

PART 1 GENERAL**1.1 RELATED DOCUMENTS**

- A. The requirements of the General Conditions, Supplementary Conditions and the following Specification sections apply to all Work herein:
1. Section 22 00 10 - General Requirements
 2. Section 22 00 20 - Plumbing Scope of Work
 3. Section 22 05 07 - Design Conditions
 4. Section 22 05 13 - Motor Requirements for Plumbing Equipment
 5. Section 22 05 48 - Vibration Isolation
 6. Section 22 05 93 - Testing, Balancing, and Adjusting
 7. Section 22 10 00 - Domestic Water Systems
 8. Section 22 12 00 - Potable Water Storage Tanks
 9. Section 22 13 00 - Sewage and Drainage System
 10. Section 22 30 00 - Plumbing Equipment

1.2 SUMMARY

- A. Furnish and install all pumps herein specified and as indicated on the Drawings.

1.3 REFERENCE STANDARDS

- A. All pumps shall be designed, manufactured and tested in accordance with the latest applicable industry standards including the following:
1. ANSI
 2. NSF/ANSI Standard 61 - Drinking Water System Components
 3. NSF/ANSI Standard 61, Annex F and Annex G
 4. NSF/ANSI Standard 372 Drinking water system components - Lead Content
 5. NEMA
 6. OSHA
 7. Energy Policy Act of 1992 (EP Act)
- B. All equipment and material to be furnished and installed on this Project shall be UL or ET listed, in accordance with the requirements of the authorities having jurisdiction, and suitable for its intended use on this Project.

1.4 SUBMITTALS

- A. The following submittal data shall be furnished according to the General Conditions and Section 22 00 10 and shall include, but not be limited to:
1. Domestic Cold Water Factory Package Pumping Systems* complete with capacity curves, test data, seals, construction details, motor horsepower, coupling and guard, electrical characteristics, pump rotation, casing temperature relief devices, pump controllers and control sequences. Provide certified factory test data and capacity curves for pumps* with motor horsepower exceeding 20 horsepower.
 2. Sewage Ejectors complete with capacity curves, test data, seals, construction details, motor horsepower, coupling and guard, electrical characteristics, rotation for pumps with motor horsepower exceeding 10 horsepower and pump controllers.
 3. Sump Pumps complete with capacity curves, test data, seals, construction details, motor horsepower, coupling and guard, electrical characteristics, rotation for pumps with motor horsepower exceeding 10 horsepower, and pump controllers.
 4. In-Line Pumps complete with capacity curves, test data, seals, construction details, motor horsepower, coupling and guard, electrical characteristics, rotation for pumps with motor horsepower exceeding 10 horsepower and pump controllers.
 5. Variable Speed Drives* complete with enclosure construction details, line reactor or tuned filter data, design features, accessories, disconnect, capacitor, mechanical bypass, if specified, and spare parts data.

6. Prior to execution of factory testing and lab testing, submit test procedures, recording forms, and test equipment cut sheets to Engineer for review. Refer to Section 22 00 20 titled "Scope of Work" for "Scheduling Procedures".
7. Factory Test Schedule.
8. Factory Test Reports.
 - a. Hydrostatic Test Reports
 - b. Dynamic Balance Reports
 - c. Factory Capacity Test Reports.
9. Certified Factory Performance Test Curves.*
10. Field Test Schedule
11. Field Test Reports.

- B. All items or equipment listed above with asterisks (*) shall be certified by the manufacturer using Manufacturer Certification "MCA" as set forth in Section 22 00 10. See Section 22 00 10 for certification requirements.

1.5 WARRANTY

- A. Comply with the requirements of the General Conditions and Section 22 00 10.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. If it complies with these Specifications, sewage ejectors manufactured by one of the following manufacturers will be acceptable:
1. ABS
 2. Aurora
 3. Flygt Corporation
 4. Gould
 5. K. J. Industrial Co., Ltd.
 6. Myers
 7. Paco
 8. Peerless
 9. Stancor
 10. Tsurumi
 11. Weil
- B. If it complies with these Specifications, factory prefabricated vertical domestic water pumping systems manufactured by one of the following manufacturers will be acceptable:
1. Canariis Corp.
 2. Liqui-Trol
 3. Metropolitan Pump Company
 4. Paco
 5. Syncroflo/Peerless
 6. Systecon
 7. TigerFlow
 8. Grundfos
- C. If it complies with these Specifications, in-line circulating pump (150 psig and below) manufactured by one of the following manufacturers will be acceptable:
1. Armstrong
 2. Bell & Gossett
 3. Grundfos
 4. Ingersoll-Rand
 5. Paco
 6. Peerless
 7. Taco

