# A. WATER PRESSURE BOOSTER PUMPING SYSTEM - VARIABLE SPEED

## PART 1 - GENERAL

**1.1** Domestic water pressure booster pump package and associated controls shall be provided as shown on the drawings and as specified.

**1.2** Refer to 22 05 07 Piping Materials and Methods for Plumbing, 22 05 23 General Duty Valves for Plumbing Piping and other sections for work related to this section.

**1.3** Package equipment shall be independently third-party tested and labeled for performance by a nationally recognized testing laboratory to the following:

- UL QCZJ - Packaged System
- UL 508 Industrial Control Equipment
- UL 508A Industrial Control Panels
- UL 778 Motor Operated water pumps
- NSF 61
- NSF 372

**1.4** All piping, fittings, valves, solders, fluxes, seals, appurtenances and other equipment in which wetted parts are in contact with water, installed in public drinking water systems and plumbing systems providing potable and/or drinking water for human consumption shall conform to the “Lead Free” requirements of NSF/ANSI 372.

## PART 2 - PRODUCTS

**2.1** Domestic Water Pressure Booster Package

**A.** Provide a completely factory assembled packaged domestic water booster pumping system. The packaged system field connections shall require only suction and discharge pipe connections and one electric power connection and one alarm connection to the Building Automation system. Do not specify Additional Pressure meters or sensors remotely.

**B.** The Duplex / Triplex / Quadraplex (select one) variable speed, variable flow pump system shall consist of pumps, electric motors, variable frequency drives (VFD) controls, valves and all necessary piping for a complete system. The system shall be designed to provide a specified GPM design flow at a constant discharge boost pressure as shown on the drawings.

**C.** The system shall include a PLC with data logging via an SD Card, manufacturer shall provide the SD card pre-installed in the HMI.

**D.** The pumps shall be sized as noted in the drawings. All system losses have been included in the sizing data noted on the drawings. The packaged system losses shall be included by the packaged system supplier to provide design discharge boost pressure at design flow. Maximum velocity through the discharge header shall be a minimum of 3.5 ft/s and a maximum of 12.5 ft/s.



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**E.** Pumps.

**General:** All pumps shall be equipped with an individual Thermal Relief device Select paragraph 1) horizontal close-coupled or 2) vertical multi-stage.

**1.** Pumps shall be single stage horizontal mounted close-coupled end suction centrifugal type. Pumps shall be cast iron construction, equipped with sleeve-mounted mechanical shaft seals and close coupled to a premium efficiency motor with class F insulation. Pump shall be fitted with mechanical seal(s), stainless steel spring and hardware and Buna-N elastomers. Pumps shall be selected closest to the best efficiency point. Motors shall be non-overloading at duty point and need to present a stainless steel impeller and bear a NSF 61 approval.

**2.** Pumps shall be multi-stage vertical centrifugal type with ANSI flanged connections. Pump shall be stainless steel construction, equipped with sleeve-mounted mechanical shaft seals and close coupled to a high efficiency motor with class F insulation. Pump shall be fitted with mechanical seals, stainless steel impellers, pump shaft, diffuser chambers, outer discharge sleeve and impeller seal rings or seal ring retainers and hardware, and Buna-N elastomers. The pump motor shall be NEMA C face design mounted directly to the top of the pump. Pumps shall be selected closest to the best efficiency point. Motors shall be non-overloading at duty point.

**F.** Motors

**1.** Motors shall be open drip proof manufactured in accordance with NEMA standards for epact motor efficiencies. Motors shall meet MG-31, Motors shall be selected so that they DO NOT exceed nameplate HP rating THROUGHOUT the programmed sequence of pump operation.

**2.** Refer to Section 22 05 13 Electrical Requirements for Plumbing Equipment.

**3.** Motors shall not operate beyond their rated service factor at any point on their performance curve.

**4.** The selection of the booster can be done considering Pumps in standby mode OR as a “shared” set up.

**G.** Control Panel

**1.** The control panel shall be NEMA 12, UL508A construction with a 100kA SCCR rating and door-interlocking motor disconnecting device, human machine interface with H-O-A operation furnished for each pump, non-proprietary programmable logic controller, separate variable frequency drive for each pumpand primary and secondary circuit fuses. Voltage supply must be through the power voltage cable only and a transformer in the panel is providing control voltage to the control equipment. The control panel shall be listed to UL508A. Panel shall include thermostatically controlled fans to cool the panel internals and provide positive pressure dust infiltration protection through filtered incoming air. The location shall be field rotatable on the booster station base frame without compromising the UL508A rating i.e. no wiring shall be required to be disconnected to facilitate relocating the panel for end mounting.

