

SECTION 22 11 23
DOMESTIC WATER PUMPS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Hot water circulating pump, hot water recirculation pump and domestic water pressure booster system.
- B. A complete listing of all acronyms and abbreviations are included in Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 13 05 41, SEISMIC RESTRAINT REQUIREMENTS FOR NON-STRUCTURAL COMPONENTS: Seismic Restraint.
- C. Section 22 05 11, COMMON WORK RESULTS FOR PLUMBING.
- D. Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT.
- E. Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS: Requirements for commissioning, systems readiness checklist, and training.

1.3 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. American Society of Mechanical Engineers (ASME):
 - ASME Boiler and Pressure Code -
 - BPVC Section VIII-1-2015 Rules for Construction of Pressure Vessels, Division 1
 - BPVC Section VIII-2-2015 Rules for Construction of Pressure Vessels, Division 2-Alternative Rules
- C. American Society for Testing and Materials (ASTM):
 - A48/A48M-2003 (R2012)...Standard Specification for Gray Iron Castings

B584-2014.....Standard Specification for Copper Alloy Sand
Castings for General Applications

D. International Code Council (ICC)

IPC-2012.....International Plumbing Code

E. National Electrical Manufacturers Association (NEMA):

ICS 6-1993 (R2001, R2006) Industrial Control and Systems:
Enclosures

250-2014.....Enclosures for Electrical Equipment (1000 Volts
Maximum)

F. NSF International (NSF)

61-2014a.....Drinking Water System Components - Health
Effects

372-2011.....Drinking Water System Components - Lead Content

G. Underwriters' Laboratories, Inc. (UL):

508-1999 (R2013).....Standards for Industrial Control Equipment

778-2010 (R2014).....Standard for Motor-Operated Water Pumps

1.4 SUBMITTALS

A. Submittals, including number of required copies, shall be submitted in
accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND
SAMPLES.

B. Information and material submitted under this section shall be marked
"SUBMITTED UNDER SECTION 22 11 23, DOMESTIC WATER PUMPS", with
applicable paragraph identification.

C. Manufacturer's Literature and Data including: Full item description and
optional features and accessories. Include dimensions, weights,
materials, applications, standard compliance, model numbers, size, and
capacity.

1. Pump:
 - a. Manufacturer and model.
 - b. Operating speed.
 - c. Capacity.
 - d. Characteristic performance curves.
2. Motor:
 - a. Manufacturer, frame and type.
 - b. Speed.
 - c. Current Characteristics.
 - d. Efficiency.
3. Tank:
 - a. Manufacturer and model.
 - b. Capacity//
- D. Certificate of shop test for domestic water booster system. Provide certified performance curves.
- E. Certified copies of all the factory and construction site test data sheets and reports.
- F. Complete operating and maintenance manuals including wiring diagrams, technical data sheets, information for ordering replacement parts, and troubleshooting guide:
 1. Include complete list indicating all components of the systems.
 2. Include complete diagrams of the internal wiring for each item of equipment.
 3. Diagrams shall have their terminals identified to facilitate installation, operation and maintenance.
- //G. Completed System Readiness Checklist provided by the CxA and completed by the contractor, signed by a qualified technician and dated on the

date of completion, in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

//H. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

1.5 QUALITY ASSURANCE

A. General:

1. UL Compliance: Comply with UL 778 for motor-operated water pumps.

2. Design Criteria:

- a. Pump sizes, capacities, pressures, operating characteristics and efficiency shall be as scheduled.
- b. Head-capacity curves shall slope up to maximum head at shut-off. Select pumps near the midrange of the curve, and near the point of maximum efficiency, without approaching the pump curve end point and possible cavitation and unstable operation. Select pumps for open systems so that required net positive suction head (NPSHR) does not exceed the net positive head available (NPSHA).
- c. Pump Driver: Furnish with pump. Size shall be non-overloading at any point on the head-capacity curve, including in a parallel or series pumping installation with one pump in operation.
- d. Provide all pumps with motors, impellers, drive assemblies, bearings, coupling guard and other accessories specified. Statically and dynamically balance all rotating parts.
- e. Furnish each pump and motor with a nameplate giving the manufacturers name, serial number of pump, capacity in GPM and head in feet at design condition, horsepower, voltage, frequency, speed and full load current and motor efficiency.
- f. Test all pumps before shipment. The manufacturer shall certify all pump ratings.

