nylon straps with a locking hub or head on one end and a taper on the other.

f. Install metal clad cable in accordance with NEC Article 330. Metal clad cable, type MC with copper sheath may only be used for branch circuits installed in walls without thermal insulation. Use fittings specifically designed for metal clad cable.

3.2 SPLICES AND TERMINATIONS

a. Install spices, taps and terminations which have equivalent-or-better mechanical strength and insulation as the conductor. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

b. Use crimp or compression type connectors for splices of all stranded conductors. Mechanical type connectors for conductor splices are not acceptable. Splices shall be kept to a minimum. Splices shall only be made in junction and/or pull boxes. Splices in conduit fittings (i.e., conduit bodies), and in panelboards are not acceptable. Use insulated electrical spring connectors for conductors No. 10 AWG and smaller. Use ring-tongue type terminators on all control wiring. All connectors shall be of material recommended by conductor manufacturer(s) to prevent any corrosion or electrolysis between dissimilar metals. Use hot or cold shrink cable end caps to seal and insulate all conductor splices in underground installations and for terminations when conductors are terminated on mechanical lugs and for motor connections.

3.3 CONDUCTOR SIZING

a. Install conductor size required by the more stringent requirements of the drawings or specifications.

b. Install No. 10 AWG conductors for single-phase, 120-volt, 20-ampere branch circuits for which the distance from panelboard to the first outlet is more than 100 feet. Voltage drop shall not exceed 2.0% at maximum load. The tap conductor from the j-box above the ceiling to the receptacle may be No. 12.

3.4 HOMERUNS

a. Install no more than three phase conductors of different phases, neutrals and a grounding conductor in a single raceway unless specifically noted on the drawings. Comply with NEC Table 310.15(B)(2)(a) for conductor adjustment (derating) factors.

b. Use homerun circuit numbers as indicated for panelboard connections.

c. Comply with ampacity adjustment factors as required by the NEC Article 310.15.

d. Each 120 volt branch circuit phase conductor shall have a neutral conductor of the same size. The neutral shall be considered a current carrying conductor.

e. Metal clad cable may only be used in accordance with NEC Article 330 as appropriate. **Do not** install exposed nor in thermal insulation. Use fittings designed for this cable type.

3.5 SIGNAL, COMMUNICATIONS, AND/OR SIMILAR SYSTEMS

a. Special system(s) conductors (i.e., telephone, communications, fire alarm system, etc.) shall be of the type and size as required by the system manufacturer.

b. Where authorized by the Engineer, plenum rated cables shall be installed parallel and perpendicular to structural members and shall be supported by clevice or bridle rings on 4-foot center unless otherwise indicated. Separate different systems cables a minimum of 6".

3.6 IDENTIFICATION

a. Refer to Section 26 05 53 for the requirements for the color code identification of 600 volt insulated conductors.

3.7 TESTING

a. Refer to Section 26 00 00 for conductor testing requirements.

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SECTION 26 05 26

GROUNDING

1.0 GENERAL

1.1 SCOPE

a. This section specifies the furnishing and installation of grounding and bonding equipment for electrical systems as required by Articles 200 and 250 of the NEC, as specified herein, and as shown on the contract documents.

1.2 REFERENCE STANDARDS

a. ANSI/IEEE Std. 81 - Guide for Measuring Earth Resistivity, Ground Impedance and Earth Surface Potentials of a Ground System.

b. ANSI/IEEE Std. 142 - Recommended Practice for Grounding of Industrial and Commercial Power Systems.

c. ANSI/UL 83 - Standard for Safety Thermoplastic-Insulated Wires and Cables.

d. ANSI/UL 467 - Standard for Safety Grounding and Bonding Equipment.

e. ANSI/UL 486A - Standard for Safety Wire Connectors and Soldering Lugs for Use with Copper Conductors.

1.3 APPLICABLE PROVISIONS

a. Refer to Section 26 00 00 - Electrical General Provisions.

1.4 SUBMITTALS

a. Submit manufacturer's technical product data and installation instructions on grounding materials. Include product data substantiating that materials comply with the requirements of this section.

2.0 PRODUCTS

a. All grounding system equipment and components used on this project shall be manufactured by firms that have been regularly engaged in the manufacturer of grounding equipment and components for at least five years.

2.1 GROUND RODS

a. Provide 3/4-inch by 10-foot long, copper-clad, steel grounding electrodes. Furnish rods to which the copper cladding is permanently and inseparably bonded to a high strength steel core.

2.2 CONNECTIONS

a. For below grade and concrete encased connections provide exothermic welded type, unless otherwise noted. For above grade connections provide bonds and clamps of a non-ferrous material which will not cause electrolytic action between the conductor and the connector.

2.3 BUSHINGS

a. Provide threaded malleable iron or steel insulated bushings with external lug for grounding conductor.

2.4 CONDUCTORS

a. Provide bare conductors for bonding jumpers. Furnish 600-volt insulated conductors having a green-colored insulation for grounding electrode and equipment grounding conductors. Use solid conductors for No. 12 AWG and No. 10 AWG wire; stranded for No. 8 AWG and larger.

2.5 FIELD INSTALLED GROUND BUS

a. Provide round-edge copper bar with 98 percent International Annealed Copper Standard (IACS) conductivity. Size the bus for not less than 25 percent of the cross-sectional area of the related feeder. A minimum size of 1/4-inch by 2-inches is required.

3.0 EXECUTION

3.1 INSTALLATION

a. All metallic conduits shall be electrically continuously.

b. Install bonding jumpers in raceway system around expansion joints.

c. Install grounding conductors in the shortest and straightest paths as possible to minimize transient voltage rises.

d. Apply corrosion-resistant finish to field-connections, buried metallic grounding and bonding products, and places where factory applied protective coatings have been destroyed.

e. Install clamp-on connectors on clean metal contact surfaces, to ensure electrical conductivity and circuit integrity.

f. Tighten grounding and bonding connectors and terminals, including screws and bolts, in accordance with manufacturer's published torque tightening values for connectors and bolts. Where manufacturer's torquing requirements are not indicated, tighten connections to comply with torque tightening values specified in UL 486A to assure permanent and effective grounding.

3.2 GROUNDING ELECTRODE

a. Install a grounding electrode system for the service entrance equipment at the building. Install a bonding conductor between the service equipment ground and neutral bus. The grounding electrode system shall consist of the following:

(1) The grounding service conductor at the service entrance switchgear.

(2) The building structural steel shall be grounded by means of a bonding jumper or conductor connected to the grounding electrode system.

(3) All interior metal water piping systems shall be bonded to the grounding electrode system using clamp type fittings. Install bonding jumpers around insulated pipe joints as required.

(4) A concrete encased electrode shall be installed. The electrode shall be installed per NEC Article 250.52(A)(3).

(5) A made electrode consisting of two ground rods located at least 10' apart and connected with #3/0 copper conductor shall be provided.

(6) Other electrodes shall be connected to the system as indicated on the drawings.

3.3 SYSTEM GROUND

a. System Neutral. Where a system neutral is used, ground the system neutral conductor as required by NEC Article 250. Ground the system neutral only at the point of service and isolate it from ground at all other points in the system.

b. Size. Size the system grounding conductors to comply with NEC Table 250.66, unless shown larger.

3.4 EQUIPMENT GROUND

a. Raceway Systems, Equipment Enclosures, and Equipment.

(1) Install bonding jumper and grounding-type bushing on each metallic raceway entering or leaving the enclosure of the service equipment.

(2) Install insulated grounding-type bushings for metal raceways 1-1/2-inch and larger terminating in equipment enclosures containing a ground bus and connect the bushing to the ground bus.

(3) Install a green insulated equipment grounding conductor for each feeder and branch circuit. Green tape may be used for conductors larger than #6 when conductor is accessible.

(4) Install bonding jumpers and ground wire throughout to ensure electrical continuity of the grounding system.

(5) Ground cabinets, boxes, motors, controllers, raceways, switchgear, transformer enclosures, other equipment and metallic enclosures. Ground equipment and enclosures to the continuous-grounded metallic raceway system in addition to any other specific grounding shown.

(6) Install a separate grounding conductor within all flexible raceways and securely bond to the conduit and device, etc., on both sides of the flexible raceway.

(7) Install a separate grounding conductor in the raceways for connection to the frame of each motor.

(8) Receptacles.

(a) All receptacles shall be bonded to its respective device box. The connection shall be made by means of a bonding jumper between the device and the box. Where the receptacle mounting yoke is designed and listed for the purpose of grounding; the bonding jumper may be omitted.

(b) All isolated ground receptacles shall have an isolated ground conductor installed complete from receptacle to the isolated ground bus in the panelboard. No other grounding connections shall be

made from these receptacles, specifically connections to the device box or raceway system.

(9) Communication equipment shall be grounded in accordance with Article 800 of the NEC, Radio and Television antennas shall be grounded per Article 810 of the NEC, and cable television systems shall be grounded per Article 820 of the NEC.

b. Size. When grounding and bonding conductors are not sized on drawings, size the grounding conductors in accordance with NEC Table 250.122. Size bonding jumper so that minimum cross-sectional area is equal to or greater than that of the equivalent grounding conductor as determined from NEC Table 250.66.

3.5 TESTING

a. Test the completed grounding system using the fall-of-potential method described in IEEE Standard 81. If the resistance of the grounding system is greater than 5 ohms, add one additional ground rod. Ensure ground rods are spaced not less than 6 feet apart.

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SECTION 26 05 29

METAL FRAMING

1.0 GENERAL

1.1 SCOPE

a. This section specifies the furnishing and installation of metal framing, including channels, hangers, brackets, fittings, clamps, hardware, anchor bolts, rods, and electrical accessories for installing electrical equipment and materials.

1.2 REFERENCE STANDARDS

a. AISI SG 673 Part I - Specification for Design of Cold-Formed Steel Structural Members.

b. ASTM A36 - Standard Specification for Structural Steel.

c. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

d. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

e. ASTM A446 - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) by the Hot-Dip Process, Structural (Physical) Quality.

f. ASTM A570 - Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled Structural Quality.

g. ASTM A575 - Standard Specification for Steel Bars, Carbon, Merchant Quality, M-Grades.

h. ASTM A576 - Standard Specification for Steel Bars, Hot-Wrought, Special Quality.

i. ASTM A635 - Standard Specification for Steel, Sheet and Strip, Heavy-Thickness Coils, Carbon, Hot-Rolled.

j. ASTM A525 - Standard Specification for General Requirements for Steel Sheet, Zinc Coated (Galvanized) by the Hot-Dip Process.

k. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel.

1.3 SUBMITTALS

a. Submit manufacturer's technical product data for all framing materials and accessories. Include data substantiating that materials comply with the requirements of this section.

1.4 DELIVERY, STORAGE AND HANDLING

a. Store metal framing fittings and accessories in suitable areas to prevent corrosion.

b. Handling shall be done to assure that channels are not crushed or damaged.

2.0 PRODUCTS

2.1 MATERIALS

a. Furnish channels, fittings, clamps, electrical accessories and brackets fabricated from sheet steel or from malleable cast iron. Furnish threaded fasteners fabricated from carbon steel.

2.2 COATINGS

a. Hot-dip galvanized all steel components.

2.3 SIZES

a. Furnish channels fabricated from not less than 12-gauge sheet steel, 1-5/8 inches wide and not less than 1-5/8 inches deep.

