

SECTION 230000 - HVAC SYSTEM

PART 1 GENERAL

1.1 DESCRIPTION

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

1.2 RELATED DOCUMENTS

- A. The drawings and the specifications including SECTION 230500 "SUPPLEMENTAL MECHANICAL GENERAL REQUIREMENTS" are hereby made a part of the work of this section.

1.3 SUBMITTALS

- A. Substitutions: Your attention is directed to Section 230500-"Substitutions", relative to competition and the (ONLY) notation. Familiarity with this section should be achieved before reading the PRODUCTS section of this specification.
- B. The items for which the submittals paragraph in Section 230500, Supplemental Mechanical General Requirements, apply are as follows:
 - 1. Piping materials.
 - 2. Hangers.
 - 3. Valves.
 - 4. Piping, valve and equipment identification.
 - 5. Hydronic specialties.
 - 6. Hydronic duct coils
 - 7. Energy Recovery Units.
 - 8. Automatic temperature controls.

PART 2 PRODUCTS

2.1 PIPING MATERIALS

- A. Hot Water Heating Piping: Type L hard copper tubing and cast bronze or wrought copper solder fittings or Schedule 40 carbon steel pipe with threaded joints and malleable iron fittings.

2.2 HANGERS

- A. Adjustable Swivel Hanger: Pipe Sizes 2" and Less: Carpenter and Paterson Fig. 800 conforming to MSS-SP-58, oversize for insulated piping systems. Pipe Sizes Larger Than 2": Carpenter and Paterson Fig. 100, oversize for insulated piping systems.
- B. Riser Clamp: Carpenter and Paterson Fig. 126 and Fig. 126 CT conforming to MSS-SP-58, provide copper plated clamps on copper pipes.

- C. Insulation Shields: 18 ga. galvanized steel, 180° wrap, Carpenter and Paterson Fig. 265P, Type H.

2.3 VALVES

- A. Ball Valves: Apollo 77-200 Series, bronze body, Fed. Spec. WW-V-35, Type II, Class A (bronze), Style 3, full port, blow-out proof stem, 600 pound W.O.G., screwed connection for steel pipe, sweat connection for copper tube. Provide stem extension to allow operation without interfering with pipe insulation.
- B. Gate Valves: Nibco Model S-113 or T-113, bronze body Fed. Spec. WW-V-54, wedge disc, rising stem, screwed connection for steel pipe, sweat connection for copper tube, 150-pound class.
- C. Check Valves: Nibco Model S-413 or T-413, bronze body Fed. Spec. WW-V-51, regrinding swing check type, 200 pound class.

2.4 PIPING, VALVE AND EQUIPMENT IDENTIFICATION

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

Hot Water Supply Piping
Hot Water Return Piping

- 1. Markers shall be placed 30-50 ft. apart for piping in accessible areas.
 - 2. Markers shall be placed outside the pipe insulation and in the most obvious location for viewing. Markers shall not be installed in exposed areas except in the mechanical rooms.
- B. Valve Tags:
 - 1. Attach to each valve a 1-1/2" round or octagonal brass tag with 1/2" indented numerals filled with a durable black compound. In addition to the valve numbers, each tag shall identify the system it controls. Service stop valves exposed in finished areas need not be tagged.
 - 2. Tags shall be securely attached to stems of valves with copper or brass "S" hooks, or chains.
 - 3. Valve charts shall be provided for each piping system and shall consist of schematic drawings of piping layouts, showing and identifying each valve and describing its function. Upon completion of the work, one (1) copy of each chart, sealed to rigid backboard with clear lacquer placed under glass and framed, shall be hung where directed. Two (2) additional unmounted copies shall be delivered to the Architect.
 - 4. Tags and charts shall be coordinated with Section 220000 Plumbing System and when completed this work shall have been done sequentially.

C. Equipment Identification:

1. Provide laminated plastic nameplates for boilers, pumps, and air handling units. Laminated plastic shall be 0.125-inch thick melamine plastic conforming to Fed. Spec. L-P-387, black with white center core. Surface shall be a matte finish, corners shall be square. Accurately align lettering and engrave into the white core. Minimum size of nameplates shall be 1.0 inch by 2.5 inches. Lettering shall be minimum of 0.25-inch high normal block lettering.