- g. After completion of balancing, provide replacement of impellers or trim impellers to provide specified flow at actual pumping head, as installed.
- B. Hot Water Circulating and Recirculating Pumps: Components shall be assembled by a single manufacturer and the pump motor assembly shall be the standard cataloged product of the manufacturer.
- C. Domestic Water Pressure Booster System:
 - 1. Components shall be furnished by a single manufacturer and the system shall be the standard cataloged product of the manufacturer.
 - 2. Shop Test: Water booster unit and its component parts shall undergo a thorough electric and hydraulic operating test prior to shipment. Tests shall include a system operating flow test from zero to 100 percent of design flow rate under specified suction and system pressure conditions. Certified performance curves shall be furnished.
- D. Bio-Based Materials: For products designated by the USDA's Bio-Preferred Program, provide products that meet or exceed USDA recommendations for bio-based content, so long as products meet all performance requirements in this specifications section. For more information regarding the product categories covered by the Bio-Preferred Program, visit <http://www.biopreferred.gov>.

1.6 AS-BUILT DOCUMENTATION

- A. Submit manufacturer's literature and data updated to include submittal review comments and any equipment substitutions.
- B. Submit operation and maintenance data updated to include submittal review comments, substitutions and construction revisions shall be // in electronic version on compact disc or DVD // inserted into a three ring binder. All aspects of system operation and maintenance procedures, including piping isometrics, wiring diagrams of all circuits, a written description of system design, control logic, and sequence of operation shall be included in the operation and maintenance manual. The operations and maintenance manual shall include troubleshooting techniques and procedures for emergency situations. Notes on all special systems or devices such as damper and door closure

interlocks shall be included. A List of recommended spare parts (manufacturer, model number, and quantity) shall be furnished. Information explaining any special knowledge or tools the owner will be required to employ shall be inserted into the As-Built documentation.

- C. The installing contractor shall maintain as-built drawings of each completed phase for verification; and, shall provide the complete set at the time of final systems certification testing. As-built drawings are to be provided, and a copy of them in Auto-CAD version //____// provided on compact disk or DVD. Should the installing contractor engage the testing company to provide as-built or any portion thereof, it shall not be deemed a conflict of interest or breach of the 'third party testing company' requirement.
- D. Certification documentation shall be provided to COR 10 working days prior to submitting the request for final inspection. The documentation shall include all test results, the names of individuals performing work for the testing agency on this project, detailed procedures followed for all tests, and certification that all results of tests were within limits specified.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Material or equipment containing a weighted average of greater than 0.25 percent lead shall be prohibited in any potable water system intended for human consumption, and shall be certified in accordance with NSF 61 or NSF 372.

2.2 HOT WATER RECIRCULATING PUMP

- A. General:
 - 1. Centrifugal, single stage, pump. Driver shall be electric motor, close coupled or connected by flexible or magnetic coupling. Pump for hot water system shall be designed for quiet, trouble-free operation at a minimum of 82 degrees C (180 degrees F) water service and 1,035 kPa (150 psig).
 - 2. Mounting shall be in-line, vertical or horizontal similar to existing.

3. Stamped or engraved stainless steel nameplate.
4. Motors: Maximum 40 degrees C (104 degrees F) ambient temperature rise, drip-proof, for operation with current, voltage, phase and cycle shown in schedule on Electrical drawings, conforming to NEMA Type 4. Motors shall be equipped with thermal overload protection. When motor has cooled down it shall re-start automatically if the operating control has been left on and the system requires pump to start.
5. Pump shall operate continuously with on-off switch, or with an HOA switch for automatically controlled pumps, for manual shut down. In the inlet and outlet piping of the pump, shutoff valves shall be installed to permit service to the pump, strainer, and check valve without draining the system.
6. A check valve shall be installed in the pump discharge piping immediately downstream of the pump. A strainer with drain valve and removable strainer screen or basket shall be installed immediately upstream of the pump. //Flexible pipe connectors and isolation pipe hangers shall be installed to prevent pump vibration from being transferred to adjacent piping and the building structure.//