**2.** Programmable logic controller (PLC) shall interface the signal from the pressure sensor to the VFD’s and provide a stabilized response to adjust the pump speed or stage pumps as required to meet system demand. The PLC shall have an adequate built-in program memory, auxiliary relays, timers, counters, data registers, extension registers, and extension file registers to perform the required control, alarm and logging as specified. Booster system control shall be in compliance with the latest edition of ASHRAE 90.1. The PLC shall include nonvolatile memory to prevent program loss due to power failure.



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Controller shall be designed for use in locations where electromagnetic noise, voltage spikes 32°F - 130°F (0°C - 54°C) temperature, 35 - 85% relative humidity, and mechanical shock are present. The controller shall provide setpoint adjustment, timer adjustment, PID functions and both system and controller self-diagnostics via panel mounted interface. All user interface setpoints shall be easily accessible via the password protected HMI screen. The programmable logic controller shall continue to function even if the visual display is inoperative, damaged, or removed. The PLC must be able to provide 3 different privilege levels: Factory, Contractor, User.

**3.** Each pump shall have its own variable frequency drive (VFD). The VFD shall be voltage source, GTR or IGBT power transistor-based inverter - PWM type with high carrier frequency to reduce drive and motor noise, capable of operating in an ambient temperature between 15°Fand 100°F(_9°C - 38°C) and include line voltage variation of less than 10 percent. Minimum 100,000 SCCR. The VFD self-protection features shall include under voltage and over voltage protection, current overload protection, short circuit protection, power failure, unless excessive (4 or more faults within an hour) protection, ground fault protection, and over-temperature protection. The VFD shall automatically restart after any over-voltage, converter over-current, inverter over-current, or power failure. The VFD parameters shall be user adjustable for acceleration speed (1 to 300 seconds), deceleration speed (1 to 300 seconds), and minimum speed. Power wiring to VFD(s) shall be grounded and shielded to minimize radiated and conducted noise.

**4.** The control panel shall include a UL Type 4 HMI touchscreen. The HMI screen shall be a minimum of 10” TFT color LCD with rugged resistive film touch panel. The interface shall display the system flow rate, set point pressure, active setpoint, system pressure, pump run status, pump speed and active alarms. The following information shall be accessible through the interface:

**a.** Method of speed control.

**b.** Usage history, along with the date and time, pump starts and pump run hours. Usageshall be resettable.

**c.** Password protected adjustable set points menu system, with factory reset, for pressure, VFD speed, power, minimum speed, lead pump shutdown mode, and tank pressurizer (as applicable). Restore to factory defaults.

**d.** Alarm History of minimum past 200 alarms. Each log shall include, system pressure and run setpoint, alarm type and the date and time.

**e.** Alarm list current state.

**f.** PLC based intuitive start-up wizard to facilitate an easy start-up process to assure the booster is properly configured to meet the jobsite conditions.

**g.** Data transfer card for system information, including fault codes from PLC & VFD. Data shall be stored in a text file. SD card shall be provided factory installed.

**h.** BACnet compatibility (Optional, select as required).

**i.** Real Flow Meter (Optional, select as required).



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**5.** Provide the following instrumentation and emergency control features and components.

**a.** Demand based control.

**b.** Low suction pressure shutoff factory set to 5 PSIG with auto reset and delay timer as required by plumbing code or local requirements. System shall provide a low suction (adjustable) warning to activate at least 5 PSIG (adjustable) above suction shut-off value.

**c.** Low system and low suction alarms (audible and visual) with alarm silence switch.

**f.** Emergency power operation shall limit the maximum number of operating pumps via a single digital input (dry contact closure) provided by others.

**6.** The control panel shall bear the label of Underwriters Laboratories. Approval of just the enclosure or the electrical devices is unacceptable. All wiring and electrical construction within the panel must conform to UL requirements. The manufacturer of the packaged pumping system must be listed by UL as an approved manufacturer of control panels.

**7.** Electric wiring shall be complete between the control panel, electric motors, and system mounted controls such as pressure sensors/switches and flow switches. Only one supply voltage without separate Control voltage supply line.

**H.** Pressure transmitters shall be included on the suction and discharge headers. The transmitter shall have 1.0% accuracy, stainless steel wetted parts and a waterproof enclosure. The transmitter shall be capable of withstanding over pressurization of double its range. Pressure gauges with shutoff valves shall be provided on the suction and discharge headers.

