

SECTION 15032

SUBMERSIBLE WASTEWATER PUMPS

PART 1 GENERAL

1.01 SCOPE

This section provides for providing and installing submersible wastewater pumps with electric motors, controls, and accessories. Diesel powered hydraulically operated submersible wastewater pumps are provided for in specification Section 15033.

1.02 PAYMENT

No separate payment will be made for equipment and work performed under this section. Include the cost of such equipment and work in the bid item unit price for which this is related.

1.03 QUALITY ASSURANCE

Provide highest quality workmanship and materials throughout. Furnish standard equipment from a manufacturer with at least five (5) years of experience in the design and assembly of water and wastewater treatment equipment.

1.04 SUBMITTALS

- A. Product Data. Submit six (6) copies of complete descriptive data for pumps and drivers, including, but not to be limited to the following: pump curves (high lite project specific performance points), NPSH requirements, horsepower requirements, project specific pump efficiency at all service points, materials of construction for pump components, solids handling capability and complete description of driver including horsepower, electrical characteristics, bearing life ratings, motor jacket insulation and insulation ratings.
- B. Shop Drawings. Submit in accordance with Section 01300.
- C. Manufacturer's Report. The manufacturer shall review the systems design in all matters relative to the proper operation of the equipment, including piping, valves, electrical service, automatic controls, alarms, locations, and related items. With the shop drawings, the manufacturer must submit a letter to the Owner's Representative stating that the design is satisfactory to the manufacturer and that the equipment will operate satisfactorily under the project design conditions.

Upon completion of installation and in addition to the operational letter, a service engineer employed by the manufacturer will provide the Owner with a written report of start-up set points and calibrations. Final settings will be reviewed.

1.05 NOISE AND VIBRATION

Select equipment to operate with minimum of noise and vibration. If, in the opinion of the Owner's Representative, objectionable noise or vibration is produced or transmitted to or through building structure by equipment, piping ducts, or other parts of work, rectify such conditions without change in the contract sum.

PART 2 PRODUCTS

2.01 SUBMERSIBLE PUMPS

- A. Manufacturer. As indicated provide non-clog pumps as manufactured by Flygt, ABS, or approved equal. Each pump shall be furnished with a sufficient length of 13-2-1 hypalon jacketed type SPC cable to extend from the pump to the junction box or control panel outside of the pump containment structure. Each pump used in a submersible application shall be supplied with 316 stainless steel chain of adequate strength, and length, to permit lifting and lowering the pump without wet well entry.
- B. Capacity and Efficiency
 - 1. Head losses through the pump are not included in the total pumping head and suction head. Use pumping head and other terms as defined in the Standards of the Hydraulic Institute (ANSI/HI) as currently amended.
 - 2. Supply pumps having peak design operating point within twenty Percent (20%) of peak efficiency. Pumps with curves constantly rising toward shut-off are preferred. Standard Maximum and minimum impellers are not to be used for initial conditions, except in special cases, and then only with approval of the Owner's Representative.
- C. Pump Characteristics. The pumps shall meet all of the design and performance requirements as outlined on the table "Pump Characteristics" on the drawings.
- D. Pump Design. The pump(s) shall be capable of handling raw unscreened sewage. The pump discharge piping shall include either a connection elbow permanently installed in the wet well along with the discharge piping or a threaded pipe connection on grinder units, 1.5 Hp and smaller. If a permanent elbow is used in a submersible application, the pump(s) shall be automatically connected to the discharge connection elbow when lowered in place, and shall be easily removed for inspection or service. Sealing of the pumping unit to the discharge connection elbow shall be accomplished by a simple linear downward motion of the pump. Using either type of connection system, there shall be no need for personnel to enter the lift station wet well.

A sliding guide bracket shall be an integral part of the pump unit. The entire weight of the pumping unit shall be guided by no less than two stainless steel

guide bars or rails. When using a permanent elbow the pump shall be laterally supported by the guide bars (rails) and pressed tightly against the discharge connection elbow, with metal-to-metal contact. All mating surfaces where watertight sealing is required shall be machined and fitted with nitrile rubber O-rings. Fitting shall be such that sealing is accomplished by metal to metal contact between machined surfaces, resulting in controlled compression of nitrile rubber O-rings without the requirement of a specific torque limit to affect this. No secondary sealing compounds, rectangular gaskets, elliptical "O"-rings, grease or other devices shall be used. No portion of the pump shall bear directly on the floor of the sump. The pump, with its appurtenances and cable, shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 60 feet. Submersible grinder pumps (where specified) may have the pump casing resting on the floor via mounting legs and may use an O-ring sealing arrangement.

