

**SECTION 22 3000
PLUMBING EQUIPMENT**

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Water Heaters:
 - 1. Commercial gas fired.
 - 2. Commercial electric.
- B. Packaged water heating systems.
- C. Domestic water heat exchangers.
- D. Domestic hot water storage tanks.
- E. Diaphragm-type compression tanks.
- F. Water softeners.
- G. Reverse osmosis equipment.
- H. In-line circulator pumps.
- I. Pressure booster systems.
- J. Sump pumps.
- K. Sewage ejectors.
- L. Cooling condensate removal pumps.
- M. Sanitary Sewage Pumps:
 - 1. Centrifugal solids handling.

1.02 RELATED REQUIREMENTS

- A. Section 26 0583 - Wiring Connections: Electrical characteristics and wiring connections.

1.03 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015.
- B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings 2014.
- C. ANSI Z21.10.1 - Gas Water Heaters - Volume I - Storage Water Heaters with Input Ratings of 75,000 Btu per Hour or Less 2011.
- D. ASME BPVC-VIII-1 - Boiler and Pressure Vessel Code, Section VIII, Division 1 - Rules for Construction of Pressure Vessels 2015.
- E. ICC (IPC) - International Plumbing Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2014.
- G. UL 174 - Standard for Household Electric Storage Tank Water Heaters Current Edition, Including All Revisions.
- H. UL 778 - Standard for Motor-Operated Water Pumps Current Edition, Including All Revisions.

1.04 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Conduct a preinstallation meeting one week prior to the start of the work of this section; require attendance by all affected installers.

1.05 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittals procedures.
- B. Product Data:
 - 1. Provide dimension drawings of water heaters indicating components and connections to other equipment and piping.
 - 2. Indicate pump type, capacity, power requirements.

3. Provide certified pump curves showing pump performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable.
 4. Provide electrical characteristics and connection requirements.
- C. Shop Drawings:
1. Indicate heat exchanger dimensions, size of tapings, and performance data.
 2. Indicate dimensions of tanks, tank lining methods, anchors, attachments, lifting points, tapings, and drains.
- D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.
- F. Project Record Documents: Record actual locations of components.
- G. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.

1.06 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Certifications:
1. Water Heaters: NSF approved.
 2. Gas Water Heaters: Certified by CSA International to ANSI Z21.10.1, as applicable, in addition to requirements specified elsewhere.
 3. Electric Water Heaters: UL listed and labeled to UL 174.
 4. Pressure Vessels for Heat Exchangers: ASME labeled to ASME BPVC-VIII-1.
 5. Water Tanks: ASME labeled to ASME BPVC-VIII-1.
 6. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.
- D. Performance: Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, operate within 25 percent of midpoint of published maximum efficiency curve.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. Provide temporary inlet and outlet caps. Maintain caps in place until installation.

1.08 WARRANTY

- A. See Section 01 7800 - Closeout Submittals, for additional warranty requirements.
- B. Provide five year manufacturer warranty for domestic water heaters.

PART 2 PRODUCTS

2.01 WATER HEATERS

- A. Manufacturers:
1. A.O. Smith Water Products Co; [____]: www.hotwater.com/#sle.
 2. Bock Water Heaters, Inc; [____]: www.bockwaterheaters.com/#sle.
 3. Rheem Manufacturing Company; [____]: www.rheem.com/#sle.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Commercial Gas Fired:
1. Type: Automatic, natural gas-fired, vertical storage.
 2. Performance:
 - a. Energy Factor: [____].
 - b. Storage Capacity: [____] gal.
 - c. First Hour Rating: [____] gal.

