

SECTION 22 30 00

PLUMBING EQUIPMENT

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes:

1. Booster pumps.
2. Circulating pumps.
3. Sump pump.
4. Packaged water heating systems.
5. Sewage ejector.

B. Related Sections:

1. Division 03 - Cast-In-Place Concrete: Execution requirements for concrete housekeeping pads specified by this section.
2. Division 22 - Common Motor Requirements for Plumbing Equipment: Product requirements for pump motors for placement by this section.
3. Division: 22 - Facility Water Distribution: Supply connections to domestic water heaters.
4. Division 23 - Hangers and Supports for HVAC and Plumbing Piping and Equipment: Product requirements for pipe hangers and supports for placement by this section.
5. Division 23 - Vibration and Seismic Controls for HVAC and Plumbing Piping and Equipment: Product requirements for vibration isolators for placement by this section.
6. Division 23 - Identification for HVAC and Plumbing Piping and Equipment: Product requirements for pipe identification for placement by this section.
7. Division 23 - HVAC and Plumbing Insulation: Field applied insulation for domestic water heaters.
8. Division 23 - Facility Fuel-Oil Piping: Execution requirements for fuel oil piping connections specified by this section.
9. Division 23 - Facility Natural-Gas Piping: Execution requirements for gas piping connections specified by this section.
10. Division 23 - Breechings, Chimneys, and Stacks: Execution requirements for breeching, chimney, and stack connections to water heaters specified in this section.
11. Division 26 - Equipment Wiring Connections: Execution requirements for electric connections specified by this section.
12. Division 31 - Fill: Requirements for backfill to be placed by this section.

1.02 REFERENCES

A. American Society of Heating, Refrigerating and Air-Conditioning Engineers:

1. ASHRAE 90.1 - Energy Standard for Buildings Except Low-Rise Residential Buildings.

B. American Society of Mechanical Engineers:

1. ASME PTC 25 - Pressure Relief Devices.
2. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
3. ASME B16.1 - Cast Iron Pipe Flanges and Flanged Fittings.
4. ASME B16.3 - Malleable Iron Threaded Fittings.
5. ASME B16.18 - Cast Copper Alloy Solder Joint Pressure Fittings.
6. ASME B16.22 - Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.
7. ASME B16.23 - Cast Copper Alloy Solder Joint Drainage Fittings (DWW).

8. ASME B16.26 - Cast Copper Alloy Fittings for Flared Copper Tubes.
 9. ASME B16.29 - Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings - DWV.
 10. ASME B31.9 - Building Services Piping.
 11. ASME B40.1 - Gauges - Pressure Indicating Dial Type - Elastic Element.
 12. ASME Section VIII - Boiler and Pressure Vessel Code - Pressure Vessels.
 13. ASME Section IX - Boiler and Pressure Vessel Code - Welding and Brazing Qualifications.
- C. National Fire Protection Association:
1. NFPA 31 - Standard for the Installation of Oil-Burning Equipment.
 2. NFPA 54 - National Fuel Gas Code.
- D. United States Department of Energy:
1. DOE 10 CFR - Uniform Test Method for Measuring the Energy Consumption of Furnaces.
- E. National Electrical Manufacturers Association:
1. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).

1.03 SUBMITTALS

- A. Division 01 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate heat exchanger dimensions, size of taps, and performance data. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, taps, and drains.
- C. Product Data:
1. Water Heaters: Submit dimensioned drawings of water heaters indicating components and connections to other equipment and piping. Indicate pump type, capacity and power requirements. Submit electrical characteristics and connection locations.
 2. Pumps: Submit pump type, capacity, certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements.
- D. Manufacturer's Installation Instructions: Submit mounting and support requirements.
- E. Manufacturer's Certificate: Certify products meet or exceed specified requirements.
- F. Manufacturer shall provide special seismic certification per OSHPD CAN-2-1708A.5 with submittal. **Submittals without certification will be returned and not reviewed.**

1.04 CLOSEOUT SUBMITTALS

- A. Division 01 - Execution and Closeout Requirements: Closeout procedures.
- B. Project Record Documents: Record actual locations of valves and equipment.
- C. Operation and Maintenance Data: Submit replacement part numbers and availability.