B. Horizontal, Wet-Rotor Circulators:

1. Maintenance free, close-coupled pump and motor with maximum 3,300 rpm rotational speed.
2. //Bronze// //Cast iron// //Stainless steel// body construction with ceramic shaft, plastic impeller, fluid lubricated bearings, no mechanical seal, and //flanged// //soldered joint// connections. Pump shall be capable of pumping //____ LPM (____ GPM) @ ____ Meters of head (____ Feet of head) when drive by ____ HP single phase, ____ VAC motor.// //the capacity scheduled on drawings //.
3. Bearings: Carbon type.

C. Horizontal, Permanently Lubricated Circulators:

1. Close-coupled pump and motor with maximum 3,500 rpm rotational speed.

2. //Bronze// //Cast iron// body construction with solid steel shaft, plastic impeller, carbon/silicon carbide mechanical seal, and //flanged// //soldered joint// connections. Pump shall be capable of pumping //____ LPM (____ GPM) @ ____ Meters of head (____ Feet of head) when drive by ____ HP single phase, ____ VAC motor.// //the capacity scheduled on drawings //.
3. Bearings: Permanently oil lubricated and sealed, stainless steel ball bearings.

D. Horizontal, In-Line Pumps:

1. Flexibly-coupled pump and motor with maximum 1,800 rpm rotational speed.
2. //Bronze// //Bronze-fitted cast iron// body construction with solid steel shaft, and flanged connections. Pump shall be capable of pumping //____ LPM (____ GPM) @ ____ Meters of head (____ Feet of head) when drive by ____ HP single phase, ____ VAC motor.// //the capacity scheduled on drawings //.
3. Bearings: Permanently oil lubricated and sealed, stainless steel ball bearings.
4. Impeller shall be high grade, cast brass or bronze, accurately machined and properly balanced.
5. Seal: Mechanical, with carbon-steel rotating ring, stainless steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.

E. Vertical, In-Line Pumps:

1. Close-coupled pump and motor with maximum 3,600 rpm rotational speed.
2. //Bronze// //Bronze-fitted cast iron// body construction with solid steel shaft and flanged connections. Pump shall be suitable for mounting in a vertical or horizontal position, and shall be capable of pumping //____ LPM (____ GPM) @ ____ Meters of head (____ Feet of head) when drive by ____ HP single phase, ____ VAC motor.// //the capacity scheduled on drawings //.

3. Bearings: Permanently oil lubricated and sealed, stainless steel ball bearings.
4. Impeller shall be high grade, cast brass or bronze, accurately machined and properly balanced.
5. Seal: Mechanical, with carbon-steel rotating ring, stainless steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.

2.3 HOT WATER CIRCULATING PUMP

SPEC WRITER NOTES: Review pump manufacturer curves for performance limitations of the various pump types. The pump types listed in this specification generally increase in pressure and flow capabilities from smallest to largest as follows:

1. Use horizontal wet-rotor (e.g., fluid lubricated) circulators with ceramic shafts and plastic impellers for the smallest water pressure and flow requirements. These circulators are available with cast iron and bronze bodies, and some manufacturers offer stainless steel bodies. These circulators may be the only pumps small enough for some smaller systems.
2. Use horizontal circulators with permanently lubricated and sealed bearings, steel shafts, and plastic impellers for small-to-medium water pressure and flow requirements. These circulators are available with cast iron or bronze bodies.
3. Use horizontal in-line pumps with permanently lubricated and sealed bearings, single stage, bronze impeller, steel shaft, and having available motor sizes up to 2.2 kW (3 HP) for medium water pressure and flow requirements. These circulators are available with cast iron or bronze bodies, although the bronze bodied pumps may not be available for the largest pump sizes within this category.
4. Use in-line pumps with permanently lubricated and sealed bearings, single

stage, bronze or brass impeller, steel shaft, capable of vertical or horizontal mounting, and having available motor sizes up to 11 kW (15 HP) for large water pressure and flow requirements. These circulators are available with cast iron or bronze bodies, although the bronze bodied pumps may not be available for the largest pump sizes within this category.

