SECTION 43 25 00
SUBMERSIBLE LIQUID PUMPS

PART 1 – GENERAL

1.01 SUMMARY

A. Section Includes

1. Raw Sewage Submersible Pumps

2. Accessories (discharge connection and guiderails)

1.02 REFERENCES

A. American Society for Testing and Materials (ASTM): Latest Edition

1. ASTM A-48: Standard Specification for Gray Iron Castings

2. ASTM A479: Standard Specification for Stainless Steel Bars

3. ASTM A-532: Standard Specification for Abrasion-Resistant Cast Irons

B. National Electric Manufacturers Association

1.03 SYSTEM DESCRIPTION

A. Furnish, install and place into operation a functional pumping system complete with motors, variable frequency drives, discharge connection, anchor bolts, guide rails, controls and all accessory equipment for a complete working installation.

B. Pumps and Controls shall be provided by a single responsible entity. Refer to Division 40 for Instrumentation and Control System Equipment requirements.

C. Pump manufacturer's cable shall be of sufficient length to be installed without splicing from the pump location to the control panel termination while providing a minimum of 2' coiled cable within the wet well.

1.04 SUBMITTALS

A. Comply with Section 01 33 00.

B. Product Data

1. Characteristic Pump Performance Curves
2. Electrical Motor Data
3. Typical Installation Guides

4. Technical Manuals

5. Operation and Maintenance Data: As defined in Section 01 73 00

6. Parts List

C. Shop Drawings

1. Pump Outline Drawing, including baseplate

2. Station Drawing for Accessories

D. Quality Assurance/Control Submittals

1. Test Reports: Prior to shipment of pumps from the factory, complete test runs shall be made on each pump under the capacity and head conditions specified. Characteristics of centrifugal pumps may have a tolerance of plus 10 percent of rated capacity at rated head or plus 5 percent of rated head at rated capacity. No minus tolerance will be acceptable. Certified copies of these tests in triplicate shall be furnished. The curves provided shall show the results of tests for capacities, heads, efficiencies and brake horsepower throughout the entire range of the pump being furnished.

2. Manufacturer's Equipment Storage Requirements

3. Manufacturer's Standard Recommended Start-Up Report Form.

1.05 QUALITY ASSURANCE

A. In order to achieve standardization of operation, maintenance, spare parts, and manufacturer's service, pumps complete with mechanical seals and motor units shall be manufactured by Flygt. Where applicable based on specific station design conditions, pump model shall be one of the following:

1. Flygt Model NP-3102.095 (463 Impeller)

2. Flygt Model NP-3127.095 (488 Impeller)

3. Flygt Model NP-3153.095 (276 Impeller)

4. Where one of the aforementioned models does not meet the design conditions of the specific station, submit an alternate Flygt Model recommendation to the Authority for review.

B. Regulatory Requirements

1. Comply with all conditions of the Pennsylvania Department of Environmental Protection Water Quality Management Permit (where applicable)

2. Comply with all conditions of the University Area Joint Authority Sewer Extension Agreement (where applicable)

3. NFPA 820: Standard for Fire Protection in Wastewater Treatment and Collection Facilities (latest edition). Wet wells

C. The pump(s) shall be heavy duty, electric submersible, centrifugal non-clog type units designed for handling raw, unscreened sewage and wastewater and shall be fully guaranteed for this use. The pumps provided shall be capable of operating in an ambient liquid temperature of 104 °F.

D. The pump and motor unit shall be suitable for continuous operation at full nameplate load while the motor is completely submerged, partially submerged or totally non-submerged. The use of shower systems, secondary pumps or cooling fans to cool the motor shall not be acceptable.

1.06 DELIVERY, STORAGE, AND HANDLING

A. Packing, Shipping, Handling, and Unloading: Comply with Manufacturer's recommendations.

B. Storage and Protection: Comply with Manufacturer's recommendations. Protect equipment from damage.

1.07 SYSTEM START UP

A. The equipment manufacturer shall furnish the services of a qualified factory trained field service engineer for an eight-hour work day at the site to inspect the installation and instruct the owner's personnel on the operation and maintenance of the pumping units. After the pumps have been completely installed and wired, the contractor shall have the manufacturer conduct the following:

1. Megger stator and power cables
2. Check seal lubrication
3. Check for proper rotation
4. Check power supply voltage
5. Measure motor operating load and no load current
6. Check level control operation and sequence

B. During initial inspection, the manufacturer's service representative shall review recommended operation and maintenance procedures with the owner's personnel.