1.05 QUALITY ASSURANCE

- A. Conform to ASME Section VIII for construction of water heaters, heat exchangers. Provide boilers registered with National Board of Boiler and Pressure Vessel Inspectors.

- B. Water Heater Performance Requirements: Equipment efficiency not less than prescribed by ASHRAE 90.1 when tested in accordance with DOE 10 CFR, ANSI Z21.10.1, ANSI Z21.10.3.

1.06 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of Project.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.07 PRE-INSTALLATION MEETINGS

- A. Division 01 - Administrative Requirements: Pre-installation meeting.
- B. Convene minimum one week prior to commencing work of this section.

1.08 DELIVERY, STORAGE, AND HANDLING

- A. Division 01 - Product Requirements: Products storage and handling requirements.
- B. Accept valves and equipment on site in shipping containers with labeling in place. Inspect for damage.
- C. Provide temporary protective coating on cast iron and steel valves.
- D. Provide temporary end caps and closures on piping and fittings. Maintain in place until installation.
- E. Protect piping systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.09 FIELD MEASUREMENTS

- A. Verify field measurements prior to fabrication.

1.10 WARRANTY

- A. Division 01 - Execution and Closeout Requirements: Product warranties and product bonds.
- B. Furnish five year manufacturer warranty for equipment packaged systems.

1.11 EXTRA MATERIALS

- A. Division 01 - Execution and Closeout Requirements: Spare parts and maintenance products.
- B. Furnish two service kits, pump seals, filters and replacement parts.

PART 2 PRODUCTS

2.01 DOMESTIC WATER HEAT EXCHANGERS

- A. Manufacturers:
 - 1. PVI
 - 2. Patterson-Kelley Co.
 - 3. A.O. Smith
 - 4. Bell & Gossett
- B. Tubes: U-tube type with seamless copper tubes suitable for 125 psi working pressure.
- C. Heads: Steel with brass tube sheets, threaded or flanged for piping connections.
- D. Water Chamber and Tube Bundle: Removable for inspection and cleaning.
- E. Code: ASME Section VIII for service pressures, ASME "U" symbol stamped on heat exchanger.
- F. Shell and Tube Type: Steel shell, coated with electroless nickel, with threaded or flanged piping connections and necessary taps, steel saddle and attaching U-bolts, designed for heating fluid in shell and heated fluid in tubes.
- G. Accessories:
 - 1. Wells for temperature regulator sensor and high limit sensor at water outlet.
 - 2. ASME rated pressure and temperature relief valve on water outlet.
 - 3. ASME rated pressure relief valves from tapping on heated waterside, set at 120 psig.
 - 4. ASME rated pressure relief valve on steam inlet on downstream side of control valve.
 - 5. Thermometers and pressure gage taps in water inlet and outlet.
 - 6. Vacuum breaker and pressure gauge taps with pigtail siphon in shell.

2.02 IN-LINE CIRCULATOR PUMPS

- A. Manufacturers:
 - 1. B&G
 - 2. Grunfos
- B. Casing: Bronze rated for 125 psig working pressure with stainless steel rotor assembly.
- C. Impeller: Bronze.
- D. Shaft: Alloy steel with integral thrust collar and two, oil lubricated bronze sleeve bearings.
- E. Seal: Carbon rotating against stationary ceramic seat.
- F. Drive: Flexible coupling.