5. Use other pump types (e.g., base mounted or multi-stage) not included in this specification when necessary for unusually large domestic water pressure or flow requirements.

A. General:

1. Centrifugal, single stage, pump. Driver shall be electric motor, close coupled or connected by flexible or magnetic coupling. Pump for hot water system shall be designed for quiet, trouble-free operation at a minimum of 82 degrees C (180 degrees F) water service and 1,035 kPa (150 psig).
2. Mounting shall be in-line, vertical or horizontal as indicated //below// //on drawing schedules//.
3. Stamped or engraved stainless steel nameplate.
4. Motors: Maximum 40 degrees C (104 degrees F) ambient temperature rise, drip-proof, for operation with current, voltage, phase and cycle shown in schedule on Electrical drawings, conforming to NEMA Type 4. Motors shall be equipped with thermal overload protection. When motor has cooled down it shall re-start automatically if the operating control has been left on and the system requires pump to start.
5. Pump shall operate continuously with on-off switch, or with an HOA switch for automatically controlled pumps, for manual shut down. In the inlet and outlet piping of the pump, shutoff valves shall be installed to permit service to the pump, strainer, and check valve without draining the system.

6. A check valve shall be installed in the pump discharge piping immediately downstream of the pump. A strainer with drain valve and removable strainer screen or basket shall be installed immediately upstream of the pump. //Flexible pipe connectors and isolation pipe hangers shall be installed to prevent pump vibration from being transferred to adjacent piping and the building structure.//

B. Horizontal, Wet-Rotor Circulators:

1. Maintenance free, close-coupled pump and motor with maximum 3,300 rpm rotational speed.
2. //Bronze// //Cast iron// //Stainless steel// body construction with ceramic shaft, plastic impeller, fluid lubricated bearings, no mechanical seal, and //flanged// //soldered joint// connections. Pump shall be capable of pumping //____ LPM (____ GPM) @ ____ Meters of head (____ Feet of head) when drive by ____ HP single phase, ____ VAC motor.// //the capacity scheduled on drawings //.
3. Bearings: Carbon type.

C. Horizontal, Permanently Lubricated Circulators:

1. Close-coupled pump and motor with maximum 3,500 rpm rotational speed.
2. //Bronze// //Cast iron// body construction with solid steel shaft, plastic impeller, carbon/silicon carbide mechanical seal, and //flanged// //soldered joint// connections. Pump shall be capable of pumping //____ LPM (____ GPM) @ ____ Meters of head (____ Feet of head) when drive by ____ HP single phase, ____ VAC motor.// //the capacity scheduled on drawings //.
3. Bearings: Permanently oil lubricated and sealed, stainless steel ball bearings.

D. Horizontal, In-Line Pumps:

1. Flexibly-coupled pump and motor with maximum 1,800 rpm rotational speed.

2. //Bronze// //Bronze-fitted cast iron// body construction with solid steel shaft, and flanged connections. Pump shall be capable of pumping //____ LPM (____ GPM) @ ____ Meters of head (____ Feet of head) when drive by ____ HP single phase, ____ VAC motor.// //the capacity scheduled on drawings //.
3. Bearings: Permanently oil lubricated and sealed, stainless steel ball bearings.
4. Impeller shall be high grade, cast brass or bronze, accurately machined and properly balanced.
5. Seal: Mechanical, with carbon-steel rotating ring, stainless steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.

E. Vertical, In-Line Pumps:

1. Close-coupled pump and motor with maximum 3,600 rpm rotational speed.
2. //Bronze// //Bronze-fitted cast iron// body construction with solid steel shaft and flanged connections. Pump shall be suitable for mounting in a vertical or horizontal position, and shall be capable of pumping //____ LPM (____ GPM) @ ____ Meters of head (____ Feet of head) when drive by ____ HP single phase, ____ VAC motor.// //the capacity scheduled on drawings //.
3. Bearings: Permanently oil lubricated and sealed, stainless steel ball bearings.
4. Impeller shall be high grade, cast brass or bronze, accurately machined and properly balanced.
5. Seal: Mechanical, with carbon-steel rotating ring, stainless steel spring, ceramic seat, and rubber bellows and gasket. Include water slinger on shaft between motor and seal.