1.08 MAINTENANCE

A. Extra Materials

1. Provide one (1) spare impeller

2. Where the installed pump model is not listed in Paragraph 1.05 A, provide a complete spare pump.

PART 2 – PRODUCTS

2.01 MANUFACTURERS

A. SUBMERSIBLE LIQUID PUMPS

1. Flygt

2.02 SUBMERSIBLE LIQUID PUMPS

A. Pump Design Configuration

1. The pump shall be supplied with a mating cast iron discharge connection and be capable of delivering the design flow and the design head conditions. The pump(s) shall be automatically and firmly connected to the discharge connection, guided by no less than two guide bars extending from the top of the station to the discharge connection. There shall be no need for personnel to enter the wet-well. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal to metal watertight contact. No portion of the pump shall bear directly on the wet well floor. Each pump shall be fitted with adequate length of stainless steel lifting chain. The working load of the lifting system shall be 50% greater than the pump unit weight.

B. Pump Construction

1. Major pump components shall be of grey cast iron, ASTM A-48, Class 35B, with smooth surfaces devoid of blow holes or other irregularities. The lifting handle shall be of stainless steel. All exposed nuts or bolts shall be of stainless steel construction. All metal surfaces coming into contact with the pumped media, other than stainless steel or brass, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish on the exterior of the pump.

2. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile O-rings. Fittings shall be the result of controlled compression of rubber O-rings in two planes and O-ring contact of four sides without the requirement of a specific torque limit.

C. Cable Entry Seal

1. The cable entry seal design shall preclude specific torque requirements to insure a watertight and submersible seal. The cable entry shall consist of dual cylindrical elastomer grommets, flanked by washers, all having a close tolerance fit against the cable outside diameter and the entry inside diameter. The grommets shall be compressed by the cable entry unit, thus providing a strain relief function. The assembly shall provide ease of changing the cable when necessary using the same entry seal. The cable entry junction chamber and motor shall be sealed from each other, which shall isolate the stator housing from foreign material gaining access through the pump top. Epoxies, silicones, or other secondary sealing systems shall not be considered equal.

D. Motor

1. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings shall be insulated with moisture resistant Class H insulation rated for

180°C (356°F). The stator shall be insulated by the trickle impregnation method using Class H monomer-free polyester resin resulting in a winding fill factor of at least 95%. The motor shall be inverter duty rated in accordance with NEMA MG1, Part 31.The stator shall be heat-shrink fitted into the cast iron stator housing. The use of multiple step dip and bake-type stator insulation process is not acceptable. The use of pins, bolts, screws or other fastening devices used to locate or hold the stator and that penetrate the stator housing are not acceptable. The motor shall be designed for continuous duty while handling pumped media of up to 104°F. The motor shall be capable of no less than 30 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of aluminum. Three thermal switches shall be embedded in the stator end coils, one per phase winding, to monitor the stator temperature. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the motor control panel. The junction chamber shall be sealed off from the stator housing and shall contain a terminal board for connection of power and pilot sensor cables using threaded compression type terminals. The use of wire nuts or crimp-type connectors is not acceptable. The motor and the pump shall be produced by the same manufacturer. Motor shall be FM rated explosion proof Class 1, Division1, Groups C & D.

2. The motor service factor (combined effect of voltage, frequency and specific gravity) shall be 1.15. The motor shall have a voltage tolerance of +/- 10%. The motor shall be designed for continuous operation in up to a 40°C ambient and shall have a NEMA Class B maximum operating temperature rise of 80°C. A motor performance chart shall be provided upon request exhibiting curves for motor torque, current, power factor, input/output kW and efficiency. The chart shall also include data on motor starting and no-load characteristics.