3.0 EXECUTION

3.1 INSTALLATION

a. Install metal framing to support wall mounted equipment and wall or ceiling mounted raceways.

3.2 ANCHOR BOLTS

a. Install 1/2-inch diameter by 3-inch long expansion bolts to attach framing to concrete. Space bolts a maximum of 24-inches on center, with not less than two bolts per piece of framing.

3.3 TOUCH-UP

a. Touch up all scratches or cuts on steel components with an approved zinc chromate or a 90 percent zinc paint.

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SECTION 26 05 33

RACEWAYS

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of raceway systems.

1.2 REFERENCE STANDARDS

a. ANSI/ANSI C80.1 - Rigid Steel Conduit - Zinc-Coated.

b. ANSI/ANSI C80.3 - Electrical Metallic Tubing - Zinc-Coated.

c. ANSI/ANSI C80.6 - Intermediate Metal Conduit (IMC) - Zinc-Coated.

d. ANSI/UL 1 - Standard for Safety Flexible Metal Conduit.

e. ANSI/UL 5 - Standard for Safety Surface Metal Raceways and Fittings.

f. ANSI/UL 6 - Standard for Safety Rigid Metal Electrical Conduit.

g. ANSI/UL 360 - Standard for Safety Liquid-Tight Flexible Steel Conduit.

h. ANSI/UL 467 - Standard for Safety Electrical Grounding and Bonding Equipment.

i. ANSI/UL 651 - Standard for Safety Schedule 40 and 80 Rigid PVC Conduit.

j. ANSI/UL 797 - Standard for Safety Electrical Metallic Tubing.

k. ANSI/UL 870 - Standard for Safety Wireways, Auxiliary Gutters and Associated Fittings.

l. ANSI/UL 1242 - Standard for Safety Intermediate Metal Conduit.

m. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.3 APPLICABLE PROVISIONS

a. Refer to Section 26 00 00 - Electrical General Provisions.

1.4 SUBMITTALS

a. Submit manufacturer's technical product data for each type of raceway system required. Include data substantiating that materials comply with the requirements of this section.

1.5 DELIVERY, STORAGE AND HANDLING

a. Deliver and store fittings in suitable containers.

b. Store raceways and fittings in suitable areas to prevent corrosion.

c. Handling shall be done to assure that raceways are not crushed or damaged in any way which would restrict cross sectional area or cause oxidation.

2.0 PRODUCTS

2.1 CONDUIT AND FITTINGS

a. Rigid Metal Conduit.

(1) Hot-dip galvanized rigid steel conduit, galvanized after fabrication. All threads shall be galvanized after cutting. A uniform zinc coating shall be applied to the inner and outer walls.

(2) Fittings shall be threaded, malleable iron, either cadmium plated or hot-dip galvanized.

b. Intermediate Metal Conduit.

(1) Conduit shall be similar to rigid steel conduit except thinner wall.

(2) Fittings shall be threaded, malleable iron, either cadmium plated or hot-dip galvanized.

c. Electrical Metallic Tubing (EMT).

(1) EMT shall be made of hot-dip galvanized strip steel. The interior shall be coated with a corrosion-resistant lubricant for ease of wiring pulling.

(2) Fittings shall be steel compression type. Die cast fittings are not acceptable.

d. Rigid Nonmetallic Conduit.

(1) Conduit shall be schedule 40 polyvinyl chloride (PVC) or fiberglass, UV stabilized, rated for 90□C conductors.

(2) Fittings shall be solvent weld socket type.

e. Flexible Metal Conduit

(1) Spirally wound continuously interlocked zinc coated strip steel.

(2) Fittings shall be one screw for smaller than 1-1/2-inch, two screw for 1-1/2-inch and larger, double clamp steel or malleable iron, either cadmium plated or hot-dip galvanized.

f. Liquid-Tight Flexible Steel Conduit.

(1) Spirally wound continuously interlocked zinc coated strip steel with a UV stabilized polyvinyl chloride (PVC) outer jacket bonded to the conduit.

(2) Fittings shall be compression type, malleable iron, with insulated throat, either cadmium plated or hot-dip galvanized.

2.2 WIREWAYS

a. Furnish lay-in wireways with hinged cover, knockouts, connectors and fittings. All screws installed towards the inside shall be protected to prevent possible wire insulation damage. Wireways shall be NEMA 1 when located in dry areas and NEMA 3R when located in damp or wet areas. Wireways shall be constructed from minimum 16 gauge sheet metal for sizes 4" x 4" and smaller and 14-gauge sheet metal for sizes larger than 4" x 4". NEMA 3R wireway shall have knockouts in the bottom only. Furnish with wire retainers on not less than 12-inch centers.

b. The finish shall be the manufacturers' standard color and shall consist of not less than two coats of enamel over a rust-inhibiting prime coat.

2.3 SURFACE RACEWAYS AND FITTINGS

a. Shall be made of not less than 20 gauge sheet steel or rigid PVC and shall be of two piece construction.

b. The cross sectional area shall be not less than 2.5 square inches.

c. The finish shall be the standard color of the manufacturer and shall consist of not less than one coat of enamel over a rust-inhibiting prime coat.

d. Couplings, elbows, outlet and devices boxes and connectors shall be designed for use with the multi-outlet system.

3.0 EXECUTION

3.1 CONDUIT AND FITTINGS

a. The minimum conduit size shall be 1/2-inch except for final connections to individual light fixtures which may be 3/8-inch flexible metal conduit in lengths up to six feet.

b. Types According to Use. Use rigid metal conduit throughout the project except as specified below. Encase rigid metal conduit in a minimum 3-inch thick concrete envelope where installed below grade outside of the building line. Concrete encasement may be omitted when conduit is installed below slabs on grade.

(1) Intermediate metal conduit may be used in lieu of rigid metal conduit.

(2) Electrical metallic tubing (EMT) may be used in interior walls or ceiling spaces and where exposed when installed more than 96-inches above finished floor in open work areas, mechanical rooms, or electrical rooms. Conduit which enters or leaves the top of panelboards or enclosures may be EMT, provided the top of the panelboard or enclosure is a minimum of 60-inches above finished floor. Electrical metallic tubing shall not be installed in concrete slabs, in crawl spaces, in contact with earth or in areas that are subject to permanent moisture. EMT shall **not** be used for circuits with voltage greater than 480-volts. ENT may be used in lieu of EMT where allowed by the NEC and the City of San Antonio.

(3) Rigid nonmetallic conduit may be installed in concrete slab on grade construction where the nominal trade size diameter is equal to or less than 20 percent of the minimum slab thickness and that all stub-ups transition to rigid steel at the elbow. Conduits in slabs shall be run under the top layer of slab reinforcing. Provide a minimum of 1-1/2-inch clear between conduits and between conduit and parallel reinforcing. Do **not** bundle conduits. Rigid nonmetallic conduit shall **not** be installed in elevated floor slabs or within the building envelope unless authorized by the Structural Engineer. Rigid nonmetallic conduit may also be used for underground branch circuits and feeders outside of the building line as permitted by the NEC and local codes. When rigid nonmetallic conduit is used for underground feeders, it

shall be encased in a minimum 3-inch thick concrete envelope. All vertical transitions in rigid nonmetallic conduit shall be made using galvanized rigid steel or fiberglass elbows.

(4) Flexible and liquid-tight flexible steel conduit shall be used for final connections to utilization equipment. Liquid-tight flexible steel conduit shall be used for all exterior locations and all interior locations subject to moisture, vibrations, rotating equipment and dry-type transformers. Refer to Section 26 00 00 for additional information concerning flexible steel conduit.

c. Transitions.

(1) Continue the heavier, more protective type conduit application not less than 4 inches into the area where lighter, less protective type conduit is permitted.

(2) For below-grade to above-grade outdoor locations, extend concrete encasement around conduit 4-inches above finished grade and slope top away from conduit with a 6-inch-per-foot slope. After concrete has set, caulk the concrete-to-conduit joint with a silicone rubber compound.

d. Install sleeves in the forms of concrete/masonry walls and floor slabs for the installation of raceways. Set sleeves in place a sufficient time ahead of concrete placement so as not to delay the work. Seal all openings and voids around sleeves through floors and walls. Refer to Section 26 00 00 for additional information concerning sleeves.

e. Installation Requirements.

(1) Raceways shall be installed perpendicular and parallel to the building lines in a neat and orderly manner.

(2) Raceways are to be concealed in all finished areas unless otherwise specifically indicated on the Drawings. When exposed in finished areas, the exact routing shall be confirmed in the field with the Architect/Engineer prior to rough-in. Install chrome-plated floor and ceiling plates around conduits exposed to view and passing through walls, floors, partitions, or ceilings in finished areas. Select plates to properly fit the conduit and securely lock in place.

(3) Install raceway systems where indicated on the Drawings, complete with all junction and pull boxes as necessary and as noted on plans.

(4) Metallic conduits shall be continuous between enclosures and boxes. The conduit shall be secured to enclosures and boxes so that the raceway system is electrically continuous throughout. Where threaded conduits enter enclosures or boxes without threaded hubs, install locknuts on the inside and outside of the enclosure or box.

(5) Where threaded conduits are terminated in enclosures without threaded hubs, install insulated bushings for conductor protection. Provide insulated throats or bushings for all fittings and terminations, including flexible, EMT and rigid conduits.

(6) Rigid nonmetallic conduit shall be solvent welded at the joints to form a tight, waterproof connection.

(7) Provide 200 pound nylon cord in all empty raceways.

f. Installation Methods.

(1) Raceway systems shall be complete before installing conductors.

(2) Raceways shall have openings temporarily plugged to exclude foreign objects. The interior of all raceways shall be cleaned before installing conductors.

(3) Joints shall be cut square and be reamed smooth. Field threaded conduits shall be coated with an approved zinc chromate or with a 90 percent zinc paint.

(4) Bends shall be made with standard ells or conduit field bent to radii in accordance with NEC Article 344. Conduit bodies may be used in lieu of conduit ells where ease of installation and appearance warrants their use. Conduit bodies larger than 1-inch may be used only where specifically approved by the Architect/Engineer. Field bends shall be made using equipment designed for the particular conduit material and size. Bends shall be free from dents or flattening. There shall be no more than the equivalent of three ninety degree bends in any raceway between enclosures and boxes.

(5) Securely fasten and support conduit to structure or metal framing using hot-dip galvanized, malleable iron pipe straps or other approved means. Branch circuit conduits 1 inch and smaller may be attached to wall studs by

use of manufactured clips. Wires of any type for securing conduits, is not acceptable. Conduit shall not be supported from suspended ceiling suspension system. Comply with NEC Article 300 and 352 for support requirements of non metallic raceway systems.

(6) Install expansion-deflection fittings where conduit crosses structural expansion joints or where required to compensate for thermal expansion and contraction. Install bonding jumpers across fittings in metal raceway systems.

(7) Terminate concealed conduit for future use with a coupling set flush with the structural surface. Install an approved conduit plug flush with the surface.

(8) All openings around electrical penetrations at fire rated walls, partitions, floors or ceilings shall be sealed to maintain the fire resistance rating of the penetration.

(9) Plug all raceways that enter the building or pass between floors after cables have been installed. The sealant shall be an intumescent, re-enterable, flame retardant type.

3.2 WIREWAYS

a. Install wireways, where shown, according to NEC Article 376, 378. Field apply a 90 percent zinc paint coating over cuts or scratches before any other finish is applied.

