

SECTION 15440

PLUMBING PUMPS

**PART 1 –GENERAL**

**1.1 INTRODUCTION**

- A. Section includes base-mounted pumps, compact circulators, in-line pumps, water pressure booster system, sewage ejectors and sump pumps.
- B. Related Sections:
  - 1. Section 16150 – Wiring Connections: Execution requirements for electrical connections to pumps specified by this section.
  - 2. Section 16225 – Motors: Product requirements for motors for placement by this section.

**1.2 REFERENCES**

- A. NEMA 250 (National Electrical Manufacturers Association)- Enclosures for Electrical Equipment (1000 Volt Maximum).

**1.3 PERFORMANCE REQUIREMENTS**

- A. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, will not overload in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.

**1.4 SUBMITTALS**

- A. Section 01330 - Submittal Procedures: Submittal procedures.
- B. Shop Drawings: Indicate mounting, attachment and drain provisions for pumps.
- C. Product Data: Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes.
- D. Manufacturer's Installation Instructions: Submit application, selection, and hookup configuration with pipe and accessory elevations. Submit hanging and support requirements and recommendations
- E. Manufacturer's Certificate: Certify that products meet or exceed specified requirements

1.5 CLOSEOUT SUBMITTALS

- A. Section 01770 – Closeout and Turnover Procedures: Closeout procedures.
- B. Operation and Maintenance Data: Submit installation instructions, servicing requirements, assembly views, lubrication instructions, and replacement parts list.

1.6 QUALITY ASSURANCE

- A. Perform Work in accordance with applicable codes and laws as well as the Stanford University Design Standards and all Stanford University documents
- B. Maintain one copy of each document on site.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.
- B. Installer: Company specializing in performing Work of this section with minimum three years documented experience.

1.8 PRE-INSTALLATION MEETING

- A. Section 01330 - Administrative Requirements: Preinstallation meeting.
- B. Convene minimum one week prior to commencing Work of this section.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Protect systems from entry of foreign materials by temporary covers, completing sections of the Work, and isolating parts of completed system.

1.10 WARRANTY

- A. Section 01770 - Execution Requirements: Product warranties and product bonds.
- B. Provide five year manufacturer warranty for plumbing pumps.

## PART 2 –PRODUCTS

### 2.1 SYSTEM LUBRICATED CIRCULATORS

- A. Type: Horizontal shaft, single stage, direct connected with multiple speed wet rotor motor for in-line mounting, for 140 psig maximum working pressure, 230 degrees F maximum water temperature.
- B. Casing: Cast iron with flanged pump connections.
- C. Impeller, Shaft, Rotor: Stainless Steel.
- D. Bearings: Metal Impregnated carbon (graphite) and ceramic.
- E. Motor: See FDG 16225 – MOTORS
- F. Performance: Per design
- G. Electrical Characteristics: Per design

### 2.2 CLOSE COUPLED PUMPS

- A. Type: Horizontal shaft, single stage, close coupled, radial split casing, for 250 psig maximum working pressure.
- B. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.
- C. Impeller: Bronze, fully enclosed, keyed to motor shaft extension.
- D. Shaft: Stainless steel.
- E. Seal: Carbon rotating against a stationary ceramic seat, 225 degrees F maximum continuous operating temperature.
- F. Performance: Per design
- G. Electrical Characteristics: Per design
  - 1. Refer to Section 16150.
  - 2. Motor: 1750 rpm unless specified otherwise; refer to Section 16225.
  - 3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box.

### 2.3 BASE MOUNTED PUMPS

- A. Type: Horizontal shaft, single stage, direct connected, radial or horizontal split casing, for 250 psig maximum working pressure.
- B. Casing: Cast iron, with suction and discharge gage ports, renewable bronze casing wearing rings, seal flush connection, drain plug, flanged suction and discharge.
- C. Impeller: Bronze, fully enclosed, keyed to shaft.
- D. Bearings: Grease lubricated roller or ball bearings.
- E. Shaft: Stainless steel shaft sleeve.
- F. Performance: Per design
- G. Electrical Characteristics: Per design
  - 1. Refer to Section 16150.
  - 2. Motor: 1750 rpm unless specified otherwise; refer to Section 16225.
  - 3. Wiring Terminations: Provide terminal lugs to match branch circuit conductor quantities, sizes, and materials indicated. Enclose terminal lugs in terminal box.

### 2.4 IN-LINE CIRCULATOR PUMPS (DOMESTIC HOT WATER RECIRCULATION)

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

H. Pump and Motor shall be designed to operate with fluid temperatures up to 160°.

## 2.5 PRESSURE BOOSTER PUMP

A. Booster pump package shall be UL Listed and have all components frame mounted, piped, painted, wired and factory tested. Package shall include pumps, manifolds, hydro-pneumatic bladder tank and control panel. Package shall have a single point 480 volt 3 phase power connection and include a transformer for lower voltage requirements.