2.2 SEWAGE EJECTORS AND SUMP PUMPS (SUBMERSIBLE WITH GUIDE RAILS)

- A. Duplex sewage ejectors and sump pumps shall be located where shown on the Drawings and shall have the capacities listed in the schedules on the Contract Documents. Depth and diameter of sump pits will be as shown on the Structural Drawings.
- B. Ejector & Sump pits will be provided under another Division. The Plumbing Subcontractor shall furnish a steel "Z" frame and a steel plate cover for the pit to receive the gas tight sump pump cover. The frame will be installed under another Division. The sump pumps in electrical vaults will not have pit cover and shall be without guide rails.
- C. Furnish and install a gas tight steel cover of adequate size to cover the entire pit opening indicated on the Structural Drawings. Openings shall be provided in the cover for a vent, discharge piping, float controls, electrical conduit, etc., and a manhole with gas tight cover designed to permit removal of the pumps without removing the large gas tight cover shall be provided.
- D. Motor controllers shall be furnished by the Division 22 Subcontractors. See Section 22 05 13 titled "Motor Requirements for Plumbing Equipment" for Specification requirements.
- E. Furnish and install as shown on the Drawings a duplex, submersible, electric pump station. Each pump shall be rated to deliver the capacities listed in the schedules on the Contract Documents. Pumps shall be complete with power cables, lifting chains, discharge connections, discharge flanges, backwater valves, guide pipes, upper guide brackets, control panel, access covers, anchor bolts and assemblies, liquid level sensors and all appurtenances necessary for complete operation of the pumping system. The pumps shall be automatically connected to the discharge connection elbow when lowered into place and shall be easily removed from the pit via lifting chains and guide bars for inspection and service, without the need for personnel to enter the sump pit. Pit depth shall be as indicated by the Drawings.
- F. Sealing of the pumping units to the discharge connection shall be accomplished by a linear downward motion of the pump. The entire weight of the pump units shall be guided by guide bars and pressed tightly against the discharge connection elbow with metal-to-metal contact. A sliding guide bracket shall be an integral part of the pump unit. The pump, with its appurtenances and cable, shall be capable of continuous submergence under water, in the operating mode, without loss of watertight integrity to depths indicated on the Drawings. No portion of the pump or guidance system shall bear on the floor of the sewage ejector sump pit except the discharge connection elbow.
- G. All major pump components shall be of gray or ductile cast iron, Class 30 or equal. Surfaces shall be devoid of casting irregularities. Watertight seals shall be made of nitrile rubber or equal and exposed nuts and bolts shall be of 304 stainless steel. Pump exterior shall be coated with epoxy primer with chloric rubber paint finish or fused polymer coating.
- H. Cable entry seals shall insure a water tight and submersible seal, with a strain relief assembly separate from the function of sealing the cable. The cable entry junction chamber and motor shall be separated by a starter lead sealing gland or terminal board, which shall isolate the motor interior from foreign material gaining access through the pump top.
- I. Pump motor horsepower and speed shall be as listed in the schedules on the Contract Documents. Pump motors shall be squirrel cage induction shell type design, housed in an air filled, watertight chamber, NEMA Design "B" Type. The stator shall be heat shrunk to the housing. The stator winding and leads shall be insulated with moisture resistant Class F or Class E insulation. The stator shall be coated for moisture resistance. The motor shall be designed for continuous duty, capable of sustaining a minimum of ten (10) starts per hour.
- J. The junction chamber shall be sealed from the motor by elastomeric compression seal. Connections between the cable conductors and stator leads shall be watertight and leak proof.
- K. Each pump unit shall be provided with a cooling system. Thermal sensors shall be used to monitor stator temperature and shall be used in conjunction with a supplemental to external motor overload protection and shall be wired to the control panel or provide built in thermal sensors to sense both heat and motor current