3.3 SURFACE RACEWAYS

a. Install surface raceways, where shown, according to NEC Article 386, 388. Field apply a 90 percent zinc paint coating to cuts or scratches before any other finish is applied. Securely ground raceway and fittings. Install bushings at raceway entrances.

3.4 INSTALLATION OF UNDERGROUND RACEWAYS

a. Minimum raceway burial depth shall be 24-inches below finished grade to top of the raceway. Multiple raceways shall be installed on nonmetallic spacers with a minimum of 2-inches from adjacent raceways. Spacers shall be on not greater than five foot spacing. Stagger joints in adjacent raceways a minimum of 6-inches. Use long sweep bends for horizontal changes in direction. Use minimum 36 radius for vertical changes of direction.

b. Excavate trenches to the proper width and depth for the installation of the underground raceways. All trenching shall be done in accordance with OSHA requirements and any state or local safety code pertaining to trench safety. Before

beginning trenching operations, stake out the proposed routing to avoid conflicts with field conditions and obtain approval of the Owner and/or Architect/Engineer for the routing.

c. Where the bottom of the trench is excavated below the necessary elevation, it shall be brought to proper grade by the use of sand or pea gravel.

d. Where unstable ground is encountered in the bottom of the trench, it shall be excavated to a depth of at least 12-inches below the burial depth of the raceways, and replaced with coarse gravel to the proper height.

e. Where the excavation for its entire depth is in water or wet sand, slope or pump trench so as to drain it effectively prior to placement of raceways.

f. Backfill trenches with the excavated material unless otherwise specified. Backfill shall be thoroughly compacted to 95 percent density of surrounding undisturbed soil. Sodded areas shall be compacted to 95 percent density up to topsoil layer. Topsoil layer shall be lightly compacted then soil mounded to allow for settling.

g. Where raceways are to be installed under existing sidewalks, roads or curbs, saw cut and remove same in order to install the raceways. All sidewalks, roads or curbs shall be replaced with material equal to or better than those now in place.

h. Conduit required to be concrete encased shall be installed on nonmetallic spacers to allow a minimum of 3-inches encasement on all sides a minimum of 2-inches between parallel runs of conduit. Care shall be taken to prevent movement of conduit during pouring. Concrete shall be 2500 PSI, 28 day compressive strength.

i. Thoroughly clean all raceways before installing conductors.

3.5 IDENTIFICATION

a. Refer to Section 26 05 53 for the requirements for identification of raceways.

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SECTION 26 05 34

ELECTRICAL BOXES

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of all outlet boxes, junction boxes and pull boxes.

1.2 REFERENCE STANDARDS

a. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers and Box Supports.

b. UL 50 - Standard for Safety Enclosures for Electrical Equipment.

c. UL 514A - Standard for Safety Metallic Outlet Boxes.

d. UL 514B - Standard for Safety Fittings for Conduit and Outlet Boxes.

1.3 APPLICABLE PROVISIONS

a. Refer to Section 26 00 00 - Electrical General Provisions.

b. Refer to Section 25 05 43.62 – Manholes/Handholes – Precast Concrete.

1.4 SUBMITTALS

a. Submit manufacturer's technical product data on electrical boxes. Include data substantiating that materials comply with the requirements of this section.

1.5 DELIVERY, STORAGE AND HANDLING

a. Deliver and store boxes in suitable containers.

2.0 PRODUCTS

2.1 OUTLET BOXES

a. Flush Device Boxes. Furnish square or rectangular galvanized steel boxes, minimum 1-1/2 inch deep by 4-inch high with raised cover for the device(s) to be installed.

b. Exposed Device Boxes. Furnish FS or FD cast boxes for rigid metal conduit systems and galvanized steel boxes for EMT conduit systems.

c. Boxes for Lighting Fixtures. Furnish octagonal galvanized steel boxes, minimum 1-1/2 inch deep by 4-inch with accessories to properly support fixtures.

d. Masonry Boxes. Furnish rectangular galvanized steel boxes, minimum 3-1/2-inch deep by 3-3/4-inch high.

2.3 JUNCTION AND PULL BOXES

a. Junction and Pull Boxes: Furnish galvanized code-gauge sheet steel junction and pull boxes where shown on the drawings or where installation conditions warrants their use. Boxes shall be furnished with screw-on covers or hinged covers. Size of cover shall be such that it can easily be handled by one person. All hardware and fasteners shall be stainless steel.

b. Furnish NEMA 1 boxes in interior dry locations.

c. Furnish NEMA 3R boxes in all exterior locations and interior locations subject to moisture.

d. Furnish NEMA 4 cast iron boxes with external flush flanged cover when cast in concrete.

3.0 EXECUTION

3.1 COORDINATION

a. In order that all outlets may come in proper relation to paneling, decorated areas, etc., the Contractor shall familiarize himself with the details of these spaces and shall carefully lay out all outlets so that the equipment or piping of other trades passing under, over, across or in close proximity to same, will not cause the device or fixtures at or in these outlets to be inaccessible for use or maintenance. The Division 26 system installer must consult with the other system installers on the project and procure all details of the various locations so as to make the outlet boxes come in proper relation to the work of all other trades. The Architect/Engineer reserves the right to relocate any outlet within reason from its original location shown on the plans prior to the application of the walls at no cost.

3.2 OUTLET BOXES

a. Flush Boxes. Unless otherwise indicated, install all outlet boxes flush within 1/4-inch of the finished wall or ceiling line. Install galvanized steel extension rings where

required to extend the box forward in conformance to NEC requirements. Attach ring with at least two machine screws. Securely fasten outlet boxes to framing.

b. Fixture Boxes. Boxes for suspended lighting fixtures shall not be attached to or supported from suspended ceilings, unless specifically approved by ceiling installer/manufacturer. Do not support boxes from ceiling suspension grid.

c. Back-to-Back Boxes. Do not install outlet boxes back to back unless specific approval is obtained from the Architect/Engineer. Where such an installation is necessary to complete a particular installation, fill the voids around and between the boxes with sound insulating material.

d. Box Openings. Install only the conduit openings necessary to accommodate the conduits at the individual location. Install knockout closures to cap all unused openings.

e. Gasketing. Install weatherproof outlets and outlets in areas subject to moisture with gaskets between the box and the coverplate.

f. Coverplates. All boxes shall be installed with coverplates.

g. Mounting Height. Mounting height of a wall-mounted outlet box means the height from finished floor to horizontal center line of the cover plate. Where outlets are indicated adjacent to each other, mount these outlets in a symmetrical pattern with all tops at the same elevation. Where outlets are indicated adjacent, but with different mounting heights, line up outlets to form a symmetrical vertical pattern on the wall. Coordinate outlet height with Architectural drawings, mill work details, casework details and equipment installation. See Section 26 27 26 for wiring device mounting heights.

3.4 JUNCTION AND PULL BOXES

a. Installation. Install boxes as required to facilitate conductor installation in raceway systems. Junction and pull boxes shall be sized to accommodate conductor system splices and associated insulation. Generally install boxes in conduit runs of more than 100 feet or as required in Section 26 05 33. Locate boxes strategically for access and make them of such shape to permit easy pulling of conductors. The use of extension rings to increase the junction boxes interior space capacity is not acceptable. Support junction and pull boxes independent of raceway system.

b. Covers. Install boxes so that covers are readily accessible and easily removable after completion of the installation. Include suitable access doors for boxes above in accessible ceilings. Select a practical size for each box and cover. All boxes shall have covers.

c. Record Drawings. All pullboxes shall be shown on the project record drawings.

3.6 SPECIAL SYSTEM BOXES

a. All junction boxes associated with special systems, i.e. fire alarm, security, etc. shall be installed as required by the special system supplier.

b. Telecommunication/data outlet boxes shall have a 3/4-inch conduit from the outlet box to an accessible location above the ceiling unless otherwise indicated. Provide a pulling line in each conduit.

3.7 IDENTIFICATION

a. Refer to Section 26 05 53 for the requirements for the identification of electrical boxes.

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SECTION 26 05 53

ELECTRICAL IDENTIFICATION

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of products for the identification of electrical materials and equipment.

1.2 REFERENCE STANDARDS

a. ANSI/NFPA 70 - National Electrical Code.

b. OSHA - Occupational Safety and Health Act.

1.3 APPLICABLE PROVISIONS

a. Refer to Section 26 00 00 - Electrical General Provisions.

b. Refer to Section 26 27 26 – Wiring.

1.4 SUBMITTALS

a. Submit manufacturer's technical product data for each type of product furnished. Include data substantiating that materials comply with the requirements of this section. Refer to paragraph 3.7(b).

2.0 PRODUCTS

2.1 UNDERGROUND INSTALLATION MARKING TAPE

a. Furnish Seton style 37236 and 45384 or approved equivalent 4-mil thick by 6" wide polyethylene non-adhesive tape for marking the installation of underground raceways.

2.2 MARKERS

a. Furnish Seton style M3846 or approved equivalent vinyl cloth self-adhesive markers with 1" high characters for identifying exposed raceways and boxes.

2.3 COLORED TAPE

a. Furnish Scotch No. 35 or approved equivalent 7-mil thick by 3/4" wide vinyl adhesive tape for color coding of No. 8 AWG and larger 600 volt insulated conductors.

2.4 WARNING SIGNS

a. Flash Protection: Panelboards and motor control equipment that are in other than dwelling occupancies and are likely to require examination, adjustment, servicing, or maintenance while energized shall be field marked to warn qualified persons of potential electric arc flash hazards. The marking shall be located so as to be clearly visible to qualified persons before examination, adjustment, servicing, or maintenance of the equipment.

2.5 PLASTIC NAMEPLATES

a. Furnish engraved black-white-black plastic laminate nameplates for identification of normal service equipment and red-white-red plastic laminate for identification of emergency service equipment. Edges of nameplates shall be chamfered.

3.0 EXECUTION

3.1 INSTALLATION

a. Install identification products as required by the NEC and OSHA and elsewhere where required by this section.

b. Install identification products in accordance with manufacturer's written instructions.

c. Where identification is to be applied to surfaces that require a field finish, install identification after completion of the finish work.

3.2 UNDERGROUND RACEWAYS

a. Install underground installation marking tape 6 to 12-inches below grade directly over all underground raceways that are exterior to the building.

(1) Warning tape over electrical installation under 600 volts shall be red with black lettering stating "BURIED ELECTRICAL LINE".

(2) Warning tape over communications installations shall be orange with black lettering stating "BURIED TELEPHONE LINE".

3.3 OUTLET, JUNCTION AND PULLBOXES

a. Label outlet box covers using a black marking pen with the identity of the circuits contained within the box.

b. Label wiring devices with pressure tape labels, or engrave where indicated. Identify with panel and circuit using black letters on clear tape.

c. Install self-adhesive markers on the outside of the covers of all junction and pullboxes. Mark the cover to identify the circuits contained within the box.

d. Paint all boxes used in the fire alarm system red.

3.4 INSULATED CONDUCTORS

a. Color code all 600 volt ungrounded, insulated conductors by installing conductors with factory colored insulation for conductors No. 10 AWG and smaller in accordance with the table in paragraph c. below. Factory colored insulation for 600 volt grounded and grounding conductors shall be provided for No. 6 and smaller.

b. Install colored tape on all 600 volt ungrounded, insulated conductors No. 8 AWG and larger in accordance with the table in paragraph c. below. Install colored tape on all 600 volt grounded and grounding conductors No. 4 and larger. Apply tape in half-lapped turns for a distance of 6 inches from terminal points and in boxes where splices or taps are made. Apply the last two laps of tape with no tension to prevent possible unwinding. Do not cover factory applied cable identification markings with taping; tape locations may be adjusted slightly to prevent the covering of factory markings.

c. Color code conductors with the table below or as required by local codes if different from the color scheme indicated.