2.03 DUPLEX SUBMERSIBLE SEWAGE PUMPS

- A. Manufacturers:
 - 1. Weil
 - 2. Peerless

3. HOMA
- B. Submersible pumps:
1. Pump casing, impeller, end bell and motor shell: ASTM A48 Class 40 cast iron.
 2. Impeller: Single vane non-clog type, solid capacity as scheduled.
 3. Volute wear ring: Non-sparking bronze, ASTM B144.
 4. Upper and lower mechanical seals shall be solid silicon carbide against silicon carbide, operating in biodegradable oil.
 5. Motor:
 - a. Four pole, Class F insulation, NEMA Design B continuous duty, sealed single row upper and double row lower heavy-duty ball bearings, solid AISI 430F stainless steel shaft, thermal sensors imbedded in motor windings.
 - b. Air-filled, Class F insulation, NEMA Design B continuous duty, sealed upper and lower heavy-duty ball bearings, solid AISI 430F stainless steel shaft, thermal sensors imbedded in motor windings.
 - c. Motors that depend on oil for both cooling and lubricating will not be considered equal or acceptable.
 6. Seal: Lower seals to be solid silicon carbide against silicon carbide, with moisture detection probes.
 7. Cutter assembly:
 - a. Adjustable bottom plate with stationary cutter disk.
 - b. Rotating cutter blade.
 - c. Cutter parts AISI 440C stainless steel, alloyed with cobalt, vanadium, and molybdenum, hardened to 55 Rockwell C minimum.
- C. Guide Rail System:
1. Auto coupling system.
 2. Cast iron stationary discharge and sliding fittings.
 3. Stainless steel lifting cable and all fittings.
 4. Provide Schedule 40 stainless steel pipe for guide rails as specified by the manufacturer.
- D. Basin, Cover:
1. Pump basin shall be constructed of heavy duty fiberglass, manufactured to National Bureau of Standards PS-15-69 and ASTM-D-4097 requirements; diameter and depth as required to complete the work.
 2. Reinforce for high water table (if required).
 3. Cover: Gastight, steel, pedestrian traffic weight, with flush-mounted hinged access opening.
- E. Pilot controls: Four UL listed tethered float switches complete with switch mounting plate.
- F. Control panel:
1. Factory pre-wired and tested.
 2. UL listed and UL 508a labeled.
 3. NEMA 1 enclosure.
 4. All operators shall be mounted on the inner panel door.
 5. Fused disconnect switches with lockout handles through door, magnetic starters, through-the-door reset buttons.
 6. Automatic thermal protection, Test-Off-Automatic selector switches, pump running lights, electric alternator.
 7. Contacts for remote alarm panel.

- G. Alarm Panel:
1. Weil 8301 "Fail-Safe", NEMA 1, with three flashing indicating lights, three reset buttons, lamp test button, audible alarm, silencing switch, and auxiliary dry contacts.
 2. Alarm to sound under any of the following (and subsequent) conditions:
 3. Power failure to the pump control panel.
 4. High water condition.
 5. Simultaneous two pump operation or failure of either pump.
 6. Subsequent alarms shall sound even if silenced.
 7. Provide dedicated 115 VAC circuit.
- H. Installation: Basin to be cleaned thoroughly, with all water and debris removed prior to installing pumps. Electrical contractor to provide separate conduit for control cables.

2.04 DUPLEX SUBMERSIBLE SUMP PUMPS

- A. Manufacturers:
1. Weil
 2. Peerless
 3. HOMA
- B. Submersible Pumps:
1. Cast iron impeller, pump casing, end bell and motor shell.
 2. Motor:
 - a. Air-filled, four pole, Class F insulation, sealed grease-lubricated upper and lower heavy-duty ball bearings.
 - b. Solid AISI 304 stainless steel shaft.
- C. Guide Rail System:
1. Cast iron stationary and movable discharge fittings, stainless steel lifting cables and all fittings.
 2. Steel base plate, with stainless steel studs and nuts.
 3. Provide schedule 40 stainless steel pipe for guide rails.
- D. Basin:
1. Pump basin shall be constructed of heavy duty fiberglass, manufactured to National Bureau of Standards PS-15-69 and ASTM-D-4097 requirements; diameter and depth as indicated.
 2. Reinforce for high water table (if required).
 3. Cover: Gastight, steel, pedestrian traffic weight, with flush-mounted hinged access opening.
 4. Provision for mounting upper guide rail brackets.
- E. Pilot controls: Four UL listed non-mercury float switches complete with switch mounting plate.
- F. Control panel:
1. NEMA 1, UL 508 listed, with disconnects (with interlocks through panel door), starters and resets, TOA switches, alternator, contacts for remote alarm panel, and running lights.
 2. All switches, warning lights, resets, etc. shall be mounted on the inner panel door.
 3. Contacts for remote alarm panel.