3. Motor horsepower shall be sufficient so that the pump is non-overloading throughout its entire performance curve, from shut-off to run-out. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

E. Bearings

1. The integral pump/motor shaft shall rotate on two bearings. The motor bearings shall be sealed and permanently grease lubricated with high temperature grease. The upper motor bearing shall be a two row angular contact ball bearing to handle radial loads. The lower bearing shall be a two row angular contact ball bearing to handle the thrust and radial forces. The minimum L10 bearing life shall be 50,000 hours at any usable portion of the pump curve.

F Mechanical Seals

1. Each pump shall be provided with a positively driven dual, tandem mechanical shaft seal system consisting of two seal sets, each having an independent spring. The lower primary seal, located between the pump and seal chamber, shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide ring. The upper secondary seal, located between the seal chamber and the seal inspection chamber shall be a leakage-free seal. The upper seal shall contain one stationary and one positively driven rotating corrosion and abrasion resistant tungsten-carbide seal ring. The rotating seal ring shall have small back-swept grooves laser inscribed upon its face to act as a pump as it rotates, returning any fluid that should enter the dry motor chamber back into the lubricant chamber. All seal rings shall be individual solid sintered rings. Each seal interface shall be held in place by its own spring system. The

seals shall not depend upon direction of rotation for sealing. Mounting of the lower seal on the impeller hub is not acceptable. Shaft seals without positively driven rotating members or conventional double mechanical seals containing either a common single or double spring acting between the upper and lower seal faces are not acceptable. The seal springs shall be isolated from the pumped media to prevent materials from packing around them, limiting their performance.

2. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and shall provide capacity for lubricant expansion. The seal lubricant chamber shall have one drain and one inspection plug that are accessible from the exterior of the motor unit. The seal system shall not rely upon the pumped media for lubrication.

3. The area about the exterior of the lower mechanical seal in the cast iron housing shall have cast in an integral concentric spiral groove. This groove shall protect the seals by causing abrasive particulate entering the seal cavity to be forced out away from the seal due to centrifugal action.

4. A separate seal leakage chamber shall be provided so that any leakage that may occur past the upper, secondary mechanical seal will be captured prior to entry into the motor stator housing. Such seal leakage shall not contaminate the motor lower bearing. The leakage chamber shall be equipped with a float type switch that will signal if the chamber should reach 50% capacity.

G. Pump Shaft

1. The pump and motor shaft shall be a single piece unit. The pump shaft is an extension of the motor shaft. Shafts using mechanical couplings shall not be acceptable. The shaft shall be stainless steel – ASTM A479 S43100-T. Shaft sleeves are not be acceptable.

H. Impeller

1. The impeller shall be of Hard-Iron^{TM} (ASTM A-532 (Alloy III A) 25% chrome cast iron), dynamically balanced, semi-open, multi-vane, back swept, screw-shaped, non-clog design. The impeller leading edges shall be mechanically self-cleaned automatically upon each rotation as they pass across a spiral groove located on the volute suction. The leading edges of the impeller shall be hardened to Rc 60 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter normally found in wastewater. The screw shape of the impeller inlet shall provide an inducing effect for the handling of up to 5% sludge and rag-laden wastewater. The impeller to volute clearance shall be readily adjustable by the means of a single trim screw. The impeller shall be locked to the shaft, held by an impeller bolt and shall be coated with alkyd resin primer.

I. Volute

1. The pump volute shall be a single piece grey cast iron, ASTM A-48, Class 35B, non-concentric design with smooth passages of sufficient size to pass any solids that may enter the impeller. Minimum inlet and discharge size shall be as specified. The volute shall have a replaceable suction cover insert ring in which are cast spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide trash release pathways and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The insert ring shall be cast of Hard-IronTM (ASTM A-532 (Alloy III A) 25% chrome cast

iron) and provide effective sealing between the multi-vane semi-open impeller and the volute housing.

J. Protection

1. Each pump motor stator shall incorporate three thermal switches, one per stator phase winding and be connected in series, to monitor the temperature of the motor. Should the thermal switches open, the motor shall stop and activate an alarm. A float switch shall be installed in the seal leakage chamber and will activate if leakage into the chamber reaches 50% chamber capacity, signaling the need to schedule an inspection.