Phase	120/240
A or L1	Black
B or L2	Red
C or L3	---
Neutral	White
Ground	Green
Isolated Ground	Green with yellow stripe

*****The stripe is only required for electronic grade branch circuits.

d. Install metal tags to identify medium voltage conductors. Engrave each tag with the following information: voltage, circuit number, phase, and installation date. Attach the tag over conductor fireproofing using nylon cable ties. Install tags at connections to equipment and in each manhole.

3.5 WARNING SIGNS

a. Install flash protection warning signs per NEC Article 110.16.

3.6 EQUIPMENT

a. Install engraved plastic laminate nameplates as listed below. The intent of the equipment nameplate is to provide 3 or 4 lines of information for future maintenance action as follows:

(1) Line 1 - Equipment name.

(2) Line 2 - Description (what it is, i.e. panelboard, disconnecting means).

(3) Line 3 - Service (what it serves).

(4) Line 4 - Additional data as appropriate.

b. Contractor shall submit a nameplate schedule for approval by the A/E prior to installation.

EQUIPMENT	SIZE LETTERING	INFORMATION
PANELBOARDS		
Name/Ratings	1/4" /1/8"	Panelboard designation/ampere rating And voltage characteristics EX: 1LB3 225A 208Y/120V
SAFETY SWITCHES	1/8"	Load served, HP and circuit number EX: ELEVATOR NO. 1, 30HP CKT 1LB3 -37,39,41
MOTOR STARTERS	1/8"	Load HP, and area served and circuit number EX: AHU-1, Library, 10 HP CKT 1LB3-38, 40, 42

TIME SWITCHES	1/8"	Load served EX: Exterior Lights

c. Install nameplates labels in locations on the equipment for best convenience of viewing without interfering with the operation and maintenance of equipment. Secure nameplate to equipment by means of stainless steel self-tapping machine screws.

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SECTION 26 09 23

TIME SWITCHES

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of enclosed time switches.

1.2 REFERENCE STANDARDS

a. ANSI/UL 917 - Standard for Safety Clock-Operated Switches.

1.3 APPLICABLE PROVISIONS

a. Refer to Section 26 00 00 - Electrical General Provisions.

1.4 SUBMITTALS

a. Submit manufacturer's technical product data on time switches. Include data substantiating that materials comply with the requirements of this section.

1.5 DELIVERY STORAGE AND HANDLING

a. Deliver and store time switches in suitable containers.

1.6 OPERATION AND MAINTENANCE DATA

a. Submit manufacturer's standard operation and maintenance data/manuals.

2.0 PRODUCTS

2.1 TIME SWITCHES

a. Furnish 365 day electronic, programmable 1, 2 or 4 channel/circuit time switch as noted on the drawings. Up to 20 set points or events can be preset to automatically repeat on a weekly or daily basis. Provide with manual override switch. Enclosure shall be steel/noryl plastic with gray/ivory finish and hinged door. Provide NEMA 3R enclosure where installed outdoors.

2.2 CONTACTS

a. Furnish each switch with 20 ampere per pole inductive 120-volt SPST, DPST, or 3PST contacts as required to perform the switching functions indicated on the drawings.

2.3 ENCLOSURE

a. Furnish each switch in a NEMA 1 enclosure for surface mounting.

2.4 HOA SWITCH

a. Furnish each switch with a Hand-Off-Automatic (H-O-A) selector switch flush mounted in the cover. The H-O-A switch shall control the mode of operation of the controlled equipment without changing the programmed operation of the time switch.

2.5 RESERVE POWER

a. Provide each time switch with a field replaceable battery system using AAA alkaline batteries that will operate for a minimum of 3 years from the date of substantial completion.

2.6 IN WALL MANUAL TIMERS

a. Provide automatic shut-off timers with minimum 30 minute timer and "Hold" feature Unit shall fit in the standard light switch enclosure. Provide this device in electrical rooms, in mechanical rooms, in janitor rooms, and additionally in other rooms as indicated.

2.7 ACCEPTABLE MANUFACTURERS

a. Intermatic Inc., Paragon Electric Co. Inc., Precision Multiple Controls, Inc. Tork.

3.0 EXECUTION

3.1 INSTALLATION

a. Install time switches in locations as shown and as recommended by the manufacturer. Synchronize all time switches and set on and off trippers as directed by Owner.

3.2 IDENTIFICATION

a. Refer to Section 26 05 53 for the requirements for the identification of time switches.

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SECTION 26 24 16

PANELBOARDS

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of distribution and branch circuit panelboards.

1.2 REFERENCE STANDARDS

a. ANSI/NEMA PB 1 - Panelboards.

b. ANSI/UL 67 - Standard for Safety Panelboards.

c. ANSI/UL 489 - Standard for Safety Molded-Case Circuit Breakers and Circuit-Breaker Enclosures.

d. NEMA AB 1 - Molded Case Circuit Breakers and Molded Case Switches.

e. NEMA AB 3 - Molded Case Circuit Breakers and Then Application.

f. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.

g. UL 50 - Standard for Safety Enclosures for Electrical Equipment.

h. UL 508 - Standard for Safety Industrial Control Equipment.

1.3 APPLICABLE PROVISIONS

a. Refer to Section 26 00 00 - Electrical General Provisions.

b. Refer to Section 26 28 00 – Overcurrent Protective Devices.

1.4 SUBMITTALS

a. Submit manufacturer's technical product data on circuit breakers and accessories.

b. Submit shop drawings for each panelboard which include outline and support points, dimensions, voltage, main bus ampacity, short circuit ampere interrupting rating,

circuit breaker arrangement, sizes and number of poles. Shop drawing shall list all circuit breakers to be installed in panelboard.

c. Circuit breaker arrangement must be identical to the schedules or one line diagram unless there is a technical reason for deviation. All reasons for deviation must be stated on the shop drawings.

1.5 OPERATION AND MAINTENANCE DATA

a. Submit manufacturer's standard operation and maintenance data/manuals.

2.0 PRODUCTS

2.1 GENERAL

a. Furnish copper bus.

b. Furnish full size neutral bus in all panels or as required by the panel schedule and/or one line diagram.

c. Furnish all panelboards with a separate equipment ground bus.

d. Furnish an isolated ground bus where noted on the drawings.

e. Furnish all spaces specified on the schedules complete with all breaker mounting accessories required to accommodate the breaker frame size specified.

f. Furnish nameplate and a welded circuit directory frame and card with a clear plastic covering on the inside of the door for all panelboards. All circuit loads shall be identified on the circuit directory as specified in Section 26 00 00.

2.2 SHORT CIRCUIT RATINGS

a. Each panelboard, shall have a short circuit current rating equal to or greater than the rating shown on the panelboard schedule or on the one-line diagram. The short circuit rating shall be based solely on the ratings of the branch breakers in the panel. Series rating of standard AIC branch breakers with high AIC integral or remote main/feeder breakers is not acceptable.

b. Panelboards shall be marked with their maximum short circuit current rating at the supply voltage. 240 volt maximum branch circuit panels shall be rated 10,000 AIC RMS

symmetrical minimum. 480 volt maximum branch circuit panels shall be rated 14,000 AIC RMS symmetrical minimum and distribution panels shall be rated 22,000 AIC RMS symmetrical minimum.

2.3 BRANCH CIRCUIT PANELBOARDS

a. Panelboard bus structure and main lugs or main circuit breaker shall have current ratings as shown on the panelboard schedule. Such ratings shall be established by heat rise tests, conducted in accordance with UL Standard 67. Bus structure shall be insulated. Bus bar connections to the branch circuit breakers shall be the "distributed phase" or phase sequence type. All current carrying parts of the bus structure shall be plated.

b. The panelboard bus assembly shall be enclosed in a steel cabinet. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. The size of wiring gutters shall be in accordance with UL Standard 67. The box shall be fabricated from galvanized steel. Each cabinet shall include a hinged door-in-door steel front cover and have a flush, cylinder tumbler-type lock with catch and spring-loaded stainless steel door pull. All panelboards shall be keyed alike. Fronts shall have adjustable indicating trim clamps which shall be completely concealed when the doors are closed. Doors shall be mounted with completely concealed steel hinges. Fronts shall not be removable with door in the locked position.

2.4 DISTRIBUTION PANELBOARDS

a. Panelboard bus structure and main lugs or main circuit breaker shall have current ratings as shown on the panelboard schedule or one line diagram. Such ratings shall be established by heat rise tests with maximum hot spot temperature on any connector or bus bar not to exceed 50°C rise above 40°C ambient. Heat rise tests shall be conducted in accordance with UL Standard 67.

b. The panelboard bus assembly shall be enclosed in a steel cabinet with door-in-door construction. The rigidity and gauge of steel to be as specified in UL Standard 50 for cabinets. The size of wiring gutters shall be in accordance with UL Standard 67. Cabinets to be equipped with chrome plated steel latch and tumbler-type lock on door of trim. All panelboards shall be keyed alike. Doors over 48" long shall be equipped with three-point latch and vault lock. Fronts shall be of code gauge steel. End walls shall be removable.

c. The panelboard interior assembly shall be dead front with panelboard front removed. Main lugs or main breakers shall have barriers on the front and sides. The barrier in front of the main lugs shall be hinged to a fixed part of the interior. The end of the bus structure opposite the mains shall have barriers.

d. Circuit breakers shall be equipped with individually insulated, braced and protected connectors. The front faces of all circuit breakers shall be flush with each other. Large, permanent, individual circuit numbers shall be affixed to each breaker in a uniform position. Tripped indication shall be clearly shown by the breaker handle taking a position between "ON" and "OFF". Provisions for additional breakers shall be such that no additional connectors shall be required to add breakers.

2.5 OVERCURRENT PROTECTIVE DEVICES

a. Furnish thermal magnetic circuit breakers for branch circuit and distribution panelboards for the specified service with the number of poles and ampere ratings indicated.

b. Furnish breakers which are quick-make and quick-break on both manual and automatic operation. Use a trip-free breaker which is trip indicating. Incorporate inverse time characteristic by bi-metallic overload elements and an instantaneous characteristic by magnetic trip. Where indicated, provide ground fault breakers (GFCB).

c. For 2-pole and 3-pole breakers, use the common-trip type so that an overload or fault on one pole will trip all poles simultaneously. Handle ties are not acceptable except where multiple single breakers are used to serve modular furniture.

d. Connect breakers to the branch circuit panelboard main bus by means of a solidly bolted connection. Connect breakers to the distribution panelboard main bus by means of a solidly bolted or plug-in connection. Use breakers which are interchangeable, capable of being operated in any position within the panel. Independently mount breakers so that a single unit can be removed from the front of the panel without disturbing or removing main bus, other units or other circuit breaker connections.

2.6 REMOTE CONTROL SWITCHES

a. Furnish ASCO Bulletin 920 or Russelectric RCS electrically operated, mechanically held remote control switches of indicated ratings, mounted in panelboards or in a separate enclosure as shown. Furnish switches wired with a Hand-Off-Automatic (H-O-A) Switch for 2-wire or 3-wire control, as indicated via time switch or Energy Management System (EMS) on the automatic control side. Derive power for the switch operating coil from line side of switched bus. Switch must be UL 508 listed.