- and open motor power circuit upon an improper heat rise and automatically reclose when the temperature drops.
- L. The pump shaft shall be stainless steel, ANSI 431. Each pump shall be provided with a tandem mechanical rotating shaft seal assembly in an oil reservoir. Lower seals between the pump and oil chamber and upper seals between the oil sump and motor housing shall be held in contact by independent systems. Seals shall require neither maintenance nor adjustment but shall be easily inspected and replaceable. The drain and inspection plug for the oil chamber shall be easily accessible from the outside and shall be leak proof.
 - M. The pump shaft shall rotate on two (2) permanently lubricated bearings. The impeller shall be of gray cast iron, Class 30, dynamically balanced, double shrouded, non-clogging design having long thru let without acute turns. The impeller for sewage ejector pumps shall be capable of handling raw, unscreened sewage, including solids, fibrous materials and heavy sludge. The impeller for sump pumps shall be capable of handling storm water and condensate wastes. The impeller shall be fitted to the shaft with one key in a sliding fit manner. Impeller and shaft vibrations shall not cause the key to disengage.
 - N. The volute shall be of a single piece construction with smooth fluid passages of dimensions not less than impeller through passages. A wear ring system or a field adjustable and replaceable wear plate shall be installed to provide sealing between the volute and impeller.
 - O. Pump manufacturer shall furnish characteristic curves for each pump, showing field performance. Tests shall include the unit's rated speed, head, capacity, efficiency, brake horsepower and other conditions required to establish the performance curve.
 - P. The pump manufacturer shall warrant the units being supplied, in writing, against defects in material and workmanship under conditions of normal use, operation and service. Refer to Section 22 00 10 for warranty requirements. Factory approved service personnel shall be available for startup and initial startup testing of the pumping system on the day scheduled by the Plumbing Subcontractor to ensure the system is in proper operating condition. The Plumbing Subcontractor shall notify the Engineer and Owner in writing three (3) weeks prior to testing and startup of the pumps.
 - Q. Access frame and cover shall be furnished complete with hinged and flush locking mechanism, upper guide holder and level sensors cable holders. Frame shall be securely placed, mounted above the pumps. Frame shall be provided with sliding nut rails to attach the accessories required. Lower guide bar holders shall be integral with the pump discharge connection. Guide bars shall be of galvanized steel pipe, of standard Schedule 40 weight or heavier. The guide bars shall not support any portion of the weight of the pump. Frames and covers shall be gas tight.
 - R. A factory wired integral pump control center shall be furnished for each motor, including a breaker/overload unit providing overload protection, short circuit protection, reset and disconnect for all phases, across-the-line magnetic contactors, hand/off/automatic (HOA) pump operations selector switch, overload device precalibrated to match motor characteristics, automatic electric alternator providing automatic alternating operation of pumps under normal conditions or in cases of high level, allowing both pumps to operate simultaneously. Terminal boards for connection of line, pump and level sensors shall be provided. Running lights shall be included on the panel. Control panel shall be pedestal mounted or wall mounted as indicated by the Drawings and shall be labeled "Sewage Ejection Pumps".
 - S. Alarms shall include a high-level alarm with local bell. Auxiliary dry contacts shall be provided for all alarm points for interface to the Division 25 "Building Management and Control System".
 - T. Liquid level sensors shall be furnished and installed with adequate electric cable. Level sensors shall be non-floating, displacement type, rated for operation at milliwatt levels.
 - U. Discharge piping shall be sized as indicated on the Drawings and shall be as specified in this Section. Discharge backwater valves and gate valves shall be located out of the pit and above the cover to allow proper lid operation and pump removal.
 - V. All field wiring required for a complete installation shall be furnished and installed by the Division 26 Electrical Subcontractor.