- d. Input: [] Btuh at sea level.
 - e. Minimum Recovery Rate: [] gph with 100 degrees F temperature rise.
 - f. Maximum Working Pressure: 150 psig.
3. Tank: Glass lined welded steel ASME labeled; multiple flue passages, 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber, encased in corrosion-resistant steel jacket; baked-on enamel finish; floor shield and legs.
 4. Accessories:
 - a. Water Connections: Brass.
 - b. Dip Tube: Brass.
 - c. Drain valve.
 - d. Anode: Magnesium.
 - e. Temperature and Pressure Relief Valve: ASME labeled.
 5. Certified For The Following Applications:
 - a. Automatic storage water heater.
 - b. Automatic circulating tank water heater.
 - c. For operation at 180 degrees F.
 - d. For operation on combustible floors.
 6. Controls: Automatic water thermostat with temperature range adjustable from 120 to 180 degrees F, automatic reset high temperature limiting thermostat factory set at 195 degrees F, gas pressure regulator, multi-ribbon or tubular burner, 100 percent safety shut-off pilot and thermocouple, flue baffle and draft hood.
- C. Commercial Electric:
1. Type: Factory-assembled and wired, electric, vertical storage.
 2. Performance:
 - a. Energy Factor: [].
 - b. Storage Capacity: [] gal.
 - c. First Hour Rating: [] gal.
 - d. Heating Element Size: [] kW.
 - e. Number of Heating Elements: [].
 - f. Minimum Recovery Rate: [] gph with 100 degrees F temperature rise.
 - g. Maximum Working Pressure: 150 psig.
 3. Electrical Characteristics:
 - a. 208 volts, three phase, 60 Hz.
 - b. [] amperes maximum fuse size.
 4. Tank: Glass lined welded steel; 4 inch diameter inspection port, thermally insulated with minimum 2 inches glass fiber encased in corrosion-resistant steel jacket; baked-on enamel finish.
 5. Controls: Automatic immersion water thermostat; externally adjustable temperature range from 60 to 180 degrees F, flanged or screw-in nichrome elements, high temperature limit thermostat.
 6. Accessories:
 - a. Water Connections: Brass.
 - b. Dip Tube: Brass.
 - c. Drain valve.
 - d. Anode: Magnesium.
 - e. Temperature and Pressure Relief Valve: ASME labeled.
 7. Controls: Ventilated control cabinet, factory-wired with solid state progressive sequencing step controller, fuses, magnetic contactors, control transformer, pilot lights indicating main power and heating steps, control circuit toggle switch, electronic low-water (probe-type) cut-off, high temperature limit thermostat, flush-mounted temperature and pressure gauges.
 8. Heating Elements: Flange-mounted immersion elements; individual elements sheathed with Incoloy corrosion-resistant metal alloy, rated less than 75 W/sq in.

2.02 PACKAGED WATER HEATING SYSTEMS

- A. Manufacturers:
 - 1. Bell & Gossett, a xylem brand; [_____]: www.bellgossett.com/#sle.
 - 2. Lochinvar LLC; [_____]: www.lochinvar.com/#sle.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. System: Gas-fired direct heating boiler, circulating pump, controls, piping and valving as indicated, storage tank, all mounted on structural steel skid.
- C. Boiler:
 - 1. Type: Gas-fired water tube boiler, with copper finned tube heat exchanger, steel jacket with glass fiber insulation.
 - 2. Boiler Trim: Gas burner, thermometer and pressure gauge, immersion thermostats for operating and high limit protection, 100 percent safety shut-off electric gas valve with transformer, electronic safety pilot and pilot burner, gas pressure regulator, manual gas shut-off, low water cut off, ASME rated temperature and pressure relief valve, coil relief valve, automatic boiler fill and expansion tank, draft inverter.
 - 3. Performance:
- D. Vertical storage tank:
 - 1. Working Pressure: 150 psi ASME labeled.
 - 2. Lining: 15 mils thick epoxy lining extended through flanges and couplings.
 - 3. Support: Two welded tank saddles not less than 4 inches wide by 1/4 inch thick, mounted on 2 inch pipe stand with minimum four cross braced legs; sheet teflon isolation strip between tank and saddle; brass unions shall be used to make connection between tank and piping system. A valve shall be installed upstream of the union.
 - 4. Insulation: 3 inch glass fiber insulation with steel jacket.
- E. Pump:
 - 1. Type: All bronze, in-line circulation pump mounted on boiler, controlled by tank mounted immersion thermostat.
- F. Thermostatic Valve: Three-way, self-contained, full line size, bronze body 1/2 to 2 inches size, iron body 2-1/2 inches and over, set at 140 degrees F.

2.03 DOMESTIC WATER HEAT EXCHANGERS

- A. Manufacturers:
 - 1. Armstrong Fluid Technology; [_____]: www.armstrongfluidtechnology.com/#sle.
 - 2. Bell & Gossett, a xylem brand; [_____]: www.bellgossett.com/#sle.
- B. Type: Double wall type that separates the potable water from the heat transfer medium with a space vented to the atmosphere in accordance with ICC IPC.
- C. Tubes: U-tube type with 3/4 inch diameter seamless copper tubes suitable for 125 psi working pressure.
- D. Heads: Cast iron or steel, with steel tube sheets, threaded or flanged for piping connections.
- E. Water Chamber and Tube Bundle: Removable for inspection and cleaning.
- F. Coating: Prime coat exterior.
- G. Code: ASME BPVC-VIII-1 for service pressures, ASME "U" symbol stamped on heat exchanger.
- H. Shell and Tube Type: Steel shell, with threaded or flanged piping connections and necessary tapings, steel saddle and attaching U-bolts, designed for heating fluid in shell and heated fluid in tubes.
- I. 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 water side, set at 120 psig.
 - 4. ASME rated pressure relief valve on steam inlet on downstream side of control valve.