2.7 ACCEPTABLE MANUFACTURERS

a. Eaton, General Electric, Siemens Energy & Automation, Square D.

3.0 EXECUTION

3.1 INSTALLATION

a. At the completion of the electrical system, the Contractor shall check each phase of all panelboards under full load conditions and arrange so that all phases shall carry approximately the same load. Refer to Section 26 00 00 for Test Requirements.

b. Stub five (5) empty 3/4-inch conduits out of each flush mounted panelboard to an accessible location above the ceiling.

3.2 MOUNTING HEIGHT

a. Install the panelboards to comply with the applicable provisions of NEMA Standard PB1.1 and such that the center of the switch or circuit breaker in the highest position will not be more than 6-1/2 feet above the floor or working platform.

3.3 PANELBOARD DIRECTORY

a. Prepare a neatly typed circuit directory and install behind a clear heat-resistant plastic protector on the inside of the door of each panelboard. Identify circuits by equipment served and by room numbers selected by the Owner; names and numbers may be different from those shown on drawings. Indicate spares and spaces with light, erasable pencil marking.

3.4 IDENTIFICATION

a. Refer to Section 26 05 53 for the requirements for the identification of panelboards.

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SECTION 26 27 26

WIRING DEVICES

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of wiring devices and device coverplates.

1.2 REFERENCES

a. ADA – American with Disabilities Act (Public Law 101-336).

b. ANSI/IEEE – C62.41 – Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

c. ANSI/UL 20 – Standard for Safety General – Use Snap Switches.

d. UL 498 – Standard for Safety Attachment Plugs and Receptacles.

e. UL 943 – Standard for Safety Ground-Fault Circuit-Interrupters.

f. NEMA WD 1 – General Requirements for Wiring Devices.

1.3 SUBMITTALS

a. Submit manufacturer's technical product data on wiring devices and coverplates. Include data substantiating that materials comply with the requirements of this section.

1.4 DELIVERY, STORAGE AND HANDLING

a. Deliver and store wiring devices and coverplates in suitable containers.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

a. Subject to compliance with the specified requirements, acceptable manufacturers are as follows:

(1) Wiring Devices:

(a) Cooper Industries.

(b) Hubbell.

(c) Leviton.

(d) Pass & Seymour Legrand (P&S)

2.2 WALL SWITCHES

a. Provide Hubbell 122X series, P&S PS20ACX series, or equivalent, heavy duty, quiet specification grade 20-ampere, 120/277 volt, back and side wired switches with grounding terminal. Switches shall be single pole, double pole, three way, four way/key operated, or with red pilot light, as scheduled on the drawings. Provide HBL122XL series, P&S PS20 ACXL series, or equivalent for key operated switch or HBL122XPL series, P&S PS20AC1RLP series, or equivalent for pilot light switch.

2.3 DUPLEX RECEPTACLES

a. Provide Hubbell 5362, P&S PS 5362, or equivalent, heavy duty, specification grade 20-ampere, 125-volt, 2-pole, 3-wire, grounding, NEMA 5-20R, back and side wired duplex receptacles. Prewired pigtail type connectors are acceptable.

b. All 15A and 20A, 120 volt devices installed in dwelling units shall be tamper resistant listed.

c. All 15A and 20A, 120 and 250 volt, non-locking devices installed in wet or damp locations shall be weather resistant listed with "WR" marking visible on the face when installed.

2.4 GROUND FAULT CIRCUIT INTERRUPTERS (GFI)

a. Provide Hubbell GF20XLA or equivalent, P&S 2095, 20-ampere, 125-volt, 2-pole, 3-wire, grounding, NEMA 5-20R, side wired duplex ground-fault circuit interrupters. Safelock protection, denying power to the device if miswired or end of life, is required. Interrupter shall be UL rated Class A with a trip threshold of 5 $\pm$ 1 mA and nominal trip time of 0.025 seconds.

2.5 ISOLATED GROUND RECEPTACLES (IG)

a. Provide Hubbell IG5362, P&S IG 5362, or equivalent, 20-ampere, 125-volt, 2-pole, 3-wire, NEMA, 5-20R back and side wired orange color isolated ground receptacles. All electronic grade 120 volt circuits shall use IG type receptacles unless otherwise noted.

2.6 DEVICE COVERPLATES

a. Device coverplates in finishes spaces shall be 0.32 inches nominal thickness, smooth 302/304 super stainless steel non-magnetic type with satin finish.

b. Device coverplates in exposed dry interior spaces shall be heavy duty cadmium-plated sheet steel. Edges of plate must be flush with edges of boxes.

c. Device coverplates in wet or damp locations shall be installed with a hinged outlet cover/enclosure clearly marked "Suitable for Wet Locations While in Use" and UL Listed". There must be a gasket between the enclosure and the mounting surface and between the hinged cover and mounting plate/base to assure proper seal. Cover shall also meet OSHA lockout/tagout requirements. TayMac, Specification Grade, Hubbell WP826MP, P&S WIU10-GL or approved equivalent (TayMac 800-526-5416).

2.7 DEVICE COLOR

a. The device color shall match the existing devices.

3.0 EXECUTION

3.1 GENERAL

a. Where items of equipment are installed under other sections of this specification or by the Owner, furnish and install a compatible receptacle for the cap or plug and cord of the equipment.

b. Multiple gang coverplates shall be used for all multiple device locations.

c. Where coverplates do not completely conceal the rough opening for the devices, it is the responsibility of the Contractor to paint, patch, etc. around the opening to the satisfaction of the Architect/Engineer.

d. Tighten screws, connectors and terminals in accordance with manufacturer's recommendations.

e. Install wiring devices only in electrical boxes which are clean and free of excess building materials, dirt, and debris.

f. Install coverplates, after painting work is completed, tight to surfaces over which they are installed.

g. Where more than one device occurs in an outlet box, resulting in a 300 volt or higher potential between them, install a barrier between the devices.

h. Coordinate the exact rough-in location of devices installed in, on or above millwork and/or casework with the millwork and/or casework drawings.

3.2 WALL SWITCHES

a. Install wall switches vertically in a suitable steel outlet box centered at a height of 48-inches from finished floor on the strike side of the door as finally hung, or as shown on the drawings. Install not less than 2-inches and not more than 12-inches from door trim unless otherwise directed.

b. Install wall switches in a uniform position so the same direction of operation will open and close the circuits throughout the job, generally up or to the left for the ON position.

3.3 RECEPTACLES

a. Install receptacles vertically in a suitable steel outlet box centered at a height of 18-inches from the floor, horizontally 6-inches above counters or as shown on the drawings. Receptacles shall be installed with the ground prong on top or to the left on horizontally mounted devices. The Architect/Engineer reserves the right to make any reasonable changes in receptacle locations without change in the contract sum.

b. Any 120 volt receptacle installed within 6 feet of a sink shall be a GFCI type per NEC 210.8.

3.4 DEVICE COVERPLATES

a. Install a device coverplate for each device or grouping of devices.

b. Engrave plates with 1/8-inch-high contrasting lettering, if designated for engraving.

c. Wall Switches. Engrave the device plates of wall switches controlling equipment which is not in sight of the switch with the designation of the equipment being controlled by the switch. Lettering shall be 1/8-inch high and of a contrasting color.

d. Blank Plates. Provide a blank smooth nylon plate for any device outlet location not receiving wiring under this project. Color of plate shall be selected by Architect/Engineer.

e. Telecommunication/Data Outlets. Jacks and device plates will be provided by the Communication System Installer.

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SECTION 26 28 00

OVERCURRENT PROTECTIVE DEVICES

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of low voltage fuses rated 600 volts and below and automatic circuit breakers.

1.2 REFERENCE STANDARDS

a. ANSI/ANSI C97.1 - Standard for Low Voltage Cartridge Fuses 600 Volts and Less.

b. NEMA FU 1 - Low Voltage Cartridge Fuses.

c. NEMA AB 1 - Molded Case Circuit Breakers.

d. NEMA AB 2 - Procedures for Verifying the Performance of Molded Case Circuit Breakers.

e. UL 198.3 - High-Interrupting-Capacity Class K Fuses.

f. UL 198.4 - Class R Fuses.

1.3 APPLICABLE PROVISIONS

a. Refer to Section 26 00 00 - Electrical General Provisions.

1.4 SUBMITTALS

a. Submit shop drawings and product data for fuses and circuit breakers.

b. Include time current curves, dimensions, voltage, short circuit ampere interrupting rating, continuous current rating and number of poles.

1.5 OPERATION AND MAINTENANCE DATA

a. Provide operation and maintenance data in accordance with Section 26 00 00.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

a. Subject to compliance with the requirements, acceptable manufacturers shall be as follows:

(1) Fuses.

(a) Bussmann - Cooper Industries.

(b) Littelfuse, Inc.

(c) Mersen.

(2) Circuit Breakers.

(a) General Electric Co.

(b) Siemens Energy and Automation Inc.

(c) Square D Co.

(d) Cutler Hammer.

2.2 FUSES

a. Provide fuses with a voltage rating suitable for the normal voltage of the system in which they are to be applied.

b. Class RK1 Time-Delay Fuses: Fuses rated from 1/10 to 600 amperes shall be UL Class RK1, dual element time-delay type. The fuses shall have separate overload and short circuit elements. The fuses shall have a spring assisted thermal element with a melting point of 284°F. The two elements shall be physically separated in different chambers. The fuse shall be capable of maintaining an overload of 500% of its rated current for a minimum of 10 seconds. The fuses shall have a U.L. listed interrupting rating of 200,000 amperes rms/sym.

c. Class RK5 Time-Delay Fuses: Fuses rated from 1/10 to 600 amperes shall be UL class RK5, dual element time-delay type. The fuses shall have separate overload and short circuit elements. The fuses shall have a spring assisted thermal element with a melting point of 284°F. The two elements shall be physically separated in different chambers. The fuse shall be capable of maintaining an overload of 500% of its rated current for a minimum of 10 seconds. The fuses shall have a U.L. listed interrupting rating of 200,000 amperes rms/sym.

2.3 CIRCUIT BREAKERS

a. Molded-Case Circuit Breakers: Provide molded-case thermal magnetic circuit breakers. Provide breakers with permanent thermal and instantaneous magnetic trips in each pole. Two and three pole breakers shall be common trip. Construct with overcenter, trip-free, toggle type operating mechanisms with quick-make, quick-break action and positive handle indication. Construct breakers for mounting and operating in any physical position and operating in an ambient temperature of 40 degrees C. Provide breakers with mechanical screw type removable connector lugs, AL/CU rated for 65° or 75°C wire for breaker sizes less than 100 amperes and 75°C for breaker sizes 100 amperes and greater. The circuit breakers shall have a minimum 10,000 AIC at 120/240 volts. Provide breakers with an AIC rating equal to or greater than the minimum rating noted on the panelboard schedules.

3.0 EXECUTION

3.1 INSTALLATION

a. Install overcurrent protective devices for all wiring and equipment as indicated, in accordance with the manufacturer's written instructions and with recognized industry practices to ensure that protective devices comply with requirements. Comply with NEC and NEMA standards for installation of overcurrent protective devices.