2.3 FACTORY PRE-FABRICATED VERTICAL DOMESTIC WATER PUMPING SYSTEMS

- A. Furnish and install three(3) factory-prefabricated domestic water pumping system(s) consisting of variable speed vertical multistage house pumps, solid or hollow shaft energy saver Type KS (NEMA Design B) motors, piping, valves, non-slam check valves and controls mounted on a fabricated steel base. Each complete pumping system must comply with OSHA and Federal Regulation 29CFR 1910.399 and 29CFR 1910.303 for independent third party total system certification. This Certification must be by UL or ETL. The domestic water pumping system(s) shall be located where indicated on the Drawings.
- B. Each pump shall have the capacities listed in the schedules on the Contract Documents. The pump construction shall be as follows:
1. Pumps shall be vertical water lubricated type turbine pumps equipped with cast iron enameled bowls or epoxy coated steel suction barrels, mixed flow balanced bronze impellers, stainless steel impeller shaft and line shaft with water lubricated bronze replaceable shaft bearings. The impeller shaft shall be adjustable vertically. The pump discharge head shall be cast iron or carbon steel with a steel baseplate and shall have mechanical surfaces for connections to the vertical shaft motor.
 2. Each pump shall be provided with a sleeve mounted mechanical seal as specified herein located at the suction end of the multistage bowl assemblies on pumps with top inlet and bottom discharge. The seal shall be replaceable without motor removal, pump disassembly, or disturbing the piping connections. The mechanical seals shall be pressure balanced Type 21 with tungsten carbide seals and stainless steel springs, as manufactured by John Crane Company or approved equal, suitable for the service specified herein and listed in the schedules on the Contract Documents. Mechanical seals located at the high pressure discharge end shall be equipped with a seal flushing line, and a "Doxie" separator to prevent abrasive particles from entering the seal chamber. The seal chamber shall be designed and equipped with a neoprene seal to minimize the pressure in the mechanical seal chamber.
 3. The entire pump assembly including, but not limited to, the casing or enclosure, suction and discharge flanges and seals shall be suitable for operation with the "Pump Working Pressure" and temperatures indicated in the schedules on the Contract Documents. For the purposes of this Specification, the "Pump Working Pressure" shall be defined as the sum of the scheduled maximum suction pressure and the maximum dynamic head at shut off developed by the pump required for pumping duty specified. The entire pump assembly shall be hydrostatically tested at the factory at least 50 psig above the "Pump Working Pressure".
 4. Pumps shall have dynamically balanced impellers.
 5. Critical speed shall be at least one hundred and fifteen (115%) percent of the running speed listed in the schedules on the Contract Documents.
 6. Pumps shall be free of flashing and cavitation at all flow rates from five (5%) percent to one hundred twenty-five (125%) percent of design flow under the suction conditions of the pump installation.
 7. Each motor shall have an aluminum or cast iron housing with cast iron end bells, copper windings, a maximum speed of 3600 rpm and shall be selected to drive the pump through its characteristic curve, without exceeding the rated full load motor nameplate horsepower. Pump motor nameplate rating shall not be exceeded in pump operation anywhere on the pump curve. Motor horsepower and speed shall be as listed in the schedules on the Contract Documents. See Section 22 05 13 titled "Motor Requirements for Plumbing Equipment" for additional requirements and listed motor manufacturers.
 8. If it complies with these Specifications, the factory prefabricated pumping systems shall utilize multistage vertical turbine pumps manufactured by one of the following manufacturers:
 - a. Floway
 - b. Gould
 - c. J-Line Pump
 - d. Metropolitan Pump Company
 - e. Paco
 - f. Peerless
 - g. Simmons
 - h. Grundfos
- C. The pumps may be partially disassembled with the motors removed prior to shipment if required to install the unit into the location indicated on the Drawings. Field reassembly shall be supervised by a factory engineer. Maximum height of the factory package pumping unit shall be coordinated with the physical space limitations of the pump location.
- D. The manufacturer shall provide a fabricated structural steel base. The base shall be of sufficient strength to prevent vibration, warping or misalignment of the pump and motor when installed without grouting. The