5. Thermometers and pressure gauge tapings in water inlet and outlet.
6. Vacuum breaker and pressure gauge tapping with pigtail siphon in shell.

2.04 DOMESTIC HOT WATER STORAGE TANKS

- A. Manufacturers:
 1. A.O. Smith Water Products Co; [____]: www.hotwater.com/#sle.
 2. Bock Water Heaters, Inc; [____]: www.bockwaterheaters.com/#sle.
 3. Wessels Company; [____]: www.westank.com/#sle.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Tank: Welded steel, ASME labeled for working pressure of 125 psig, steel support saddles, tapings for accessories, threaded connections of stainless steel, access manhole.
- C. Lining: 0.024 inches self-priming polymer epoxy continued into flanged connections.
- D. Openings: Up to 3 inches, copper-silicone threaded; over 4 inches, flanged; flanged collar for heat exchanger; manway fitting.
- E. Accessories: Tank drain, water inlet and outlet, thermometer range of 40 to 200 degrees F, ASME pressure relief valve suitable for maximum working pressure.

2.05 DIAPHRAGM-TYPE COMPRESSION TANKS

- A. Manufacturers:
 1. Amtrol Inc; [____]: www.amtrol.com/#sle.
 2. Bell & Gossett, a xylem brand; [____]: www.bellgossett.com/#sle.
 3. Taco, Inc; [____]: www.taco-hvac.com/#sle.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Construction: Welded steel, tested and stamped in accordance with ASME BPVC-VIII-1; supplied with National Board Form U-1, rated for working pressure of 125 psig, with flexible EPDM diaphragm sealed into tank, and steel legs or saddles.
- C. Accessories: Pressure gauge and air-charging fitting, tank drain; precharge to 12 psig.
- D. Size: [____] inches diameter, [____] inches overall length, [____] gal capacity.

2.06 WATER SOFTENERS

- A. Manufacturers:
 1. Aquapure, 3M Purification, Inc; [____]: www.aquapure.com/#sle.
 2. Culligan International Company; [____]: www.culligan.com/#sle.
 3. Sterling Water Treatment; [____]: www.sterlingtonwatertreatment.com/#sle.
- B. Performance:
 1. Softening Capacity: [____] grains.
 2. Service Flow: [____] gpm.
 3. Electrical Characteristics:
 - a. [____] rated load amperes.
 - b. [____] volts, single phase, 60 Hz, [____] minimum circuit ampacity.
- C. Softener Tank:
 1. Glassfiber reinforced plastic tank.
- D. Brine Tank:
 1. Glassfiber reinforced plastic tank.
- E. Microprocessor Based Control: Brass control valve cycled to regenerate from one to twelve day period.
- F. Cold water in patient care facilities is not to be treated with water softeners.

2.07 REVERSE OSMOSIS EQUIPMENT

- A. Manufacturers:
 1. Culligan International Company; [____]: www.culligan.com/#sle.
 2. Marlo Incorporated; [____]: www.marlo-inc.com/#sle.