3.2 FUSES

a. Check all fuse clip fasteners for alignment and tightness in accordance with the manufacturers recommendations.

b. Install fuses so label is in an upright, readable position.

c. Fuses for HVAC equipment shall be provided in accordance with equipment manufacturer's recommendations.

d. All fused disconnects shall have a label placed on the inside of the door that indicates fuse size and type. The manufacturers standard label shall suffice.

e. 1/10 to 600 ampere fuses for individual motor circuits shall be Class RK5/RK1 sized at 1.25 times the full load amperes of the motor for 1.15 service factor motors and 1.15 times the full load amperes for 1.0 service factor motors.

3.3 CIRCUIT BREAKERS

a. Fasten circuit breakers without mechanical stresses, twisting or misalignment being exerted by clamps, supports, or cabling.

b. Set field-adjustable circuit breakers for trip settings as indicated, subsequent to installation of units.

c. Inspect circuit-breakers operating mechanisms for malfunctioning and, where necessary, adjust or replace units for free mechanical movement.

3.4 SPARE FUSES

a. As spares, provide the greater amount of either three fuses or 10 percent of each size and type installed. Deliver the spare fuses to the Owner at the time of final acceptance of the project. Neatly encase the spare fuses in suitable containers or cabinets.

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SECTION 26 28 16

ENCLOSED SAFETY SWITCHES

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of enclosed safety switches.

1.2 REFERENCE STANDARDS

a. ANSI/UL 98 - Standard for Safety Enclosed and Dead-Front Switches.

b. NEMA KS 1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).

1.3 APPLICABLE PROVISIONS

a. Refer to Section 26 00 00 - Electrical General Provisions.

1.4 SUBMITTALS

a. Submit manufacturer's technical product data for all disconnect switches. Include data substantiating that materials comply with the requirements of this section.

2.0 PRODUCTS

2.1 CHARACTERISTICS

a. Voltage. Furnish switches with voltage rating of 250 volts d-c, 240 volts or 600 volts a-c, as required for the installed system voltage.

b. Type. Furnish switches conforming to NEMA Standard KS 1 for Type HD (heavy duty).

c. Contacts. Furnish switches with quick-make, quick-break contacts.

d. Poles. Furnish 3-pole, visible blade switches, unless otherwise indicated on the drawings.

2.2 CONSTRUCTION

a. Enclosure. Furnish NEMA 1 switch enclosures for indoor dry locations, NEMA 3R

for outdoor and NEMA 4X for all interior wet or damp locations, unless otherwise indicated.

b. Operating Handle. Furnish a handle suitable for padlocking in the OFF position with as many as three padlocks of 5/16-inch diameter shank. Use a defeatable, front accessible, coin-proof door interlock to prevent opening the door when the switch is in the ON position and to prevent turning the switch ON when the door is open.

c. Terminal Shield. Furnish incoming line terminals with an insulated shield so that live parts are not exposed when the door is open.

d. Neutral. Where neutrals are indicated furnish switches with an isolated, fully rated neutral block. Make provisions for bonding the block to switch enclosure.

e. Fuse Holders. Where fusible switches are indicated, furnish switches with rejection-type fuse holders and fuses conforming to Section 26 28 00, Overcurrent Protective Devices.

f. Nameplates. Furnish a front cover mounted metal nameplate, indicating the switch type, catalog number and horsepower rating (with both standard and time delay fuses).

g. Provide grounding bar.

2.3 ACCEPTABLE MANUFACTURERS

a. Eaton, General Electric, Siemens Energy & Automation, Square D.

3.0 EXECUTION

3.1 INSTALLATION

a. Install switches for all equipment that requires them. Mount so that operating handle is approximately 48-inches above finished floor. Where grouped, align tops of switches.

3.2 IDENTIFICATION

a. Refer to Section 26 05 53 for the requirements for the identification of safety switches.

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SECTION 26 29 13

MOTOR STARTERS - 600 VOLT AND BELOW

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of individually enclosed motor starters.

1.2 REFERENCE STANDARDS

a. ANSI/NEMA ICS1 - General Standards for Industrial Control and Systems.

b. ANSI/NEMA ICS2 - Industrial Control Devices, Controllers and Assemblies.

c. UL 508 - Standard for Safety Industrial Control Equipment.

1.3 APPLICABLE PROVISIONS

a. Refer to Section 26 00 00 - Electrical General Provisions.

1.4 SUBMITTALS

a. Submit manufacturer's technical product data on starters and accessories. Include data substantiating that materials comply with the requirements of this section.

2.0 PRODUCTS

2.1 MAGNETIC MOTOR STARTER

a. Type. Furnish magnetic, full-voltage, non-reversing motor starters unless otherwise indicated on the drawings.

b. Overload Relays. Furnish three ambient-compensated thermal overload relays, one per phase leg.

c. Contactor. Furnish contactors sized according to NEMA standards, minimum size one, or as shown on the drawings. Furnish three main poles, the number and type of auxiliary contacts to perform the required functions, and two spare auxiliary contacts, one normally open and one normally closed, rated 10 amperes (NEMA contact rating

designation A600). Use double break contacts of silver alloy or similar material to minimize sticking or welding. Furnish contactor coils suitable for continuous operation at 120 volts, 60 hertz.

d. Control Power Transformer.

(1) Voltage. In each enclosure furnish a single-phase control power transformer with a 240-volt primary and a 120-volt secondary.

(2) Fuses. Fuse both primary lines of the transformer and connect to Line 1 and Line 2. Fuse the secondary line leaving transformer terminal X1. Ground the secondary line leaving terminal X2. Coordinate primary fuses with secondary fuse to clear a faulted transformer but not blow on magnetizing inrush current. Furnish fuses conforming to Section 26 28 00 – Overcurrent Protective Devices.

(3) Size. Furnish manufacturer's standard size transformer unless otherwise indicated.

(4) For exterior motors with space heaters, the control power transformer shall be of adequate size to power the motor space heater when the motor is not running. The Contractor shall wire the motor space heater through a normally closed contact of the starter.

e. Enclosure. Furnish a NEMA 1 enclosure for indoor dry location, NEMA 3R for outdoors, and NEMA 4X for all interior wet or damp locations, unless otherwise indicated on the drawings.

f. Control Devices. Furnish control devices as indicated below:

(1) Selector Switches. Heavy-duty, oil-tight, maintained contact, with marked nameplate. Unless otherwise indicated, provide switch for each starter.

(2) Pushbutton Units. Heavy-duty, oil-tight, momentary contact, spring return, or maintained contact with marked nameplate.

(3) Indicating Lights. Pilot light assemblies shall be heavy-duty, oil-tight, transformer type with rated life of 20,000 hours. Neon lamps are not acceptable. Unless otherwise indicated, provide red (running) and green (stopped) lenses. On two-speed starters, provide amber (low speed), red (high speed) and green (stopped) lenses.

2.2 COMBINATION SWITCH-STARTER

a. Type. Furnish combination disconnect switch and magnetic motor starter as indicated on the drawings.

b. Switch. Heavy-duty, quick-make and quick-break. Furnish fused or unfused type as indicated on the drawings. Make provisions for padlocking in the open position.

c. Fuse Clips. Furnish rejection-type fuse clips.

d. Starter. Furnish magnetic motor starter as specified in Paragraph 2.1.

e. Enclosure. Furnish a NEMA 1 enclosure for indoor dry location, NEMA 3R for outdoor and NEMA 4X for all interior wet or damp locations, unless otherwise indicated.

f. Fuses. Furnish fuses conforming to Section 26 28 00, Overcurrent Protective Devices.

2.3 MANUAL MOTOR STARTERS

a. Provide line voltage 20 ampere or 30 ampere rated manual motor starters for each single phase motor and each resistance heating element. Include bimetallic thermal overload protection in each ungrounded phase leg. Furnish a toggle-operated starter in a NEMA 1 indoors and NEMA3R outdoor enclosure unless otherwise indicated on the drawings.

2.4 ACCEPTABLE MANUFACTURERS

a. Eaton, General Electric, Siemens Energy & Automation, Square D.

3.0 EXECUTION

3.1 INSTALLATION

a. In general, install combination units so that operating handle is approximately 48-inches above finished floor. On non-combination units, install so that control device is approximately 48 inches above finished floor. Where grouped, align tops of all starter units.

3.2 OVERLOAD SETTINGS

a. Set overload relays to maximum values permitted by NEC 430.32, based on actual motor nameplate full load amperes. Keep a record of the nameplate full load amperes for

each motor and the thermal heater element installed in the overload relay. Submit a copy of the record to the Architect/Engineer as a condition of final acceptance.

3.3 IDENTIFICATION

a. Refer to Section 26 05 53 for the requirements for the identification of motor starters.

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SECTION 26 51 00

LIGHTING FIXTURES AND LAMPS

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of lighting fixtures complete with lamps, ballasts and other accessories.

1.2 REFERENCE STANDARDS

a. ANSI/ANSI C78 Series - Lamps.

b. ANSI/ANSI C82 Series - Ballasts.

c. ANSI/IEEE C62.41 - Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.

d. ANSI/UL 844 - Standard for Safety Electric Lighting Fixtures for Use in Hazardous (Classified) Locations.

e. ANSI/UL 924 - Standard for Safety Emergency Lighting and Power Equipment.

f. ANSI/UL 935 - Standard for Safety Fluorescent Lamp Ballasts.

g. ANSI/UL 1029 - Standard for Safety High-Intensity-Discharge Lamp Ballasts.

h. ANSI/UL 1570 - Standard for Safety Fluorescent Lighting Fixtures.

i. ANSI/UL 1574 - Standard for Safety Track Lighting Systems.

j. UL 1572 - Standard for Safety High Intensity Discharge Lighting Fixtures.

1.3 APPLICABLE PROVISIONS

a. Refer to Section 26 00 00 - Electrical General Provisions.

1.4 SUBMITTALS

a. Submit manufacturer's technical product data for all lighting fixtures, lamps, ballasts and accessories. Include published photometric data, coefficients of utilization and candlepower distribution curves for lighting fixtures.

1.5 DELIVERY, STORAGE AND HANDLING

a. Deliver all lighting fixtures in factory-fabricated containers or wrappings, which properly protect fixtures from damage.

b. Store all lighting fixtures in original packaging. Store laid flat and blocked off ground inside a well-ventilated area protected from weather, moisture, soiling, extreme temperatures and humidity.

c. Handle all lighting fixtures carefully to prevent damage, breaking, and scaring of finishes. Do not install damaged units or components.

1.6 OPERATION AND MAINTENANCE DATA

a. Submit manufacturer's standard operation and maintenance data/manuals in accordance with Section 26 00 00. Provide lamp ordering information for each type of lamp and the local lamp distributor's address and phone number.

1.7 COORDINATION

a. The various ceiling types are indicated on the architectural plans and in the room finish schedules. All lighting fixtures shall be coordinated with the architectural requirements to insure that the proper trim kit, and/or mounting accessory is provided with each fixture for the intended application. All trim kits and accessories shall be provided by Contractor whether or not they are specifically indicated by the manufacturer's catalog numbers on the lighting fixture schedule.

2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURES

a. Lighting fixtures are scheduled on the drawings.

b. Lamps. General Electric, Osram/Sylvania, Philips.

c. Electronic Ballast - Integrated Circuit Type. Advance, Motorola.

2.2 LIGHTING FIXTURES

a. Lighting fixtures are specified by type and manufacturer in the Lighting Fixture Schedule on the drawings. All lighting fixtures shall be installed complete with lamps, ballasts and accessories.