2.4 DOMESTIC WATER PRESSURE BOOSTER SYSTEM

SPEC WRITER NOTES:

1. Coordinate and assure that the electrical characteristics specified

below are clearly shown on the Contract Drawings.

2. Specify conventional centrifugal pumps when possible, but specify vertical turbine pumps when added pressure is required, for example, in high rise applications.
 3. In accordance with the latest edition of the VA Plumbing Design Manual, specify duplex and triplex pump packages for the designated applications. The November 2014 edition of the Plumbing Design Manual requires:
 - a. Use three-pump packages in Patient Care applications, where the lead pump is sized for one-third of the total demand and the two redundant lag pumps are each sized for two-thirds of the total demand.
 - b. Use two-pump packages in Non-Patient Care applications, where both pumps are sized for three-fourths of the total demand, and the second pump serves as both a lag pump and a stand-by pump at lower demands.
 - c. Pump lead/lag/stand-by assignments shall alternate to automatically equalize the run time in similarly sized pumps. (This excludes the normal assignment of lead pump responsibility to the uniquely-sized smallest pump in three-pump systems.)
- A. General: Provide a factory prefabricated, prewired and pretested multi-stage pumping system including variable speed drive motors, pressure regulating valves with integral check valves, pressure transducers, vibration pads, emergency switches, duplex flow switches, power and control panels, suction and discharge manifolds, butterfly isolation valves, ball drain valves, bypass loops with appropriate valves and check valves, low pressure cut-off switches, hydropneumatic tanks and accessories. All components shall be furnished by a single manufacturer and the system shall be the standard cataloged product of the manufacturer. All components shall be factory installed on a common

structural steel skid and shall be completely tested in the factory before shipment. Manufacturer shall assume "unit responsibility" to ensure that all components effectively interface to execute the operation of the designed system.

B. System Operation and Configuration:

1. System shall automatically maintain constant system pressure //as scheduled on drawings// //of // // kPa (// // psig) at the outlet of the pressure control valve and hydropneumatic tank check valve at all times. Suction pressure varies from // // kPa (// // psig) to // // kPa (// // psig).// The multi-stage pumping system shall include //two// //three// //the scheduled quantity of// pumps.
2. Duplex pump systems shall include both pumps sized for //75// // // percent of the total capacity.
3. Triplex pump systems shall include a lead pump sized for //33// // // percent of the total capacity and lag and stand-by pumps sized for //67// // // percent of the total capacity.

C. Centrifugal Pump: Pumps shall be single stage, in-line pump with variable speed drive motor, low pressure cut-off switches and bypass loops with ball, gate, and check valves as indicated on the Contract Drawings.

1. Impellers: ASTM B584 Cast bronze, radially or vertically split keyed to shaft and secured by a locking cap-screw. Each impeller shall be statically and dynamically balanced prior to assembly in pump casing. Provide replaceable bronze casing wear rings.
2. Pump shaft: Steel, with replaceable bronze shaft sleeve completely covering the wetted area of the shaft under the seal.
3. Lubrication: Water lubricated type pump.
4. Pump Casing: ASTM A48/A48M CL20 Cast iron suitable for 1200 kPa (175 psig). Pump volute shall be supplied with vent and drain tappings. Connections shall be female NPT. The casing shall be O-ring sealed to the seal housing.