- base shall be leveled and rigidly bolted to the vibration isolation base. Suction and discharge piping shall be adequately supported from the structural steel base. At the Plumbing Subcontractor's option, the pump base and the concrete inertia base specified in Section 22 05 48 titled "Vibration Isolation" may be an integral unit. See Section 22 05 48 titled "Vibration Isolation" for inertia base requirements. The base must be configured such that all pumping system components are removable.
- E. Unless specified otherwise, the domestic cold water piping, valves, fittings, gauges, etc., furnished on the domestic water pumping unit shall be as specified in Section 22 10 00 titled "Domestic Water Systems" for the working pressure listed in the schedules on the Contract Documents. The domestic water pumping system shall be equipped with at least the following components:
1. Discharge full lug type butterfly stop valve and a discharge spring-loaded quiet type full lug body check valve on each pump.
 2. Suction full lug type butterfly stop valve on each pump.
 3. Suction and discharge headers as well as the branch piping and valves sized for a maximum velocity of 8 feet per second.
 4. One (1) suction header pressure gauge, one discharge header pressure gauge and a discharge pressure gauge for each pump. The gauges shall be flush mounted in a central gauge board adjacent to the control panel. All gauges shall be equipped with pressure snubbers. At the Subcontractor's option pressure sensors connected to the control panel may be furnished.
 5. Each pump shall be equipped with an electric type combination temperature probe and relief valve purge assembly suitable for the scheduled working pressure to prevent the water temperature at the pump casing from rising above 135°F during periods of no demand or low flows. The pressure relief valve and high temperature relief valve shall discharge into an adequately sized pressure absorbing expansion chamber/tank prior to discharge to the sewer.
 6. A flow meter or insertion type flow sensor similar to Data Industrial SDI Series flow sensor with a Data Industrial Series 1500 micro processor based digital flow monitor shall be provided for the purpose of activating and deactivating pumps in response to system demand. The flow meter sensor shall be located in a prefabricated spool piece manufactured by the pumping system manufacturer for each pumping system. The prefabricated assembly must incorporate the flow meter manufacturer's recommended upstream and downstream distances and straightening vanes if required. The flow meter or sensor shall be of stainless steel construction. The meter shall have an accuracy of at least $\pm 1\%$ and a repeatability of at least $\pm 0.5\%$.
- F. The control system shall consist of a UL listed NEMA Design 12 or 3R steel enclosure, with all devices factory mounted and wired. Each pump shall be wired to the control panel. The control panel shall be UL labeled and shall include at least the following:
1. A nonfused disconnect switch mounted in the cabinet door with an interlocking external door handle for each pump. See the Electrical Drawings for the feeder arrangement to the system.
 2. A variable speed drive controller and a compatible inverter rated pump motor shall be provided by the pump manufacturer for each pump. Each variable speed drive controller shall be as specified herein. The variable speed drive controllers shall utilize local and remote pressure transmitters, feedback pressure transmitters and variable set point controllers to maintain adequate system pressure at the hydraulically most remote point and to shut down the pumps.
 3. A hand-off-automatic or selector switch and run light or a touch pad control device mounted in the panel door for each pump.
 4. Automatic alternator with manual override selector switch to interchange the equal capacity pumps in each system or a manual transfer switch in conjunction with an operator keypad control.
 5. Stainless steel pressure transducers with a minimum accuracy of one (1%) percent of full scale as required to accomplish the control sequence specified below. Pressure switch shall be suitable for the working pressure listed in the schedules on the Contract Documents, with a NEMA 1 enclosure and a range suitable for the service intended.
 6. A solid state programmable PLC controller with operator interface and keypad, which will operate the pumps in the sequence specified herein and control time delays, minimum run time and automatic system diagnosis. Program shall be contained on a disc or a cassette, which can be replaced for a new program.
 7. 120V control power transformer with cabinet door mounted fused disconnect to operate switches and controls in panels. Control power shall be obtained from the emergency power source on the line side of the lead pump disconnect switch.
 8. A digital flow monitor similar to Data Industrial Model 900T or 950T indicator, which shall be fully compatible with the system flow meter sensor, which and continuously displays the system flow in

- gallons per minute. Control output shall be provided as required to accomplish the specified pump control sequence. All set points shall be individually adjustable.
9. An adjustable zero to thirty (0-30) minutes minimum run timers for each pump initially set at ten (10) minutes.
 10. An elapsed run time meter for the entire pump assembly.
 11. Manual reset and silence push button(s) for all alarm conditions.
 12. Low suction pressure alarm, low system pressure alarm, pressure and/or temperature relief valve activation.
 13. All necessary dry contacts and relays as required for interface with the Building Control System provided by Division 25.
 14. The domestic water pump control software programming and protocol shall support Danfoss/Graham variable speed drives and at least one additional acceptable manufacturer listed herein. Provide a BacNet or Modbus or equipment interface between the Division 25 BMCS and the domestic water pump control unit.
- G. The domestic water pumping system control sequence shall be as follows:
1. The controls for each system shall start and stop the pumps automatically. The starting and stopping of each pump shall be accomplished without causing a sudden pressure change in the building domestic water system.
 2. The three (3) equally sized pumps shall operate at variable speed and automatically alternate duty.
 3. During periods of low or no demand, the pump shall be stopped when a pressure transmitter located at the remote storage hydropneumatic tank and a flow switch or flow meter located at the pumping system, indicates the pumps are operating at shutoff and there is no flow. If the system pressure then drops to a predetermined setpoint, a pump shall start to charge the storage tank to maintain system pressure.
 4. Each system shall be equipped with pressure switches and alarm circuits as required to control operation of the pumps under the emergency conditions specified below. Each condition shall activate a visual and audible alarm at the local pump control panel and through dry contacts signal an alarm at the remote Building Control System provided by Division 25. All conditions shall include a time delay to prevent nuisance alarms at the local control panel.
 - a. A low system pressure condition shall stop the lead pump and start the lag pump. If the system pressure has not returned to normal within five (5) seconds, all pumps shall be stopped. The time delay shall be adjustable from zero to thirty (0-30) seconds.
 - b. Activation of any pressure and/or temperature relief valve on a pressure reducing station shall stop all pumps in the system serving the station.
 - c. Activation of any relief valve on a pressure reducing station shall activate the visual and audible alarm only.
 - d. A low suction pressure condition shall stop all pumps. Pressure setting shall initially be set at 10 psig.
- H. The water pressure systems shall operate satisfactorily with no excessive noise, vibration or motor overload throughout the full range of flows.
- I. Each system shall include a factory pre-charged potable water storage tank with a FDA approved internal coating located as shown on the Drawings. See Section 22 12 00 titled "Potable Water Storage Tanks" for Specification requirements.
- J. The pumps and control system will be purchased under a unit contract stipulating compliance with these Specifications and satisfactory performance of the pumping units and storage tank when installed where indicated on the Drawings. The pump manufacturer shall assume unit responsibility and shall provide supervision at the time of installation and startup to insure proper operation of the pumping unit. In accepting this contract, the domestic water pumping manufacturer shall guarantee the system to give capacities and pressures not less than those specified with the pumping units installed as indicated on the Drawings and will be required to meet the guarantee at no additional cost to the Owner, regardless of the extent of the revisions required.
- K. The pump assembly wiring shall be designed for two separate electrical services. One (1) lead pump shall be wired to the emergency power supply service and all other pumps connected to the normal power service. The pumping system controls shall be wired to the emergency power supply service.