2.3 LAMPS

a. All lamps shall comply with Public Law 102-486, the National Energy Policy Act of 1992.

b. Fluorescent lamps shall be as indicated in the Lighting Fixture Schedule and shall have a Color Rendering Index (CRI) of 85 or greater. Additionally all four (4) foot, energy saving, T-8 fluorescent lamps shall comply with EPA hazardous waste requirements and shall have a rated average life of 20,000 hours.

c. Compact fluorescent (twin tube, double twin tube and triple tube) lamps shall be as indicated in the Lighting Fixture Schedule.

d. Metal halide lamps shall have the wattage, bulb and base as specified in the Lighting Fixture Schedule.

2.4 BALLASTS

a. All fluorescent ballasts must conform to the following:

(1) Where required by Public Law 100-357, comply with the Energy Policy and Conservation Act of 1987 and the National Appliance Energy Conservation Amendments of 1988.

(2) Thermally protected Class P.

(3) Class "A" sound rating.

(4) Power factor equal to or greater than .90.

(5) Contain no PCBs.

(6) CBM approved.

b. Furnish electronic (integrated circuit) ballasts for fluorescent lighting fixtures similar to Advance Mark V, GE/Motorola, or approved equivalent which meet the following standards:

(1) Operating frequency of 20KHZ or greater without visible lamp flicker.

(2) Input current Total Harmonic Distortion (THD) shall not exceed 10%.

(3) Crest factor not to exceed 1.7.

(4) Withstand line transients as defined in ANSI/IEEE C62.41, Category A.

(5) Comply with the requirements of the Federal Communication Commission Rules and Regulations, Part 18, 152J for EMI/RFI, for non-consumer equipment.

(6) Comply with ANSI C82.11 - High Frequency Fluorescent Lamp Ballasts.

c. Furnish electronic ballasts for compact fluorescent lighting fixtures with low THD, high power factor, "A" sound rating, and Class P thermal protection.

d. Furnish lag type high reactance autotransformer type HX, high power factor ballasts for 50-150 watt metal halide ballasted fixtures and constant wattage autotransformer high power factor ballasts for 175-1500 watt metal halide ballasted fixtures.

2.5 EMERGENCY BATTERY SYSTEM

a. Where indicated on the drawings, furnish fixtures with a factory installed emergency battery system consisting of a sealed rechargeable maintenance-free rechargeable nickel cadmium battery, battery charger, solid state inverter, test switch, and "ready" light. System shall be suitable for use in both normal and emergency operational modes. System shall operate one lamp in each fixture at not less than 33% light output initially to not less than 25% light output after 90 minutes of operation. Furnish Bodine B50 or approved equivalent.

2.6 FUSING AND THERMAL PROTECTION

a. All fixtures with ballast(s) shall be externally fused with an inline fuse.

b. All incandescent fixtures shall be thermally protected.

2.7 LENS/LOUVERS

a. Lenses for fluorescent fixtures shall be pattern acrylic pattern 12 with minimum thickness
of 0.125 inches unless otherwise indicated in the Lighting Fixtures Schedule.

b. Furnish one lens retaining hold-down clip on all sides of fluorescent light fixtures with length exceeding two feet.

3.0 EXECUTION

3.1 INSTALLATION

a. Install lighting fixtures at locations and heights as indicated or directed by the Architect/Engineer, in accordance with fixture manufacturer's written instructions and applicable requirements of NEC.

b. Install fixtures and/or fixture outlet boxes with hangers to properly support fixture weight.

c. Install hangers and support members for fixtures as required for proper installation. Provide appurtenances which include stud supports, stems, mounting brackets, frames and plaster rings.

d. Support fixtures from the building structure or from furring channels. Furring channels must be a minimum size of 1-1/2-inches. Lay-in (recessed) lighting fixtures shall be supported from building structure by minimum 12 gauge galvanized carbon steel soft temper hanger wires. Install two hangers at diagonally opposite corners of each lay-in light fixture 2' x 4' or smaller and one hanger at each corner of each lay-in lighting fixture larger than 2' x 4'. Supporting of lighting fixtures from ceiling system is not acceptable.

e. Install support members for exit fixtures as required to provide rigid installation.

f. Each lay-in lighting fixture shall be separately connected to an above ceiling junction box (i.e. daisy chaining from fixture to fixture with flexible conduit is not allowed). Flexible metal conduit from junction box to lighting fixture shall not touch the ceiling as finally installed.

g. Install flush mounted fixtures properly to eliminate light leakage between fixture frame and finished surface.

h. Tighten connectors and terminals, including screws and bolts, in accordance with equipment manufacturer's published torque tightening values for equipment connectors. Where manufacturer's torquing requirements are not indicated, tighten connectors and terminals to comply with tightening torques specified in UL Standard 486A.

I. Provide for independent switching of ballasts where dual level switching of lighting fixtures is indicated.

3.2 GROUNDING

a. Install equipment grounding connections for all lighting fixtures.

3.3 ADJUSTING AND CLEANING

a. Adjust all directional lighting fixtures as directed by the Architect.

b. Clean all lighting fixture housings, reflectors, lenses and diffusers at completion of project.

3.4 DEMONSTRATION

a. Demonstrate that all lighting fixtures are complete and operational.

b. Demonstrate the operation of all lighting controls, including the setting and adjustment of
time switches and other automatic controls.

c. Incandescent lamps shall be new at time of final acceptance.

d. Fluorescent and HID lamps may be used in the final finishing of the facility. Those that have exceeded more than 20 percent of their rated life (as established by Owner) or that have blackened ends shall be replaced with new lamps before final acceptance.

e. Any ballast that in the Owner and Architect/Engineer opinion generates excessive noise
shall be replaced at no additional cost.

3.5 SPARE LAMPS

a. As spares, provide a minimum of 6 lamps of each size and type installed. Deliver the spare lamps to the Owner at the time of final acceptance of the project in a suitable lamp container or box.

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SECTION 28 31 00

FIRE ALARM SYSTEM

1.0 GENERAL

1.1 SCOPE

a. This Section specifies the furnishing and installation of new fire alarm system equipment to be connected to the existing Radionics system. Coordinate with existing fire alarm supplier for new devices.

1.2 REFERENCE STANDARDS

a. ADA - American with Disabilities Act (Public Law 101-336).

b. ANSI/NFPA 70 - National Electrical Code.

c. ANSI/NFPA 72 - National Fire Alarm Code.

d. ANSI/NFPA 90A - Standard for the Installation of Air Conditioning and Ventilating Systems.

e. ANSI/NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.

f. ANSI/UL 38 - Standard for Safety Manually Actuated Signaling Boxes for Use with Fire-Protective Signaling Systems.

g. ANSI/UL 268 - Standard for Safety Smoke Detectors for Fire-Protective Signaling Systems.

h. ANSI/UL 464 - Standard for Safety Audible Signal Appliances.

i. ANSI/UL 521 - Standard for Safety Heat Detectors for Fire-Protective Signaling Systems.

j. ANSI/UL 864 - Standard for Safety Control Units for Fire-Protective Signaling Systems.

k. ANSI/UL 1424 - Standard for Safety Cables for Power-Limited Fire-Protective Signaling Circuits.

l. ANSI/UL 1480 - Standard for Safety Speakers for Fire-Protective Signaling Systems.

m. ANSI/UL 1481 - Standard for Safety Power Supplies for Fire-Protective Signaling Systems.

n. ANSI/UL 1638 - Standard for Safety Visual Signaling Appliances.

o. UL 228 - Standard for Safety Door Closers-Holders, With or Without Integral Smoke Detectors.

p. UL 268A - Standard for Safety Smoke Detectors for Duct Application.

q. UL 1971 - Standard for Safety Signaling Devices for the Hearing Impaired.

r. Factory Mutual (FM).

s. Article 5.43-2 - Texas Insurance Code and Fire Alarm Rules.

t. Texas Accessibility Standards of the Architectural Barriers Act, Article 9102, Texas Civil Statutes.

1.3 APPLICABLE PROVISIONS

a. Refer to Section 26 00 00 - Electrical General Provisions.

b. Refer to Division 08.

c. Refer to Division 23.

1.4 SUBMITTALS

a. Submit the following information for review:

b. Manufacturer's technical product data on all components and miscellaneous materials. Include data substantiating that equipment and materials comply with the requirements of this section.

c. Floor plans, at the same scale as the Contract Documents, showing the location of all devices, interconnecting wiring, and raceways.

d. Riser diagrams and proposed labeling designations for all devices.

e. Complete point-to-point wiring diagrams.

f. Clear, concise design calculations showing main and auxiliary power supply loading, module space requirements on the mother board and/or in the cabinet, stand-by

battery requirements per the applicable NFPA standard, and initiating and indicating loop wire sizes.

g. A written system description detailing all significant modules and/or components of the system; with particular emphasis on conformity to this specification.

h. A written system sequence of operation detailing all operational aspects of the system. It shall satisfy the Architect/Engineer and the reviewing Authority Having Jurisdiction of the system's conformity to this specification and the applicable codes.

i. Written proof of installer's current State license.

j. Only basic fire alarm equipment devices have been indicated. It is the Contractor's responsibility to design and submit for approval by the Authority Having Jurisdiction the complete engineered system configuration indicating all fire alarm devices, wiring and any other information required by International Fire Code, NFPA 72 and specified herein to provide a complete operational system.

1.5 QUALITY ASSURANCE

a. All components of the Fire Alarm System shall be listed as products of a single fire alarm system manufacturer under the appropriate category by the Underwriter's Laboratories, Inc. and shall bear the UL label. Systems shall be engineered by a factory authorized representative or supplier/installer with factory trained personnel.

1.6 SUBCONTRACTOR

a. The installer shall be an authorized representative of the manufacturer of the fire alarm system.

b. The installer shall be licensed by the State Fire Marshal to install and service fire alarm systems. The Contractor installing this system shall employ (1) NICET Level 3 Planner and (2) NICET Level 2 technicians on a full time (40 hour per week) basis. Installation superintendent NICET (Level 3) shall be licensed by the State Fire Marshal to supervise and check out the installation of the fire alarm system. Installation personnel (NICET Level 2) must have a minimum of 3 years of experience in installing systems of this magnitude. Contract agents will not be acceptable as NICET employees.

c. The installer shall maintain a 24-hour service department with a guarantee of service within 8 hours after being called any time 7 days a week, 365 days a year. The service department shall have service technicians, factory trained in the care, maintenance and troubleshooting of the equipment supplied.

d. The installer shall coordinate his work with the work of all other trades affected by the fire alarm system, especially the HVAC installers.

1.7 OPERATION AND MAINTENANCE DATA

a. Submit operations and maintenance data and parts lists for each component of fire alarm equipment installed. Include with this data all items required in Paragraph 1.4.

1.8 SYSTEM DESCRIPTION

a. The fire alarm system consists of microprocessor based, analog addressable, 24 volt d-c, electrically supervised equipment. The system shall include, but not be limited to, all control equipment, power supplies, alarm initiating devices, ADA approved audible and visual indicating appliances, conduit, wire, and all other accessories required to provide a complete and fully operable system, whether or not the required items are specified or shown on the drawings.

b. The system shall be completely field programmable and configured from the control panel keypad or laptop computer. No special tools shall be required to program or configure the system.

c. The system shall operate as a noncoded, continuous sounding system which shall have multiple or zoned alarm indicating circuits which sound alarm until manually silenced.

d. The system shall consist of Style 4 signaling line circuits for all alarm initiating devices.

e. The system shall consist of Style Y indicating appliance circuits for all alarm indicating devices.

f. The system shall be capable of automatic testing of detector calibration and sensitivity.