3. Siemens AG; [____]: www.water.siemens.com/#sle.
4. Substitutions: See Section 01 6000 - Product Requirements.

B. Performance and Design Requirements:

1. Influent Water Analysis:
 - a. Barium: [____] ppm.
 - b. Bicarbonate: [____] ppm.
 - c. Calcium: [____] ppm.
 - d. Carbonate: [____] ppm.
 - e. Chloride: [____] ppm.
 - f. Chlorine (Total): [____] ppm.
 - g. Color: [_____].
 - h. Fluoride: [____] ppm.
 - i. Iron: [____] ppm.
 - j. Magnesium: [____] ppm.
 - k. Manganese: [____] ppm.
 - l. Nitrate: [____] ppm.
 - m. pH: [_____].
 - n. Potassium: [____] ppm.
 - o. Silica: [____] ppm.
 - p. Silt Density Index (SDI): [_____].
 - q. Sodium: [____] ppm.
 - r. Strontium: [____] ppm.
 - s. Sulfate: [____] ppm.
 - t. Temperature: [____] degrees F.
 - u. Total Dissolved Solids (TDS): [____] ppm.
 - v. Total Hardness: [____] ppm.
 - w. Turbidity: [_____] NTU.
 - x. Water Quality: [____] ppm TDS.
2. Design Constraints:
 - a. Nominal Capacity: [____] gpd.
 - b. Recovery: [_____] percent.
 - c. Daily Water Usage: [____] gpd.
 - d. Daily Hours of Water Demand: [_____].
 - e. Motor hp: [_____].
 - f. Operating Temperature Range: [____] degrees F.
 - g. Maximum Pump Operating Pressure: [____] psi.
 - h. Pump Flow: [____] gpm.
 - i. Dynamic Inlet Pressure:
 - 1) Maximum Pressure: [____] psi.
 - 2) Minimum Pressure: [____] psi.
 - j. Electrical Requirements: [_____] volts, [_____] phase, 60 Hz.
 - k. Daily Hours of Water Demand: [_____].
 - l. Overall Size & Weight/Mass:
 - 1) Length: [____] inch, maximum.
 - 2) Width: [____] inch, maximum.
 - 3) Height: [____] inch, maximum.
 - 4) Weight/Mass: [____] pounds, maximum.
3. Effluent Water Quality: [____] ppm TDS.

C. Piping, Equipment, and Controls: Factory mounted on steel frame.

1. Pre-filter Assembly: [_____].
2. Pump: [_____].
3. Module Assembly: [_____].
4. Plumbing Valves and Specialties:

- a. Water Supply Line: [_____].
 - b. Waste Line: [_____].
 - c. Concentrate Return Line: [_____].
 - d. Operating Pressures: [_____].
 - e. Rate of Product and Waste Flow: [_____].
5. Hydraulic Connections:
- a. Pre-filter Inlet: [_____] inch.
 - b. Product Water: [_____] inch.
 - c. Concentrate Water: [_____] inch.
6. Electric Controls: [_____].
7. Safety Shutdown Controls: [_____].
8. Electronic Controls: [_____].
9. Electronic Controller: [_____].
- a. Indicated data via integral LED display.
 - 1) TDS flow.
 - 2) Feed and product flow.
 - 3) Totalized product flow.
 - 4) Pumping time.
 - 5) Percent recovery.
 - 6) Operational modes.
 - 7) Error occurrence and description via keypad.
 - b. Provide a connection allowing the use of an external monitoring device for USB, RS232, or RS485 protocols.
 - c. Include provisions for installation of modem, telemetry service allowing the unit to record daily operating conditions, immediate email notification on system shut-down on any alarm condition, and [_____].
10. TDS Monitor:
- a. Remote Display: Allows user to view operation status and conditions of RO unit up to 200 ft.
 - b. Provide TDS monitor to track product water quality to service.

2.08 IN-LINE CIRCULATOR PUMPS

- A. Manufacturers:
- 1. Armstrong Fluid Technology; [_____]: www.armstrongfluidtechnology.com/#sle.
 - 2. Bell & Gossett, a xylem brand; [_____]: www.bellgossett.com/#sle.
 - 3. Wilo USA; www.wilo-usa.com
 - 4. Substitutions: See Section 01 6000 - Product Requirements.
- 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 a stationary ceramic seat.
- F. Drive: Flexible coupling.
- G. Performance:
- 1. Flow: [_____] gpm, at [_____] feet head.
 - 2. Electrical Characteristics:
 - a. [_____] hp.
 - b. [_____] volts, single phase, 60 Hz, [_____] minimum circuit ampacity.

2.09 PRESSURE BOOSTER SYSTEMS

- A. Manufacturers:
- 1. Armstrong Fluid Technology; [_____]: www.armstrongfluidtechnology.com/#sle.
 - 2. Bell & Gossett, a xylem brand; [_____]: www.bellgossett.com/#sle.
 - 3. Wilo USA; wilo-usa.com