2.5 HYDRONIC SPECIALTIES

- A. Strainers: Watts Model 77S, MIL-S-16293, 125 psig minimum rating wye strainers, cast iron or bronze body, screen shall be stainless steel, monel or bronze with 20 mesh perforations. Provide with blowdown ball valve and 3/4" hose connection.
- B. Automatic Air Vents: Armstrong No. 1-AV, float type to vent air in hydronic systems. Vent constructed with cast iron body and stainless steel internals and with NPT male inlet and outlet for 1/4 inch overflow for safe water connection. 150 psi working pressure, 250°F maximum temperature.
- C. Manual Air Vents: Brass body, fiber discs, 125 psi working pressure, 240°F maximum temperature, adjustable for quick venting at system start-up.
- D. Flexible Connectors at Pumps and at Coils: Multi-layer neoprene-nylon cord fabric twin-sphere connectors with flange ends, rated at 150 psig at 220°F. Sizes 1-1/2" to 2-1/2": 6" long, sizes 3" to 6": 9" long, line size.
- E. Temperature and Pressure Test Ports: Peterson Equipment Co. Model 110 "Pete's Plugs" temperature and pressure test capability, brass body, 1/4" NPT fitting, Nordel valve cores, 275°F maximum temperature, 500 psig maximum pressure. Provide with (1) pressure and temperature test kit.

2.10 TOTAL ENERGY HEAT RECOVERY EQUIPMENT (ERV-#)

- A. Shall be RenewAire HE1XINH with capacities and performance as scheduled. The heat recovery equipment shall be a factory assembled and tested package, constructed and rated in accordance with AHRI. System components shall include fan(s), air-to-air heat exchanger, low-leakage dampers, filter sections, non-fused disconnect switches and double-wall, insulated airtight casing with interior sheetmetal liner. The casing shall have 1" thick (minimum) 3.0 pcf fiberglass thermal insulation.
- B. The air-to-air "total energy" heat recovery units shall include a static plate core capable of sensible and latent energy transfer. Rotating wheel exchangers with variable speed drive shall include a purge section and a five (5) year replacement warranty for materials and labor.
- C. Supply and exhaust prefilters shall be 2" thick, 30-35% efficient extended surface pleated media disposable type by Farr, or approved equal. Furnish a total of three (3) complete sets of filters for each filter bank.

- D. Dampers shall be galvanized steel, airfoil blade, or approved equal, "ultra low leak" type with a maximum leakage of 4CFM/sf @ 1.0" w.g. per IECC. Blade seals shall be neoprene and jamb seals shall be compressible aluminum or stainless steel. Motorized backdraft dampers and actuators with end switches shall be provided for the supply and exhaust fans.
- E. Electrical work shall be in accordance with the National Electrical Code (NFPA 70) and shall include motor starters, junction boxes. Provide switches with pilot lights. Wiring shall be in galvanized steel or liquidtight conduit. A single point electrical connection shall be provided.
- F. The heat recovery units shall be started up and their operation verified by an authorized representative of the equipment manufacturer.

2.12 DUCT COILS

- A. Coils: Capacities and pressure drops shall be rated in accordance with ARI 410. Coils shall be pressure tested at 300 psig and shall be suitable for 150 psig service. Coils shall be constructed of copper tubes with aluminum fins and copper headers. Casings shall be 16 gage galvanized steel.

2.13 AUTOMATIC TEMPERATURE CONTROLS

- A. Provide electric/electronic automatic temperature controls to perform the specified sequence of operation.
- B. Sequence of operation:
 - 1. Energy Recovery Units:
 - a. During the occupied mode, the outside air and exhaust air dampers shall be open and the fan shall operate.
 - b. The three way control valve shall modulate to maintain a discharge temperature of 75°F (adjustable) when outside air temperatures are below 65°F.
 - c. During the unoccupied mode, the fans shall be de-energized and the outside air and exhaust air dampers shall be closed.
 - d. Occupied/Unoccupied mode shall be determined by a Grasslin 7-day programmable, digital timeclock.
 - 2. Exhaust fans (EF-1/EF-2) shall operate continuously.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

- A. Inspection:
 - 1. Prior to work of this Section, carefully inspect the installed work of other trades and verify that such work is complete to the point where this installation may properly commence.
 - 2. Verify that the heating system may be installed in accordance with pertinent codes and regulations and the reviewed Submittals.