B. Pumps:

1. Pumps shall be horizontal or vertical mounted, close coupled, end suction, cast iron type with bronze fitted construction and mechanical seals or vertical multi-stage with stainless steel fitted construction and mechanical seals as called out on the plans. Pumps casings shall include vent and drain ports at the top and the bottom of the casings.
2. Pumps shall be rated with a maximum working pressure of 175 psig and 225F continuous operating temperature. Manufacturer shall certify ratings.
3. Pumps shall run without excessive noise or vibration.

C. Pump motors shall be VFD-Rated and shall meet the requirements of NEMA MG1 Sections IV 31.4.4.2 for premium efficiency motors.

D. Each pump and motor to have nameplate listing manufacturer's name, pump serial number, capacity in GPM and feet of head at design conditions, motor horsepower, voltage, frequency, speed and full load current.

E. Check valves shall be silent center guided type with resilient rubber seats and stainless steel spring. Check valves shall have cast iron bodies with FDA approved fusion epoxy coating and bronze discs.

OR

F. Provide isolation valves at inlet and outlet of each pump and union or flange connections. Valves shall be butterfly or ball valves.

G. Pump manifold header piping shall be Schedule 10 welded, 304 stainless steel for cold water and schedule 10 welded, 316 stainless steel for hot water. Header pipe size shall be designed for a maximum of 8 fps velocity. All pipe welds shall be performed by ASME Section IX certified welders and piping shall be welded to ASME/ANSI B31-9 specifications. Connections to headers shall be flanged.

H. Pressure transducers shall be supplied on the suction and discharge manifold headers and factory wired to the control panel.

I. Each pump shall be fitted with a thermally activated purge valve to allow water to be purged to a remote drain in the event of a system over heating.

- J. The booster pump package shall be controlled by a skid mounted and factory wired, UL 508 listed, control in a NEMA 4X enclosure with single point power connections and all the necessary components to allow for automatic operation of the variable speed pumps. The panel shall include the following components:
1. Variable Frequency Drive for each motor.
  2. Main power disconnect.
  3. Through the door circuit breaker disconnect for each VFD.
  4. H-O-A selector switch for each pump.
  5. Control circuit transformer with protected secondary.
  6. Digital programmable logic controller with door mounted LED display with a minimum of three lines of text and keypad.
  7. Audio General Alarm – with push to silence button
  8. Pump operation and status lights
    - a. Door Mounted Status Lights Shall Include as a minimum:
      - 1) Pump Run
      - 2) Pump Out of Service
      - 3) General Alarm
  9. Provide a set of dry contacts, wired to a terminal strip in the control panel for transmission of general fault alarm to building automation system. A general fault shall include: pump fault, VFD fault, PLC fault, transducer failure, high system pressure, low suction pressure, overload and network failure. The PLC shall provide a data log of all system faults. These faults shall be displayed in English text on the door mounted supervisory controller (HMI).
  10. The micro-processor based supervisory controller (HMI) shall be a panel door mounted unit with graphic type LCD display and sealed membrane keypad. The controller shall include PID control, floating point math with square root function and control the VFD's through a network interface. In addition to sending the run command and speed reference signal to the VFD's through the network interface, the HMI shall display line voltage, output frequency, output current and fault conditions for each VFD. The HMI shall provide an easy to use operator interface to all system parameters and display those parameters in plain English and engineering units. Monitoring functions shall be available to all users, but access to parameters shall be restricted by two levels of password protection.
  11. Standard Variable Frequency Drive (VFD) features shall include over current, earth fault, electronic motor overload protection, over temperature, over voltage, under voltage, phase failure, PID close-loop controller, and automatic energy saving mode, motor synchronization, and user macro storage, auto restart after power failure, electronic motor potentiometer, 16 mixed frequencies and min/max frequency limitation.
  12. Control logic shall include an energy saving proof of no demand shutdown, (NDS), which tests the system demand and then shuts off the lead pump if no demand is proven. The lag pump(s) shall shut off when it

operates at its minimum speed for an adjustable elapsed time. The control logic shall also include the energy saving feature of dynamic setpoint adjustment, (DSA), which automatically lowers or increases the system discharge operating pressure set point as the system demand changes. Alternative designs that do not utilize a built in software algorithm to compensate for the for variable friction losses shall not be allowed to have their pressure transducer mounted on the discharge header; instead their transducer shall be provided loose and installed at the furthest remote location of the system to account for the variable friction losses within the piping system. The controls shall automatically stage the pumps and adjust the pump speed based on discharge pressure control. The lead and lag pumps shall be rotated after each system shutdown. The controls shall start a lag pump on lead pump failure. A high temperature safety shut down system shall be provided which uses a digital controller to monitor the water temperature of all pumps. If a high temperature occurs the system shall shut down and go into alarm. The pump water temperature monitoring must be used as a safety feature and can not be used as an operating control. The controls shall include pump minimum run time and pump maximum run time adjustable set points.