Alternatively, when the pump is used in a dry pit (non-submersible) application a permanent bolt down mounting base is to be supplied by the manufacturer. This mounting base is to be close-coupled to the pump suction connection and be constructed of either gray cast or ductile iron with a standard flange coupling pattern on both connection ends.

- E. Pump Construction. Major pump components shall be of gray cast iron, Class 30, with smooth surfaces devoid of blow holes and other irregularities. Where watertight sealing is required, O-rings made of nitrile rubber shall be used. All exposed nuts and bolts shall be of stainless steel 316. All surfaces coming into contact with sewage, other than stainless steel, shall be protected by an approved sewage resistant coating. Pump exterior shall be sprayed with zinc primer and a high solids epoxy finish.
- F. Cable Entry. 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 acceptable.
- G. Pump Motors
 - a. Pump Motor 10 horsepower and below. Cooling characteristics suitable to permit continuous operation in totally submerged, partially submerged, or non-submerged conditions without overheating. 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 bolts, pins or other fastening devices requiring penetration of the stator housing is not acceptable. The motor shall be designed for continuous duty handling pumped media of 40°C (104°F) and capable of no less than 15 evenly spaced starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches set to open at 125°C (260°F) shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction with and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber containing the terminal board shall be hermetically sealed from the motor by an elastomer compression seal. Connection between the cable conductors and stator leads shall be made with threaded compression type binding posts permanently affixed to a terminal board. The motor and the pump shall be produced by the same manufacturer.

The pump shaft shall rotate on two bearings. Motor bearings shall be permanently grease lubricated. The upper bearing shall be a single deep groove ball bearing. The lower bearing shall be a two row angular contact bearing to compensate for axial thrust and radial forces. Single row lower bearings are not acceptable.

The combined service factor (combined effect of voltage, frequency and specific gravity) shall be a minimum of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. The motor shall be designed for operation up to 40°C (104°F) ambient and with a temperature rise not to exceed 80°C. A performance chart shall be provided showing curves for torque, current, power factor, input/output kW and efficiency. This chart shall also include data on starting and no-load characteristics.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of

continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

Securely affix in a conspicuous place on each pump and motor a standard stainless steel nameplate showing the serial number and name of the manufacturer. Also, show the capacity in gallons per minute at rated rpm and head in feet, impeller diameter, horsepower, speed and electric current characteristics. Nameplates with distributing agents only are not acceptable.

- b. Pump Motor above 10 horsepower and below 100 horsepower. Cooling characteristics suitable to permit continuous operation in totally submerged, partially submerged, or non-submerged conditions without overheating. 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 15 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.

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 single ball type 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

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 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.

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.

The power cable shall be sized according to the NEC and ICEA standards and shall be of sufficient length to reach the junction box without the need of any splices. The outer jacket of the cable shall be oil resistant chlorinated polyethylene rubber. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet or greater.

The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

Securely affix in a conspicuous place on each pump and motor a standard stainless steel nameplate showing the serial number and name of the manufacturer. Also, show the capacity in gallons per minute at rated rpm and head in feet, impeller diameter, horsepower, speed and electric current characteristics. Nameplates with distributing agents only are not acceptable.

- H. Pump Shaft and Seals. 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 will not be acceptable.

Each pump shall be provided with a tandem mechanical shaft seal system consisting of two independent seal assemblies. The seals shall operate in a lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate. The lower, primary seal unit, located between the pump and the lubricant chamber, shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide ring. The upper, secondary seal unit, located between the lubricant chamber and the motor housing, shall contain one stationary and one positively driven rotating, corrosion resistant tungsten-carbide seal ring. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment nor depend on direction of rotation for sealing. The position of both mechanical seals shall depend on the shaft. Mounting of the lower mechanical seal on the impeller hub will not be acceptable. For special applications, other seal face materials shall be available.

Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The drain and inspection plug, with positive anti-leak seal shall be easily accessible from the outside. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate dry without damage while pumping under load. Seal lubricant shall be FDA Approved, nontoxic.

- I. Impellers. Non-clog: The impellers shall be of gray cast iron, Class 35B, dynamically balanced, semi-open, multi-vane, back-swept, non-clog design. The impeller vane leading edges shall be mechanically self-cleaned upon each rotation as they pass across a spiral groove located on the volute suction which shall keep them clear of debris, maintaining an unobstructed leading edge. The impeller(s) vanes shall have screw-shaped leading edges that are hardened to Rc 45 and shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in waste water. The screw shape of the impeller inlet shall provide an inducing effect for the handling of sludge and rag-laden wastewater. Impellers shall be locked to the shaft and held by an impeller bolt.