1.9 SYSTEM OPERATION

a. The system alarm operation subsequent to activation of any alarm initiating device shall be as follows:

(1) The system alarm LED on the control panel shall flash until acknowledged. Once acknowledged, the LED shall revert to steady state. A subsequent alarm signal received after acknowledgement shall flash the alarm LED on the control panel.

(2) An audible alarm shall sound within the control panel until acknowledged. Once acknowledged, the audible alarm shall be silenced. A subsequent alarm signal received after acknowledgement shall sound the alarm on the control panel.

(3) A back-lit LCD display on the control panel shall indicate all applicable information associated with the alarm condition.

(4) Activate all alarm indicating appliances.

(5) Shut down fans and air handling units on the fire floor.

(6) Activate smoke and/or combination fire and smoke dampers.

(7) Activate magnetic door holders.

(8) Log the event to the system history buffer.

(9) Transmit an alarm signal to the Owner's central monitoring system.

b. The system trouble operation subsequent to detection of a trouble condition shall be as follows:

(1) The system trouble LED on the control panel shall flash until acknowledged. Once acknowledged, the LED shall revert to steady state. A subsequent trouble signal received after acknowledgement shall flash the trouble LED on the control panel.

(2) An audible trouble alarm shall sound within the control panel until acknowledged. Once acknowledged, the alarm shall be silenced. A subsequent trouble signal received after acknowledgement shall sound the audible trouble alarm on the control panel.

(3) A back-lit LCD display on the control panel shall indicate all applicable information associated with the trouble condition.

(4) Log the event to the system history buffer.

(5) Transmit a trouble signal to the Owner's central monitoring system.

2.0 PRODUCTS

2.1 FIRE ALARM CONTROL PANEL

a. The existing Radionics system shall be expanded as necessary to serve the new equipment.

b. Comply with UL Standards 864 and 1481.

c. Provide remote UL listed power supplies as required for audio/visual devices compatible with main fire alarm control panel.

2.2 MANUAL PULL STATIONS

a. Furnish Radionics or approved equivalent manual pull stations. Manual pull stations shall be double action type and shall be constructed of high impact, red lexan with raised white lettering and a smooth high gloss finish.

b. Comply with UL Standard 38.

2.3 AREA SMOKE DETECTORS

a. Furnish Radionics or approved equivalent photoelectric smoke detectors.

(1) The detectors shall obtain their operating power from the fire alarm panel supervised detection loop. The operating voltage shall be 24VDC (nominal). Removal of the detector head shall interrupt the supervisory circuit of the fire alarm detection loop and cause a trouble signal to be generated at the control panel.

(2) Each detector shall have a flashing status indicating LED for visual supervision. When the detector is actuated, the flashing LED will latch on steady and at full brilliance. The detector may be reset by actuating the control panel reset switch.

(3) To minimize nuisance alarms, voltage and RF transient suppression techniques shall be employed as-well-as a smoke verification circuit and an insect screen. The detector design shall provide full solid-state construction and compatibility with other normally open fire alarm detection loop devices, (heat detectors, pull stations, etc.). The detector head shall be easily disassembled to facilitate cleaning.

b. Comply with UL Standard 268.

2.4 DUCT MOUNTED SMOKE DETECTORS

a. Furnish Radionics or approved equivalent duct mounted photoelectric smoke detectors.

b. Furnish Radionics or approved equivalent remote alarm LED indicator.

c. Installation must comply with NFPA 90A. Coordinate mounting with HVAC installer.

d. Comply with UL Standard 268A

2.5 AUTOMATIC HEAT DETECTORS

a. Furnish Radionics or approved equivalent 135°F fixed temperature heat detectors.

b. Comply with UL Standard 521.

2.6 ISOLATOR MODULE

a. Furnish Radionics or approved equivalent. Isolator module to isolate wire-to-wire short circuits in a loop and to limit the number of other modules or detectors that are incapacitated by the short circuit fault. The loop should be wired style 6, and isolator modules should be placed between every 25 or fewer devices. If a wire-to-wire short occurs, the isolators on either side of the short shall automatically open-circuit. When the short is corrected, the isolators shall automatically re-connect with isolated section of the loop.

b. The isolator module shall not require any address-setting, although each isolator will electrically reduce the capacity of the loop by one detector or module address. The Isolator module will mount in a standard 4-inch electrical box. It shall provide a single LED which shall flash to indicate that the Isolator is operational and shall illuminate steadily to indicate that a short has been detected and isolated.

2.7 MONITOR MODULE

a. Furnish Radionics or approved equivalent. Addressable monitor modules where required to interface to contact alarm devices. The monitor module shall be used to connect a supervised zone of conventional initiating devices, any normally open dry contact device, to an intelligent loop. The monitor will mount in a 4-inch square electrical box. Each zone may be wired either Class A or Class B field selectable.

b. Each monitor module shall be set to a distinct address and internal identification code which the control panel shall use to identify the location and type of device. A status/power LED shall be provided which shall flash under normal conditions, indicating that the monitor module is operational and in regular communication with the control panel. The status LED shall illuminate steady upon detection of an alarm condition.

2.8 CONTROL MODULE

a. Furnish Radionics or approved equivalent. Control/Relay Modules where required to provide audible alarm interface and/or relay control interface. The control module shall be used to connect a supervised zone of conventional indicating devices to an intelligent loop. The control module will mount in a standard 4-inch electrical box. The zone may be wired Class A or Class B field selected. The control module may be optionally wired as dry contact (form C) relay. Power for the relay actuation shall be provided by the intelligent detector loop to reduce wiring connection requirements.

b. Each control module shall be set to a distinct address and internal identification code which the control panel shall use to identify the location and type of device. A status LED shall be provided which shall flash under normal conditions, indicating that the control module is operational and in regular communication with the control panel. The LED shall illuminate steady when the device is actuated via the fire alarm control panel.

2.9 VISUAL DEVICES

a. Furnish Radionics or approved equivalent visual indicating appliances. The visual indicating appliances shall comply with the "American with Disabilities Act". Visual units shall be of the stand alone type or be incorporated as part of an audio/visual unit.

b. Comply with ADA and UL Standards 1638 and 1971.

2.10 AUDIBLE/VISUAL DEVICES

a. Furnish Radionics or approved equivalent multi-tone electronic audio/visual indicating appliances with a minimum rating of 90dBA at 10 feet.

b. Comply with ADA and UL Standards 464, 1638, and 1971.

2.11 ADDITIONAL FIRE ALARM DEVICES

a. In addition to the fire alarm devices indicated on the Drawings and/or Specified, the Contractor shall include the following listed fire alarm system devices. These additional fire alarm devices shall be included in the contract price completely installed,

connected and zoned as directed by the Owner's Representative as the project progresses at no additional cost. Also include fifty feet (50'-0") of cable in 1/2" conduit for each of the fire alarm devices.

(1) 3 Ceiling Mounted Smoke Detectors.

(2) 3 Visual Alarm Units.

(3) 3 Audio/Visual Alarm Units.

(4) 3 Duct mounted detectors.

b. Any additional devices that are not used for the project shall be given to the Owner at the end of the project.

2.12 WIRING

a. Furnish conductors in accordance with requirements of manufacturer and as required by NEC Article 760 and local requirements.

b. Furnish conductors which are listed and approved for fire alarm usage. All conductors shall be solid copper and shall have a red colored outer jacket.

c. Furnish minimum conductor size No. 14 AWG for power consuming circuits and No. 16 AWG for non-power consuming alarm initiating circuits.

d. Comply with UL Standard 1424.

3.0 EXECUTION

3.1 INSTALLATION

a. Install the system in accordance with the plans and specifications, all applicable codes and the manufacturer's recommendations. Furnish and install duct detectors in the return ducts of <u>all</u> air handling units with a CFM of 2,000 or greater.

b. The work shall be installed by personnel having experience in the specific type of system being furnished. The services of a qualified technician shall be provided to supervise the installation, testing and adjustment.

c. Labeling.

(1) The control panel and annunciator LCD read-outs shall be identified with

area designations and nomenclature which has been reviewed and approved on submittals.

(2) All duct mounted smoke detectors and their remote indicators shall be labeled with corresponding air handling unit designation and area served.

d. Paint all fire alarm boxes, junction boxes and pull boxes red.

3.2 WIRING

a. Installation of the wiring for the fire alarm system is part of the work of this section, but is not specifically detailed on drawings. Determine exact number of wires for each type of device installed. Determine the size of wire to prevent excessive voltage drop which might render the fire alarm devices inoperable.

b. Install all wiring using plenum rated cables. Install all cables and wiring in concealed raceways in CMU and gypsum board walls and above inaccessible ceilings. Plenum rated wiring may be used above accessible type ceilings provided the cables are installed parallel and perpendicular to structural members and supported by 'J' hooks or bridle rings on 4 foot centers. Provide sleeve through each sound wall and seal cable after installation.

c. Color code all fire alarm system wiring and install per manufacturer's point-to-point wiring diagram.

3.3 TESTING

a. Furnish all instruments, labor and materials required for the tests and a qualified technician to conduct the tests. Refer to Section 26 00 00 for additional requirements.

b. Upon completion of the installation, the system shall be subjected to operational tests. Any deficiencies found shall be corrected and the system shall be retested prior to final acceptance. Tests shall include but not be limited to the following:

(1) An operation of each alarm initiating device shall confirm correct address and sensitivity.

(2) Operation of all features of the systems under normal operations, including message and light display for each alarm input.

(3) Check of power failure alarm and battery back-up system.

(4) Submit certified test report that each duct smoke detector has been tested and has sufficient air flow through detection chamber for proper operation.

3.4 DEMONSTRATION AND OWNER TRAINING

a. The completed fire alarm system shall be demonstrated in the presence of the Owner. The essential functions of the system shall be demonstrated and the Owner's designated personnel shall be trained in all aspects of software programming and hardware operation, testing and maintenance of the system. See Section 26 00 00 for additional training requirements. Provide a minimum of four (4) hours of training to designated Owner personnel. The Contractor shall video the training session and shall provide two copies to the Owner for their future use.

3.5 CERTIFICATION

a. Upon completion of the testing, the manufacturer or his representative shall issue to the Owner a letter of certification that he has tested and adjusted the system, that all components are properly installed and free of defects, and that the system is in compliance with these Specifications and all applicable codes. In addition, the installation sticker and the certification certificate provided by the local Fire Marshal and the State Fire Marshal shall be completed with copies distributed and posted as required.

3.6 INSPECTIONS

a. Two periodic inspections, at no expense to the Owner, shall be made within the guarantee period to ensure satisfactory operation of the system. Inspections shall conform to the requirements of NFPA 72 Chapter 14.

b. The Contractor shall pay for all permits and fees including the first year monitoring charges for the remote listed station. Phone line to panel will be provided by the Owner.

3.7 GUARANTEE

a. The system shall be guaranteed to be free from all defects in material and workmanship for a period of one year from the date of substantial completion. Equipment or components showing inherent defects of a mechanical or electrical nature shall be replaced promptly at no expense to the Owner.

3.8 RECORD DOCUMENTS

a. Upon completion of the entire system installation, record documents shall be submitted before final acceptance of the work. The record documents shall be on a CD in a computer assisted drafting DXF format. Record documents shall include plan drawings and system wiring diagrams as well as system programming in hard copy and on CD.

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