3.2 INSTALLATION OF PIPING

- A. In general, piping shall be run concealed above ceilings in occupied areas. Piping in other areas may be run exposed. Piping shall not be exposed in occupied spaces unless written authorization is given by the Architect.
- B. Provide and erect in accordance with the best practice of the trade piping shown on the Drawings and as required to complete the intended installation. Make offsets as shown or required to place piping in proper position to avoid other work and to allow the application of insulation and finish painting to the satisfaction of the Architect.
- C. The size and general arrangements, as well as the methods of connecting piping, valves, and equipment, shall be as indicated, or so as to meet the requirements of the Architect.
- D. Piping shall be erected so as to provide for the easy and noiseless passage of heating fluid under working conditions. Inverted eccentric reducing fittings shall be used whenever water pipes reduce in size.
- E. Water mains shall be run level or pitch slightly upward so that no air pockets are formed in the piping. The mains shall be set at elevations such that the runouts feeding equipment shall have no pockets where air can collect except where vents are provided. Provide drains at low points in the piping systems.
- F. High points in water piping shall be provided with manual vents.
- G. In the erection of water piping, make proper allowances for expansion and contraction. Piping shall be anchored as necessary to control expansion. Hot water runouts to units shall be the size as indicated on the Drawings and shall come off the main downward or off the side with a minimum of two 90° elbows provided on runout from main.
- H. Install stop valves and unions to facilitate isolation and removal of equipment. Provide final connections for hydronic specialties furnished under other sections of the Specifications.
- I. Steel piping with screwed connections. Threads on piping shall be full length and clean-cut with inside edges reamed smooth to the full inside bore. Close nipples shall not be used. Pipe threads: standard pipe threads, machine cut and full length. Pipe: reamed to remove burrs and up-ended and rapped to dislodge dirt and scale. Joint compound shall be applied to male thread only. If it is necessary to back off a screwed joint after it is made, the thread shall be cleaned and new compound applied. Caulked threads will not be permitted.
- J. Connections between copper and steel piping shall be made with bronze fittings.
- K. Install thermometer wells for temperature gauges and sensors, projecting a minimum of 2" into the pipe with extension to face of insulation. Piping 1-1/2" and smaller shall be enlarged to 2" where wells are installed. Wells shall be installed in active sections of piping. Fill wells with heat transfer fluid.

- L. Solder joints shall be made with non-lead solder. Clean surfaces to be soldered and use a paste flux. Wash joints with sodium bicarbonate and water to remove corrosive effects of heated solder paste. Hot wipe solder at each fitting.
- M. PVC piping shall have solvent welded joints except at connections to equipment and valves which shall be screwed for sizes 2" and smaller and flanged for sizes 2-1/2" and larger. Solvent welded joints: Pipe ends deburred, and beveled. Pipe end and fitting: Cleaned and dried, primed to soften bonding surfaces. Pipe end: Apply even full layer of solvent cement after priming. Before cement starts to set, insert pipe end into fitting and turn 1/4 turn to evenly distribute cement. Hold joint together until cement sets-up, wipe excess cement off joint.
- N. Pipe penetrations through walls, floors and ceilings shall be in accordance with Section 230500 "Supplemental Mechanical General Requirements". Traverse points of piping shall be escutcheoned with split chrome floor and ceiling plates and spring anchors, where visible to occupancy.
- O. Automatic Air Vents: Shall be installed with a manual isolation valve. The vent discharge shall be piped to a local floor drain.

3.3 PIPE HANGERS

- A. Impact driven studs are not acceptable.
- B. Pipes (copper or steel) shall be supported at intervals and rod sizes as follows, double nuts on hangers and on beam clips.

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

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

Steel Pipe: Not more than 16 ft.

Copper Pipe and Tubing:

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

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

- D. Provide welded steel saddles at each hanger on steel piping systems 4" and larger.
- E. PVC Piping: Supported at 4' intervals.
- F. Spring Isolators: All piping within 20' upstream and downstream of the pumps.

3.4 CLOSING IN WORK

- A. Cover up or enclose work after it has been properly and completely tested and reviewed.
- B. No additional cost to the Owner will be allowed for uncovering or recovering any work that is covered or enclosed prior to required test and review.

3.5 TEST AND ADJUST

- A. Piping Systems: Test with water to a pressure of 75 psi and hold for a period of two hours. Repair any leaks and retest the piping system; repeat process until systems are leak-free. Test piping before it is insulated.
- B. Before operating any system, flush the piping to remove oil and foreign materials.
- C. After the installation is complete and ready for operation, test the system under normal operating conditions in the presence of the Architect and demonstrate that the system functions as designed.
- D. Demonstrate that the HVAC systems have free and noiseless circulation of water, that all air has been purged and that systems are watertight.
- E. Correct defects which develop in operational testing, conduct additional testing until defect free operation is achieved.
- F. Provide balancing and adjusting of terminal devices in accordance with Specification Section 230593.

3.6 CLEANUP AND CORROSION PREVENTION

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

3.7 INSTRUCTIONS

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

3.8 FIRESTOPPING

- A. Firestopping shall be performed in accordance with Specification Section 078400 "Firestopping". All penetrations of fire-rated assemblies including walls and floors by

mechanical system components (piping, ductwork, conduits, etc.) shall be firestopped as specified.

* END OF SECTION *