4. Substitutions: See Section 01 6000 - Product Requirements.
- B. System: Packaged with two pumps, factory assembled, tested, and adjusted; shipped to site as integral unit; consisting of pumps, valves, and copper 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 disconnect interlocked with door, fused circuit for each motor, magnetic starters with three overloads, control circuit transformer with fuse protection, selector switch for each pump, low limit pressure switch, low pressure alarm light, running lights, current sensing devices, minimum run timers, manual alternation, and suction and discharge pressure gauges.
- D. Lead Pump: Operate continuously with lag pump operating on system demand. Should lead pump fail to operate, next pump in sequence shall start automatically.
- E. Time Delay Relay: Prevent lag pump short cycling on fluctuating demands.
- F. Thermal Bleed Circuit with Solenoid Valve: Prevent overheating during low demand.
- G. Low Pressure Control: Stop pump operation if incoming water pressure drops to atmospheric.
- H. Pump Switch: Permit manual or automatic operation.
- I. Valving: Each pump outlet combination pressure reducing and check valve to maintain constant system pressure. Provide gate or butterfly valves on suction and discharge of each pump. Provide check valve on each pump discharge.
- J. Time Clock for Automatic Day-Night Changeover:
 1. Day cycle: System shall operate continuously with pressure to fixtures maintained by pressure reducing valves.
 2. Night Cycle: Pump shall operate intermittently on pressure switch located near pressure tank operating pump for pre-determined adjustable time period.
- K. Performance:
 1. Flow: [] gpm, at [] feet head.
 2. Motors: [] hp.
 3. Electrical Characteristics:
 - a. [] volts, single phase, 60 Hz, [] minimum circuit ampacity.
 - b. [] amperes maximum fuse size.

2.10 SUMP PUMPS

- A. Manufacturers:
 1. Armstrong Fluid Technology; []: www.armstrongfluidtechnology.com/#sle.
 2. Goulds Water Technology, a xylem brand; []: www.goulds.com/#sle.
 3. Zoeller Company; []: www.zoeller.com/#sle.
 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Type: Vertical centrifugal, direct connected, simplex arrangement.
- C. Casing: Cast iron volute with radial clearance around impeller, inlet strainer, slide away couplings.
- D. Impeller: Cast iron; open non-clog, keyed to corrosion resistant alloy steel shaft.
- E. Support: Cast iron pedestal motor support on steel floor plate with gas tight gaskets.
- F. Bearings: Forced grease lubricated bronze sleeve spaced maximum 48 inches and grease lubricated ball thrust at floor plate.
- G. Drive: Flexible coupling to vertical, solid shaft ball bearing electric motor.
- H. Sump: Steel cover plate with steel curb frame for grouting into concrete sump with inspection opening and cover, and alarm fittings.
- I. Controls (Simplex): Float switch with float rod, stops, and corrosion resistant float, and separate pressure switch high level alarm with transformer, alarm bell and stand-pipe.

2.11 COOLING CONDENSATE REMOVAL PUMPS

- A. Manufacturers:
 - 1. Franklin Electric Company; [____]: www.franklin-electric.com/#sle.
 - 2. Liberty Pumps Inc; [____]: www.libertypumps.com/#sle.
 - 3. Substitutions: See Section 01 6000 - Product Requirements.
- B. Construction: Commercial grade, nonferrous pump with stainless steel shaft, integral discharge check valve, integral float switch, safety switch, thermoplastic reservoir, motor assembly, and power cord with ground.
- C. Safety: UL 778.
- D. Performance:
 - 1. Flow: [____] gpm, at [____] feet head.
 - 2. Size: [____] inches diameter, [____] inches overall length, Reservoir Capacity: [____] gal.
 - 3. Electrical Characteristics:
 - a. [____] hp.
 - b. [____] volts, single phase, 60 Hz, [____] minimum circuit ampacity.

2.12 SANITARY SEWAGE PUMPS

- A. Centrifugal Solids Handling:
 - 1. Manufacturers:
 - a. Buffalo Pump, a subsidiary of Ampco-Pittsburgh Corporation; [____]: www.buffalopumps.com/#sle.
 - b. Flowserve Corporation; [____]: www.flowserve.com/#sle.
 - c. Hayward Gordon ULC; [____]: www.haywardgordon.com/#sle.
 - d. Substitutions: See Section 01 6000 - Product Requirements.
 - 2. General: Non-clogging centrifugal type suitable for pumping solids up to 3 inches in diameter without internal interstices that can collect stringy materials and solids resulting in clogging.
 - 3. Casing:
 - a. Capable of withstanding operating pressures 50 percent greater than the maximum operating pressure.
 - b. Plugged and tapped holes for draining and venting pump.
 - c. Volute to consist of smooth passages.
 - d. Configuration to permit removal of impeller without disturbing discharge and suction connections.
 - e. Handhole to allow cleaning and inspection of pump interior.
 - f. Lifting eyes to facilitate handling of pump.
 - 4. Impeller:
 - a. Design to consist of smooth passages to prevent clogging and pass fibrous or stringy material.
 - b. Securely keyed to shaft with locking arrangement preventing loosening by torque from either forward or reverse direction.
 - c. Balance statically, dynamically, and hydraulically within the operating range and to the first critical speed at 150 percent of the maximum operating speed.
 - 5. Wearing Rings:
 - a. Provide renewable wearing rings on the casing and impeller with wearing surfaces normal to the axis of rotation.
 - b. Construction: Cast iron.
 - c. Factory designed for simple maintenance and secured to prevent rotation.
 - d. In lieu of wearing rings on impeller and casing, replaceable steel wear plates fastened to casing may be used.
 - 6. Pump Shaft:
 - a. Provide with adequate size and strength to transmit full driver horsepower with liberal safety factor.