The pump volute shall be a single piece gray 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 volute insert ring containing spiral-shaped, sharp-edged groove(s). The spiral groove(s) shall provide the relief path and sharp edge(s) across which each impeller vane leading edge shall cross during rotation so to remain unobstructed. The internal volute bottom shall provide

effective sealing between the multi-vane semi-open impeller and the volute. The insert ring shall be cast of (ASTM A-48 Class 35B cast iron or ASTM A 532 (Alloy III A), 25% chrome cast iron)

A wear ring system shall be installed to provide efficient sealing between the volute and impeller. The wear ring shall consist of a stationary ring made of nitrile rubber molded with a steel ring insert which is drive fitted to the volute inlet and a rotating stainless steel ANSI 304 ring which is drive-fitted to the impeller eye.

- J. Electrical Controls. Are to be provided as part of the process control with all connections, wiring and circuitry. See specification sections specific to electrical and controls.
- K. Liquid Level Sensors. Furnish and install the liquid level sensing system as indicated on the drawings or specified in process control:
- L. Access Hatch. Were indicated on the plans provide an aluminum access hatch complete with frame, hinged access doors with 316 stainless steel safety latch lockable hasp of size or dimensions shown on the plans and as required to install or remove submersible pump. The access hatch assembly shall include stainless steel springs for easy opening. This access hatch is to have 316 stainless steel tamper resistant nuts, bolts and stainless steel anchors affixed to the frame for embedment in concrete top covers.

Each hatch shall include an internal fall-through prevention aluminum safety grate, OSHA orange finish, with a minimum design capacity of 300 p.s.f. All mounting hardware shall be 316 stainless steel. The safety grate shall be independent of the access hatch, the safety grate shall be hinged to swing up and out of the way, leaving a clear access area as required to install or remove the submersible pump. The safety grate shall be removable for maintenance purposes.

2.02 PROCESS CONTROL

Provide a control panel complete with all mounting hardware, wiring, conduit, and components as shown on the drawings and/or indicated below. Related component and electrical specifications are found in Division 16 and/or indicated below.

- A. Control Panel: Provide a NEMA 4x stainless steel free standing enclosure with a minimum 4 inch mounting legs on panel or as indicated on the drawings. The panel shall be affixed to corrosion resistant vertical mounting supports, and shall have a minimum 36 inch mounting height. All Motor Control Panels shall be made with external transformers for lighting and appurtenances.
- B. Controls: Provide all required relays, circuit breakers, motor starters, phase and surge protection, alarm horn and light for a complete and operating system.

- C. Liquid Level Controls: See plans.
- D. Transformers shall be mounted independently in NEMA 4x stainless steel enclosure.

PART 3 EXECUTION

3.01 SERVICE

- A. A factory representative, as an advisor, shall be provided during the initial installation work; for the inspection and checkout of the erected equipment; and during instruction for initial operation. These services are to be for two (2) periods not exceeding five (5) days each.
- B. Furnish the Owner with a written report from a service engineer employed by the manufacturer denoting start-points and calibrations. Obtain Owner's Representative's approval of final setting.
- C. Arrange for manufacturer to have service personnel on 24-hour call.

3.02 WARRANTY

The manufacturer shall warrant the units being supplied to the Owner against defects in workmanship and material for a period of two (2) year from the date of final project acceptance, under normal use, operation and service. The warranty shall be in printed form and apply to all similar units. (Contractor's responsibility shall end after the one year warranty period they are required to provide).

Each manufacturer shall review the systems design in all matters relative to the proper operation of their equipment, including piping, electrical, automatic controls, locations, and related items. With their shop drawings, the manufacturer must submit a letter to the Owner's Representative stating that the design is satisfactory to the manufacturer and that the equipment will operate satisfactorily under the design conditions. Further, the manufacturer must review the final installation at site and write a second letter stating that the installation is satisfactory to the manufacturer and that the equipment will operate satisfactorily under the installed conditions.

3.03 PUMP TEST

The pump manufacturer shall perform the following inspections and tests on each pump before shipment from factory.

- A. Impeller, motor rating and electrical connections shall first be checked for compliance to the customer's purchase order.
- B. A motor and cable insulation test for moisture content or insulation defects shall be made.

- C. Prior to submergence, the pump shall be run dry to establish correct rotation and mechanical integrity.
- D. The pump shall be run for 30 minutes, submerged a minimum of six (6) feet under water.
- E. After operational test submerged, the motor and cable insulation test is to be performed again.
- F. A written report stating the foregoing steps have been done shall be supplied with each pump at the time of shipment.
- G. The pump cable end will then be fitted with a shrink fit rubber boot to protect it from moisture or water seepage prior to electrical installation.

END OF SECTION