5. Seal: Mechanical general purpose type, with sleeve mounting. Seal shall be rated at 1200 kPa (175 psig) maximum.
 6. Adjustable Spacer Coupling: Removable type required so that pump seal can be replaced without disturbing motor.
 7. Motor: Solid shaft motors balanced to 0.22 mm (0.0085 inch) vibration amplitude shall be operated at any point on the pump head curve without overloading the motor. Conform to NEMA Type 2.
- D. Vertical Multistage Pump: Pumps shall be vertical multistage short-coupled pumps with variable speed drive motor, low pressure cut-off switches and bypass loops with ball, butterfly, check valves as indicated on the Contract Drawings.
1. Impellers: Cast bronze, mixed flow enclosed type.
 2. Balancing of Impellers: Each impeller shall be statically and dynamically balanced prior to assembly in pump casing.
 3. Pump shaft: Stainless steel Type 416.
 4. Lubrication: Water lubricated type pump.
 5. Pump Bowls: Cast Iron, stainless steel or bronze flanged and bolted.
 6. Pump Bearings: Bronze, radial type.
 7. Pump Head: Fabricated steel with continuous bypass for low seal pressure. Cast iron heads are prohibited. Pump head shall be lined same as pump barrel.
 8. Seal: Mechanical general purpose type, with sleeve mounting. Seal shall be rated at 1200 kPa (175 psig) maximum.
 9. Adjustable Spacer Coupling: Removable type required so that pump seal can be replaced without disturbing motor.
 10. Motor: Solid shaft motors balanced to 0.22 mm (0.0085 inch) vibration amplitude shall be operated at any point on the pump head curve without overloading the motor. Conform to NEMA Type 2.
 11. Pump Barrel: Schedule 40 steel pipe with two-coat "baked" internal lining to meet the potable water requirements of U.S. Food and Drug

- Administration. Bio-based materials shall be utilized when possible. Unlined pump barrels are prohibited. Provide drain tapping.
- E. Pressure Regulating Valves: System pressure shall be maintained by pilot-operated, diaphragm type pressure regulating valves, rated at 2070 kPa (300 psig) minimum, one for each pump. Valves shall be piloted to control system pressure and to cause the valve to act as a non-slam check valve. Pilot shall be rated at 1200 kPa (175 psig) minimum.
- F. Hydropneumatic Tank: Bladder type, hydropneumatic, designed and constructed in accordance with requirements of the ASME Pressure Vessel Code and stamped with appropriate symbol. Tank shall include pre-pressurized, sealed-in air cushion which shall accommodate pressure increases and expanded water volumes in the tank. Tank shall include butyl rubber or poly-propylene liner in lower, or water side of chamber. Minimum working pressure of tank shall be 1200 kPa (175 psig). Unit shall be designed and manufactured for domestic water applications. Insulate tank as specified. Check valve at hydropneumatic tank shall include small orifice for undue loading.
- G. Power and Control Panel: Class "A" shadow box double NEMA 1 enclosure, UL labeled, bonderized double prime coated with baked enamel finish:
1. Fused disconnect switches with external operating handles.
 2. Magnetic contactor for each motor with HOA switch.
 3. Door interlock.
 4. Thermal overload protection relay for each motor, three leg type.
 5. Running light for each motor.
 6. Power light for each motor.
 7. Control transformer, switch, circuit breaker, light.
 8. Lead pump failure protection.
- H. Motor and Starter: Maximum 40 degrees C (104 degrees F) ambient temperature rise, drip-proof type motor, ball bearings, voltage and phase as shown in schedule on Electrical drawings, conforming to NEMA Type 4. Motor shall be of such capacity that brake horsepower required

by driven equipment at normal rated capacity will not exceed nameplate rating of the motor. Refer to Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT. Provide each motor with automatic, fully enclosed, magnetic starter of type specified in Section 26 29 11, MOTOR CONTROLLERS.

I. Instrumentation: All instrumentation shall be factory installed and shall include the following 115 mm (4-1/2 inch) dial gages with shut-off cock.

1. Pump pressure gage for each pump.

2. System pressure gage.

3. Suction pressure gage.

J. Operating and Emergency Controls:

1. The pump station shall receive a 4-20mA signal from each pressure transducer, as provided by the pumping station manufacturer. A pressure transducer signal shall be provided for each pump controller. The differential pressure transducers shall monitor system discharge pressure versus suction line pressure and provide an analog signal 4-20mA to the pump control software, and allow the variable speed pump controller, to provide a variable Volts/Hz output to the motor. Once the pressure drops below the set system pressure, the pump shall start and provide system pressure (as determined by the station operator or program), if this pressure cannot be maintained by one pump, the next pump in sequence shall operate in a //lead/lag// //stand-by// capacity to provide the extra flow and pressure automatically without the use of additional panels or alternators. The sequence of the pumps shall be field adjustable, and completely automatic without additional panels or alternator controls. The variable speed pump controller shall be completely integrated with the VFD. Special type motors shall not be allowed. Refer to Section 22 05 12, GENERAL MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT. Pump assignments shall alternate as described below. All program settings shall be based on centrifugal pump language and centrifugal pumps. Program settings shall be field adjustable to provide onsite adjustments. When the system experiences low demand,