- G. Alarm Panel:
1. "Fail-Safe", NEMA 1, with three flashing indicating lights, three reset buttons, lamp test button, audible alarm, silencing switch, and auxiliary dry contacts.
 2. Alarm to sound under any of the following (and subsequent) conditions:
 - a. Power failure to the pump control panel.
 - b. High water condition.
 - c. Simultaneous two pump operation or failure of either pump.
 3. Subsequent alarms shall sound even if silenced.
 4. Provide dedicated 115 VAC circuit.

- H. Installation:
1. Basin to be cleaned thoroughly, with all water and debris removed prior to installing pumps.
 2. Coordinate location and wiring of alarm panel with electrician.
 3. Electrical contractor to provide separate conduit for power cables.

2.05 PRESSURE BOOSTER SYSTEMS

- A. Manufacturers:
1. Weil
 2. Grunfos
 3. Peerless
- B. System: Packaged with multiple pumps, factory assembled, tested, and adjusted; shipped to site as integral unit; consisting of pumps, valves, and galvanized piping, with control panel assembled on fabricated steel base with structural steel framework.
- C. Controls and Instruments: Locate in NEMA 250 Type 1, general-purpose enclosure with main disconnecting switch interlocked with door.
1. Furnish for each motor, fused circuit, magnetic starter with overloads, control circuit transformer with fuse protection and selector switch for each pump.
 2. Furnish low limit pressure switch, low pressure alarm indicator, running indicator, current sensing devices, minimum run timers, manual alternation, and suction and discharge pressure gages.
- D. System:
1. Factory assembled and flow tested, NFS 61 compliant, variable speed, constant pressure water booster system.
 2. The packaged water booster pump system shall be a standard product of a single pump manufacturer.
 3. The complete packaged water booster pump system shall be certified and listed by UL for conformance to U.S. and Canadian Standards. Systems that have only the sub-assemblies certified and listed by UL, and/or UR and/or cUR recognized components will not be considered equal.
 4. All components shall be suitable for the maximum working pressure of the pump shutoff head plus maximum anticipated suction pressure.
- E. Pumps:
1. Vertical multistage diffuser type.
 2. Pumps shall be certified to ANSI/NSF Standard 61 for drinking water system components.

3. Impellers, pump shaft, diffuser chambers, outer discharge sleeve, impeller seal rings, and seal ring retainers shall be constructed of stainless steel
4. Pump suction/discharge chamber, motor stool, and pump shaft couplings shall be constructed of cast iron.
5. Single silicon carbide mechanical shaft seal shall be of the cartridge design so that the seal may be replaced without removing motor.
6. Shaft journal and chamber bearings shall be tungsten carbide and bronze.

F. Motors:

1. Each motor shall be of the Integrated Variable Frequency Drive design consisting of a motor and a Variable Frequency Drive (VFD) built and tested as one unit by the same manufacturer.
2. The VFD shall be of the PWM (Pulse Width Modulation) design using current IGBT (Insulated Gate Bipolar Transistor) technology.
3. The VFD shall convert incoming fixed frequency three-phase AC power into a variable frequency and voltage for controlling the speed of motor. The motor current shall closely approximate a sine wave. Motor voltage shall be varied with frequency to maintain desired motor magnetization current suitable for centrifugal pump control and to eliminate the need for motor de-rating.
4. The VFD shall have a minimum of two skip frequency bands which can be field adjustable.
5. The VFD shall have internal solid-state overload protection designed to trip within the range of 125-150% of rated current.
6. The integrated VFD motor shall include protection against input transients, phase imbalance, loss of AC line phase, over-voltage, under-voltage, VFD over-temperature, and motor over-temperature.
7. The integrated VFD motor shall have, as a minimum, the following input/output capabilities:
 - a. Speed Reference Signal: 0-10 VDC, 4-20mA
 - b. Digital remote on/off
 - c. Fault Signal Relay (NC or NO)
8. The motor shall be Totally Enclosed Fan Cooled (TEFC) with a standard NEMA C-Face, Class F insulation with a Class B temperature rise.
9. Motor drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump at full rated speed.