- b. Fabricate from stainless steel.
- 7. Pump Shaft Sleeve:
 - a. Fabricate from stainless steel.
 - b. Seal joint between shaft and sleeve to prevent leakage.
 - c. Stuffing Box:
 - 1) Factory designed for minimum 5 rings of packing with removable split type glands.
 - 2) Fabricate from same material as casing and water sealed.
- 8. Mechanical Seal System:
 - a. Furnish single seals to seal pump shaft against leakage.
 - b. Each seal to be held in place by its own spring system, supplemented by external liquid pressures.
 - c. System to be readily removable from the shaft.
- 9. Bearings:
 - a. Provide ball type designed to handle all thrust loads in either direction.
 - b. Furnish with a L-10 life of minimum 50,000 hours as required by ABMA 9 or ABMA 11.
 - c. Pumps depending only on hydraulic balance and thrust are not acceptable.
- 10. Lubrication:
 - a. Bearing:
 - 1) Grease Lubricated:
 - (a) Provide grease fitting of the type that prevents over-lubrication and the building up of pressure injurious to the bearings.
 - (b) Provide grease tubing if fitting is not readily accessible.
- 11. Pump Support:
 - a. Vertical Dry Pit Centrifugal Pumps: Heavy cast iron base with legs designed for maximum rigidity and balance.
- 12. Coupling:
 - a. Provide heavy duty, flexible type, locked to the shaft.
 - b. Disconnection of the coupling possible without removing the driver half or the pump half of the coupling from the shaft.
- 13. Performance:
 - a. Flow: [] gpm, at [] feet lift.
 - b. Motor: [] hp, [] volt, single phase, 60 Hz.

2.13 ELECTRICAL WORK

- A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.
- B. Electrical characteristics to be as specified or indicated.
- C. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.
- D. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.
- C. Domestic Water Heat Exchangers:
 - 1. Install domestic water heat exchangers with clearance for tube bundle removal without disturbing other installed equipment or piping.
 - 2. Support unit on pipe stand.
 - 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. Provide steam pressure gauge at exchanger inlet.
 5. Provide steam traps and valves as indicated.
 6. Pitch shell for condensate drain to traps.
- D. Domestic Water Storage Tanks:
1. Provide steel pipe support, independent of building structural framing members.
 2. Clean and flush prior to delivery to site. Seal until pipe connections are made.
- E. Pumps:
1. Ensure shaft length allows sump pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.
 2. Provide air cock and drain connection on horizontal pump casings.
 3. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
 4. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
 5. Ensure pumps 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.

3.02 SCHEDULES

- A. Water Heaters:
1. Drawing Code:
 2. Manufacturer:
 3. Model:
 4. Input:
 5. Heating Element Size:
 6. Number of Heating Elements:
 7. Recovery:
 8. Recovery Temperature Rise:
 9. Storage Capacity:
 10. Volt/phase:
- B. Domestic Water Heat Exchangers:
1. Drawing Code:
 2. Location:
 3. Service:
 4. Heating Media:
 - a. Type:
 - b. Entering:
 - c. Leaving:
 - d. Flow:
 - e. Max. Head Loss:
 - f. Fouling Factor:
 - g. Working Pressure:
 5. Heated Media:
 - a. Type:
 - b. Entering:
 - c. Leaving:
 - d. Flow:
 - e. Max. Head Loss:
 - f. Fouling Factor:
 - g. Working Pressure:
- C. Tanks:
1. Drawing Code:

2. Location:
3. Service:
4. Capacity:
5. Diameter:
6. Length:

D. Pumps:

1. Drawing Code:
2. Manufacturer:
3. Model No.:
4. Location:
5. Service:
6. Capacity:
7. Head:
8. Minimum Efficiency:
9. Seal Type:
10. Motor Size:
11. Motor volt/phase:

END OF SECTION