- the variable speed pump controllers shall reduce the speed of each pump, until demand has stopped. Pump controllers shall stop each pump at zero demand, without the use of external switches or controls.
2. The pumping system includes multiple pumps as indicated above. //In two-pump systems, the first (lead) pump operates initially, and the second pump serves as a lag pump capable of operating concurrently with the lead pump to add capacity when needed. The second pump also acts as a stand-by pump at lower demands, ready for operation if the lead pump is taken out of service.// //In three-pump systems, the lead pump, lag pump, and stand-by pump normally satisfy demand in three stages. The first (lead) pump operates initially, until the water demand exceeds the lead pump's capacity. The second (lag) pump starts and the lead pump stops, allowing the lag pump to operate until the water demand exceeds the lag pump's capacity. At this point, the lead pump restarts, and operates concurrently with the lag pump to add capacity when needed. The third pump is a stand-by pump, ready for operation if the lead or lag pump is taken out of service and the system demand requires two pumps. The system is to be configured so that at least two pumps can be in service if any one pump is taken out of service.// Pump assignments shall alternate to automatically equalize the run time in similarly sized pumps, which excludes uniquely-sized lead pumps.
 3. The pump logic controller shall provide the following standard user-selectable features:
 - a. Low Suction Pressure Alarm and Cut Out
 - b. High Suction Pressure Alarm and Cut Out
 - c. Low System Pressure Alarm
 - d. High System Pressure Alarm and Cut Out
 - e. High Temperature Alarm and Cut Out
 - f. Low Level Alarm and Cut Out
 - g. No-Flow Shut Down

- h. Audible/Visible alarm with push to silence feature
 - i. Overload Failure Alarm
 - j. Pump Failure Alarm
 - k. Pump operating order assignments
 - l. Minimum run timers to prevent short cycle operation.
4. Provide auxiliary contacts for remote communication with the BAS, including the following input/output points:
- a. Domestic water supply pressure (analog input to BAS)
 - b. Alarm condition activated (binary input to BAS)
 - c. Run status of lead pump (binary input to BAS)
 - d. Run status of lag pump (binary input to BAS)
 - //e. Run status of stand-by pump (binary input to BAS)//

K. Factory Test: The booster system and its component parts shall undergo a complete operation flow test from zero to 100 percent design flow rate under the specified suction and net system pressure conditions. The system certification shall include copies of the test and test data as performed in the factory prior to shipment. Performance test certifications should be placed inside the system control panel and two extra copies shall be provided to the COR with the installation manual.

PART 3 - EXECUTION

3.1 STARTUP AND TESTING

- A. Make tests as recommended by product manufacturer and listed standards and under actual or simulated operating conditions and prove full compliance with design and specified requirements. Tests of the various items of equipment shall be performed simultaneously with the system of which each item is an integral part.
- B. System Test: After installation is completed provide an operational test of the completed system including flow rates, pressure compliance, alarms and all control functions.

- C. When any defects are detected, correct defects and repeat test at no additional cost or time to the Government.
- D. The CxA will observe startup and contractor testing of selected equipment. Coordinate the startup and contractor testing schedules with the COR and CxA. Contractor shall provide a minimum of 10 working days prior to startup and testing.

//3.2 COMMISSIONING

- A. Provide commissioning documentation in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.
- B. Components provided under this section of the specification will be tested as part of a larger system.//

3.3 DEMONSTRATION AND TRAINING

- A. Provide services of manufacturer's technical representative for //four// // // hours to instruct VA Personnel in operation and maintenance of the system.
- //B. Submit training plans and instructor qualifications in accordance with the requirements of Section 22 08 00, COMMISSIONING OF PLUMBING SYSTEMS.//

- - - E N D - - -