G. System Controller:

1. The pump system controller shall be a standard product developed and supported by the pump manufacturer.
2. The controller shall be microprocessor based. The controller user interface shall have a large display, minimum of 3-1/2" x 4-5/8", for easily viewing of system status parameters and for field programming of controller. Password protection of system settings shall be standard.
3. The controller shall display the following as status readings from single display on the controller:
 - a. Current value of the control parameter, (usually discharge pressure).
 - b. Latest current alarm, if any.
 - c. System status with current operating mode and current value of control parameter.
 - d. Status of all pumps with current operating mode and speed of pumps as percentage (%).
4. Pump system programming (field adjustable) shall include as a minimum the following:
 - a. Qty (7) closed loop programmable setpoints (usually Constant Pressure setpoints)
 - b. Qty (7) open loop programmable setpoints
 - c. Pressure Transducer supply/range
 - d. System time (reaction)
 - e. Backup pump designation
 - f. High system pressure shut-down
 - g. Low suction pressure shutdown
 - h. Low system pressure shutdown
 - i. Ethernet connection for field programming from a remote location

5. The system pressure set-point shall be capable of being automatically adjusted by using up to two external set-point influences in conjunction.
6. The system shall include an "Influence Function". Influence function allows user ability to determine relationship between the measuring parameter which is to influence the set-point and the desired influence as a percentage.
7. The controller shall be capable of receiving a remote analog set-point (4-20mA or 0-10 VDC) as well as a remote on/off (digital) signals.
8. The pump system controller shall store up to 24 warning and alarms in memory. The time, date and duration of each alarm shall be recorded. A potential-free relay shall be provided for alarm notification to the building management system. The controller shall display the following alarm conditions:
 - a. High System Pressure
 - b. Low system pressure
 - c. Low suction pressure
 - d. Individual pump failure
 - e. VFD trip/failure
 - f. Loss of sensor signal (4-20 mA)
 - g. Loss of remote set-point signal (4-20mA)
 - h. System power loss
9. The pump system controller shall be mounted in a NEMA 4 enclosure (NEMA 3R if cooling fan is required). The entire control panel shall be UL 508 listed as an assembly. The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit and control relays for alarm functions.
10. Control panel options shall include, but not be limited to:
 - a. Pump Run Lights
 - b. Pump Alarm Lights
 - c. System Fault Light
 - d. Audible Alarm (80 db[A])
 - e. Surge Arrestor
 - f. Control Panel Internal Illumination
 - g. Emergency/Normal Operation Switches
 - h. Service Disconnect Switches
11. The controller shall be capable of using a redundant primary sensor to function as backup sensor to primary sensor.
12. The controller shall have a "Test Run" feature with settings of once every 24 hours, 48 hours or once a week for cycling pumps in periods of inactivity.
13. The controller shall be capable of providing power consumption and energy consumption information when used with integrated VFD motors connected through the field bus.
14. The controller shall be capable of providing a calculated flow rate.