2. The thermal switches and float switch shall be connected to a Mini CAS control and status monitoring unit. The Mini CAS unit shall be designed to be mounted in the pump control panel.

2.03 ACCESSORIES

A. Guide Rail System

1. Provide a guide rail system for each pump consisting of two 304 stainless steel schedule 40 guide rails with upper guide rail mounting bracket, and intermediate guide brackets every 10 feet.

2. Guide rail system shall facilitate the removal and installation of the pump and shall align the pump with the discharge elbow as it is lowered into place.

3. Guide rails under 20’ in total length shall be continuous.

4. Diameter of the guide rail system shall be as recommended by the pump manufacturer for the specific model of pump used.

5. All hardware to be 304 stainless steel.

B. Discharge Connection

1. Discharge connection shall be manufactured by the pump manufacturer and shall be specifically paired with the pump model.

2. Discharge connection shall support the total weight of the pumping unit. The base shall be bolted directly to the floor with the 90 degree elbow having a 125 lb. ANSI flange discharging vertically.

2.04 FINISHES

A. Manufacturers standard finish

PART 3 – EXECUTION

3.01 PREPARATION

A. Protection

1. Protect the wet well liner from damage during installation of pumps and accessories. If damage occurs, provide a field welded repair patch in accordance with the liner manufacturer's recommendations.

B. Wet Well Preparation

1 Coordinate installation of wet well concrete fillet.

3.02 INSTALLATION

A. Maintain Manufacturer's recommended clearance between pumps and between the wet well floor and the pump suction.

B. Discharge Connection (aka pump base) shall be grouted after initial fitting and alignment, but before final bolting of the connection piping. After final alignment and bolting, pump connections shall be tested for applied piping stresses by loosening the flange bolts. If any movement or opening of the joints is observed, piping shall be adjusted to ensure that piping stresses are not transmitted to the pump flanges.

C. Install, level, and align pumps as indicated on project drawings. Installation must be in accordance with written instructions supplied by the manufacturer.

D. Check motor and control data plates for compatibility to site voltage. Install and test the electrical ground prior to connecting line voltage to pump control panel.

3.03 FIELD QUALITY CONTROL

A. Manufacturer's Pre-Startup Protection

1. Coordinate system pre-startup with manufacturer's factory-trained service technician. The factory-trained service technician will inspect the installation and answer any installation questions by the Contractor, Engineer, or Authority.

2. Verify that operations and maintenance manual is on site and installation instructions contained in the manual have been followed.

3. Verify that all pumping equipment, piping, level control system, alarms and ancillary equipment has been properly installed and all wiring is complete.

4. Verify that all spare parts for the pumping equipment are on site.

5. Pre-startup inspection shall be a separate trip and shall not be less than two weeks prior to the startup of the equipment.

6. Demonstrate pump installation (including proper seal to discharge connection) and removal using guide rail system.

B. Pumping Equipment:

1. Prior to acceptance by the Authority, an operational test of all pumps drives, and control systems shall be conducted to determine if the installed equipment meets the purpose and intent of the specifications. Tests shall demonstrate that all equipment is electrically, mechanically, structurally, and otherwise acceptable; it is safe and in optimum working condition; and conforms to the specified

operating characteristics. Testing performed upon each pump shall include the following:

a. Impeller, motor rating and electrical connections shall be checked for compliance with this specification.

b. Prior to submergence, each pump shall be run dry to establish correct rotation.

c. Each pump shall be run submerged in water.

d. Motor and cable insulation shall be tested for moisture content or insulation defects.

e. Prior to start-up, clean wet well by removing construction debris and foreign material.

B. Manufacturers' Field Services

1. Refer to Paragraph 1.07, herein.

3.04 PROTECTION

A. The pumping equipment should be placed into service soon after delivery of the equipment. If installation is delayed, the equipment and motor control center shall be stored indoors, free of excessive dust, in a low humidity, heated environment.

B. During installation and after the pumping equipment is placed into operation the motor control center shall operate in an environment free of excessive dust, in a low humidity, heated environment.

END OF SECTION