13. The entire system shall be pre-assembled on a heavy structural steel frame. The frame shall be welded in accordance with AWS D1.1 specifications. The steel frame shall have a zinc oxide primer and a machine enamel topcoat.
14. Hydro-pneumatic bladder tank shall be ASME rated with a ring stand base and replaceable bladder. The tank shall ship loose for field installation. The tank shall be skid mounted and piped. The tank shall be provided and installed with a union isolation ball valve, pressure gauge and drain valve.

## 2.6 PRESSURE BOOSTER SYSTEMS

- A. System: Packaged with two, three or four 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.
- B. 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 gages.
- C. Lead Pump: Operate continuously with lag pump(s) operating on system demand. Should lead pump fail to operate, next pump in sequence shall start automatically.

- D. Time Delay Relay: Prevent lag pump(s) short cycling on fluctuating demands.
- E. Thermal Bleed Circuit with Solenoid Valve: Prevent overheating during low demand.
- F. Low Pressure Control: Stop pump operation if incoming water pressure drops to atmospheric.
- G. Pump Switch: Permit manual or automatic operation.
- H. Valves: Each pump outlet combination pressure reducing and check valve to maintain constant system pressure. Provide gate or ball valves on suction and discharge of each pump. Provide check valve on each pump discharge.
- I. Performance: Per design

## 2.7 SUMP PUMPS AND SEWAGE EJECTORS

- A. Type: Vertical centrifugal, direct connected, duplex arrangement.
- B. Casing: Cast iron volute with radial clearance around impeller, inlet strainer and where applicable, slide away couplings.
  - 1. Impeller: Bronze, open non-clog, keyed to stainless steel shaft.
  - 2. Support: Cast iron pedestal motor support on steel floor plate with gas tight gaskets.
  - 3. Bearings: Forced grease lubricated bronze sleeve spaced maximum 48 inches and grease-lubricated ball thrust at floor plate.
  - 4. Drive: Flexible coupling to vertical, solid shaft ball bearing electric motor.
  - 5. Sump: Steel cover plate with steel curb frame for grouting into concrete sump or on steel sump basin with inspection opening and cover, and alarm fittings.
- C. Controls (Simplex): Mercury-free float switch in corrosion resistant float, and separate pressure switch high level alarm with transformer, alarm bell and standpipe
- D. Controls (Duplex): Mercury-free float switch in corrosion resistant float to alternate operation of pumps. Multiple floats can be used. Cut-in second pump on rising level or lead pump failure. Provide separate pressure switch high level alarm with transformer, alarm bell, and standpipe, and extra set of wired terminals for remote alarm circuit and emergency float switch to operate both pumps on failure of alternator.
- E. Performance: Per design



## 2.8 SUBMERSIBLE SUMP PUMPS OR SEWAGE EJECTORS

- A. Type: Completely submersible, vertical, centrifugal.
- B. Casing: Bronze pump body and oil filled motor chamber.
- C. Impeller: Bronze; open non-clog, with stainless steel shaft.
- D. Bearings: Ball bearings.
- E. Sump: Fiberglass basin with steel cover plate.
- F. Discharge piping: Cast iron, galvanized steel, or stainless steel. Plastic piping may not be used.
- G. Accessories: Oil resistant 6 foot cord and plug with three-prong connector for connection to electric wiring system including grounding connector.
- H. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.
- I. Controls < 1 hp: Integral mercury-free switch type level controls with separate, liquid-level, control for high level alarm.
- J. Controls > 1 hp: Motor control panel containing across-the-line electric motor starters with ambient compensated quick trip overloads in each phase with manual trip button and reset button, circuit breaker, control transformer, electromechanical alternator, hand-off-automatic selector switches, pilot lights, high water alarm pilot light, reset button and alarm horn. Provide mercury switch liquid level controls, steel shell switch encased in polyurethane foam with cast iron weight for pump on (each pump), pump off (common), and alarm.
- K. Performance: Per design

## PART 3 –EXECUTION

### 3.1 INSTALLATION

- A. Install long radius reducing elbows or reducers between pump and piping. Support piping adjacent to pump such that no weight is carried on pump casings. For close coupled or base mounted pumps, provide supports under elbows on pump suction and discharge line sizes 4 inches and over.

- B. Provide line sized shut-off valve and strainer pump suction fitting on pump suction, and line sized soft seat check valve and balancing valve or combination pump discharge valve with separate shut off on pump discharge.
- C. Provide air cock and drain connection on horizontal pump casings.
- D. Provide drains for bases and seals. Pipe to nearest floor drain.
- E. Install close coupled and base mounted pumps on concrete housekeeping base, with anchor bolts, set and level, and grout in place.
- F. Lubricate pumps before start-up.
- G. Install unions on section and charge sides of pump below shut-off valves.

### 3.2 FIELD QUALITY CONTROL

- A. Section 01770 - Execution Requirements: Testing, adjusting, and balancing.
- B. Inspect for alignment of base mounted pumps.

END OF SECTION