H. Sequence of Operation:

1. The system controller shall operate equal capacity variable speed pumps to maintain a constant discharge pressure (system set-point). The system controller shall receive an analog signal [4-20mA] from the factory installed pressure transducer on the discharge manifold, indicating the actual system pressure. As flow demand increases the pump speed shall be increased to maintain the system set-point pressure. When the operating pump(s) reach 96% of full speed (adjustable), an additional pump will be started and will increase speed until the system set-point is achieved. All pumps in operation will be running at the same speed to maintain the system set-point. As flow demand decreases the pump speed shall be reduced while system set-point pressure is maintained. When all pumps in operation are running at low speed the system controller shall switch off pumps when fewer pumps are able to maintain system demand.
2. If a no flow shut-down is required (periods of zero demand) a bladder type diaphragm tank shall be installed. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When zero flow is detected by the system controller, the remaining pump(s) shall

be switched off. When the system pressure falls to 50% of ON/OFF band below the system set-point (flow begins after shut-down), a pump shall be switched on, increasing speed to maintain the system set-point pressure.

I. Factory assembly:

1. The entire packaged pumping system shall be mounted on a 304 stainless steel fabricated skid.
2. Type 316 stainless steel discharge and suction headers, designed to attach to the system piping at either end of the manifold.
3. Each manifold shall include a liquid-filled pressure gauge.
4. Isolation valves shall be installed on the suction and discharge of each pump.
5. A check valve shall be installed on the discharge of each pump.
6. Manifold velocity at maximum system flow shall not exceed 7.5 fps.

J. Testing and Warranty:

1. All systems shall be factory flow tested for performance and hydrostatic tested to 300 psi.
2. Provide a written guarantee covering all the equipment as well as the system performance for one year from date of start-up.
3. Factory trained engineer shall be provided for start-up and instruction of maintenance personnel.

K. Hydropneumatic tank:

1. The system shall include an ASME pressure tank rated for 150 PSIG working pressure, with NSF approved bladder, sized by the manufacturer.
2. Tank must be charged at the jobsite to a pressure equal to "system" pressure.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Maintain manufacturer's recommended clearances around and over plumbing equipment.
- B. Install plumbing equipment on concrete housekeeping pad, minimum 4 inches high and 12 inches larger than equipment base on each side. Refer to Division 03.
- C. Connect all plumbing service, including steam and condensate.
- D. Install the following piping accessories. Refer to Division 22.
 1. On supply:
 - a. Thermometer well and thermometer.
 - b. Strainer.
 - c. Pressure gage.
 - d. Shutoff valve.
 2. On return:
 - a. Thermometer well and thermometer.
 - b. Pressure gage.
 - c. Shutoff valve.

- E. Domestic Water Heat Exchangers:
1. Install domestic water heat exchangers with clearance for tube bundle removal without disturbing other installed equipment or piping.
 2. Seismically support unit.
 3. Pipe relief valves and drains to nearest floor drain.
 4. Connect steam branch line from top of main. Pipe in flexible manner, pitched with steam flow, with pipe union connections. Install steam pressure gauge at exchanger inlet.
 5. Install steam traps and valves.
 6. Pitch shell for condensate-drain to traps.
- F. Pumps
1. Provide pumps to operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
 2. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump so no weight is carried on pump casings. For close coupled or base mounted pumps, install supports under elbows on pump suction and discharge line sizes 4 inches and over.
 3. Install pumps on vibration isolators. Refer to Division 21.
 4. Install flexible connectors at or near pumps where piping configuration does not absorb vibration. Refer to Division 23.
 5. Provide line sized shut-off valve, strainer and pump suction fitting on pump suction, and line sized soft seat check valve, balancing valve, and shut-off valve, combination pump discharge valve on pump discharge. Refer to Division 23.
 6. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump so no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and larger.
 7. Provide air cock and drain connection on horizontal pump casings.
 8. Provide drains for bases and seals.
 9. Check, align, and certify alignment of base mounted pumps prior to start-up.
 10. Install close coupled and base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place. Refer to Division 03.
 11. Lubricate pumps before start-up.
- G. Install discharge piping from relief valves and drain valves to nearest floor drain.
- H. Install circulator and diaphragm expansion tank on water heater.
- I. Install equipment trim and accessories furnished loose for field mounting.
- J. Install electrical devices furnished loose for field mounting.
- K. Install control wiring between equipment control panel and field mounted control devices.
- L. Connect flue to water heater outlet, full size of outlet. Refer to Division 23.

END OF SECTION