**I. Sequence of Operation**

**1.** The lead pump shall run only as necessary to maintain system pressure and be controlled automatically by means of a pressure transmitter and programmable logic controller (PLC) programmed to prevent short cycling. If the lead pump is unable to maintain system pressure the lag pump(s) shall be called on, after a time delay, and shall operate in parallel with the lead pump in accordance with the PLC program. When one pump can satisfy the system demand the controls shall shut down the lag pump(s). Pump system low or no flow condition control shall be compliant with the referenced edition of ASHRAE 90.1. The lead pump shall alternate to the next available on each consecutive pump shutdown.



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**2.** Automatic pump sequencing shall include the following features.

**a.** End-of-curve protection, based on pump differential, with 2% accuracy.

**b.** VFD speed sequencing.

**c.** Lead pump shutdown feature that can be enabled or disabled by the operator.

**d.** Low-flow test feature testing pressure, power, VFD speed, and flow to reduce pump short-cycling, pressure swings, power surges, and motor wear.

**e.** Tank pressurization sequence to increase the energy stored in the tank prior to shutdown.

**f.** Sequence shifting that adjusts the pump sequence when any pump is disabled.

**g.** Adjustable alternation of equal capacity pumps.

**h.** Lag pump exerciser function.

**i.** Minimum run and stop delay timer for each pump.

**j.** Field adjustable low suction pressure alarm.

**k.** Manual speed control on pressure transmitter failure.

**J.** All components shall be mounted on a galvanized base without a requirement for grouting and a minimum of four anchor points. All piping shall be 304 / 316 Stainless Steel with welded ASME B16.5 flanged connections, rated for system pressure. Piping system connections shall be field selectable without disturbing the factory header orientation. Suction and discharge connections can be either fom the left or right as shown on the plans.

**K. OPTIONAL:** Provide an optional bladder type hydro-pneumatic tank with the pumping package. The tank shall be capable of providing water supply during low flow periods and to avoid unnecessary pump starting. The tank shall be _____ gallon capacity, ASME 125 / 150 / 200/ 250 psig, NB stamped, NSF listed for potable water. The tank shall include an air charge valve, bottom or top system connection, and a pressure gauge. Tank pre-charge shall be adjusted in the field to the booster discharge pressure as shown on the schedule.

**L.** The complete packaged pumping system shall be factory tested, electrically and hydraulically. The electrical test shall include a complete checkout at the specified voltage, including testing and setting of all controls and alarms. The hydraulic testing shall include a checkout of all alarm sensors, operation of each pump at its design conditions plus operation of each pump and the entire system throughout the total system operating range.

**OPTIONAL:** The data to be recorded shall be flow, head, motor amps (each motor), voltage, and power consumption (KW). The test shall include a system operating flow test from zero to 100 percent system design flow rate under the specified suction and net system pressure conditions. The Owner and/or Engineer shall, at their request, be permitted to witness all testing. The entire assembly shall be primed and painted after testing. Furnish a written test report to Engineer for approval.

**M.** On the jobsite system start-up, adjustment and operating personnel instruction shall be provided by a factory-trained representative of the pump system manufacturer.

**OPTIONAL:** An extended warranty option of 60 months is available.

## PART 3 - EXECUTION

**3.1** Installation

The Booster system shall include a nameplate with Rated flow, Max rated pressure, Suction and System pressure. This Information shall be available through the means of a QR code. The QR code shall link Product information such as Nameplate, Installation and Operating Manual, Replacement parts list and provide access to start up Sheet information Show pump bypass and isolation valves on plans, details or in piping diagrams.

**A.** Install pump on concrete housekeeping pad, bolted to housekeeping pad. Extend all drains, drips and relief discharges, full size, and air gap over a floor drain. The pump system shall be piped with a bypass check and isolation valves, and with flexible connectors at the header connections.

**Spec writer note:** Delete requirement for full size bypass as required by your project requirements.

**B.** Coordinate electrical requirements. Coordinate remote alarm requirements.

**C.** Set bladder type accumulator tank air side to pump package manufacturers recommended pressure. Installing contractor shall pipe the discharge from the thermal relief valves to a suitable locations.

**D.** On the jobsite system start-up, adjustment and operating personnel instruction shall be provided by a factory-trained representative of the pump system manufacturer.

**E.** Furnish written factory start-up report on domestic booster pump system. Submit to Commissioning Authority/Engineer/Architect.



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