- L. Each factory assembled variable speed pumping system shall have a complete factory operating and sequence test, capacity performance test, and hydrostatic test prior to shipment. The test shall include a system operating flow test from zero to one hundred (0-100%) percent of design flow for the pumping unit with the specified suction and net discharge pressure conditions specified in the schedules on the Contract Documents. The accuracy of the system flow meter shall be verified with an independently calibrated test flow meter. The factory operating and performance test may be witnessed by the Engineer and Owner. The Mechanical Subcontractor shall notify the Engineer and Owner in writing at least three (3) weeks prior to the factory performance test. Before the pumping assembly is shipped from the factory, the manufacturer shall transmit certified factory performance test data for factory testing including flow, head and horsepower at all flow rates, an X-Y plot of the system flow test and certifications that the pumps have been satisfactorily tested as specified herein and are in compliance with the requirements of the Contract Documents. The certified factory test data and performance test curves shall accompany the certified letter. The pumping system shall not be installed at the Project Site before the test data has been reviewed by the Engineer.
- M. The entire assembly shall be painted with two (2) coats of enamel after shop testing.
- N. All operating controls and safety devices must be demonstrated after the system has been installed and put into operation at the Project Site by the pump manufacturer's factory engineer.

2.4 AIR HANDLING UNIT CONDENSATE PUMP

- A. Provide and install condensate return systems as indicated on the Drawings with the capacity indicated in the schedules on the Contract Documents.
- B. System shall be a simplex pumping system with a cast iron sump having an inlet center line no higher than 7". Pumps shall be all bronze construction with stainless steel shafts and built in brass strainer.
- C. Control shall be a float switch in a NEMA 1 enclosure.
- D. Condensate systems shall be similar and approved equal to Weil Series 4100.

2.5 DOMESTIC HOT WATER CIRCULATING PUMP

- A. In-line circulating pumps shall be bronze fitted with a dynamically balanced brass enclosed type impeller and with mechanical seal. Mechanical seal shall be Type 1 or 2 material code BP-1D1 as manufactured by John Crane Company, or an approved equal, suitable for service specified and listed in the schedules on the Contract Documents. Motor shall have a maximum speed of 1750 rpm. Pump capacities shall be as listed in the schedules on the Contract Documents.
- B. Pumps, casings, flanges and seals shall be suitable for operation with the working pressures and temperatures indicated in the schedules on the Contract Documents. The scheduled working pressure applies to the entire pump assembly.

PART 3 EXECUTION

3.1 INSTALLATION

- A. All pumps shall be installed in accordance with the latest industry standards, per the manufacturer's recommendations, and as indicated on the Drawings.

3.2 FACTORY TESTING

- A. All pumps shall be tested in accordance with the latest applicable industry standards and as specified herein.

3.3 FIELD TESTING

- A. Refer to Section 22 05 93 for additional testing requirements for pumps.

END OF SECTION