

SECTION 11228 - SUBMERSIBLE MIXERS

City of San Diego, CWP Guidelines

PART 1 -- GENERAL

1.1 WORK OF THIS SECTION

- A. The WORK of this Section includes providing direct drive submersible mixers with electric motors and appurtenances.
- B. The WORK also includes coordination of design, assembly, testing, and installation.

1.2 RELATED SECTIONS

- A. The WORK of the following Sections applies to the WORK of this Section. Other Sections of the Specifications, not referenced below, shall also apply to the extent required for proper performance of this WORK.
 - 1. Section 01660 Equipment Testing and Plant Startup
 - 2. Section 05500 Miscellaneous Metalwork
 - 3. Section 11000 Equipment General Provisions
 - 4. Section 13300 Instrumentation and Control
 - 5. Section 11175 Pumps, General
 - 6. Section 16040 Electric Motors
 - 7. Section 16480 Motor Control

1.3 SPECIFICATIONS AND STANDARDS

- A. Except as otherwise indicated, the current editions of the Specifications and Standards listed in Section 11175 and the following apply to the WORK of this Section:
 - 1. ASTM A 53 Pipe, Steel, Black and Hot-Dipped Zinc Coated, Welded and Seamless
 - 2. ANSI A 58.1 Minimum Design Loads for Buildings and Other Structures
 - 3. ASTM A 283 Low and Intermediate Tensile Strength Carbon Steel Plates

1.4 SHOP DRAWINGS AND SAMPLES

- A. Shop drawings and samples shall comply with the requirements of Sections 01300 and 11000.

1.5 OWNER'S MANUAL

A. OWNER'S Manual shall comply with the requirements of Sections 01300 and 11000.

1.6 SERVICES OF MANUFACTURER

- A. Manufacturers' services for training OWNER'S personnel, equipment system testing and startup shall comply with the requirements of Section 11000.
- B. **Inspection, Startup, and Field Adjustment:** An authorized service representative of the manufacturer shall visit the site for not less than [2] days to furnish the indicated services.
- C. **Instruction of OWNER'S Personnel:** The authorized representative shall furnish the indicated services for not less than [2] days.
- D. **Local Service:** The manufacturer shall have a local service agency within 100 miles of the site which maintains factory trained and authorized technicians and an adequate inventory of parts and is able to respond and complete repairs within 24 hours.

1.7 FACTORY TESTING

- A. Mixers shall be witness tested at the factory.
 - 1. Verify that propeller, motor rating, and electrical connections comply with this Section.
 - 2. Measure for moisture content and insulation defects in motor and cable, both before and after the submergence test below.
 - 3. Run mixer dry to verify proper rotation and alignment.
 - 4. Run mixer submerged at least 30 minutes under at least 6 feet of water to check for balance, unusual noise, and overheating. Verify proper pumping capacity.
 - 5. Test motor for no-load current at rated voltage, high potential, and locked rotor current.
- B. A factory test report shall accompany the mixers in shipment.

1.8 FIELD TESTING

- A. A functional wet test shall be conducted at plant startup in accordance with Section 01660 - Equipment Testing and Plant Startup. Verify operation without excessive noise, vibration, cavitation, or overheating. Document motor voltage and current draw.

PART 2 -- PRODUCTS

2.1 MIXER NAME: []

A. Service Conditions

- 1. Number of Mixers: - []
- 2. Liquid Mixed: - []
- 3. Design Liquid Suspended Solids Concentration (mg/l.): - []

- 4. Design Liquid Suspended Solids Concentration Range (mg/l.): - [to]
- 5. Mixing Cycle: - [continuous]
- 6. Zone Configuration and Dimensions: - [see Drawings]
- 7. Maximum Liquid Depth (ft): - []

B. Performance Requirements

- 1. Minimum Clean Water Pumping Capacity (gpm): - []
- 2. Maximum Propeller Speed (rpm): - []
- 3. Minimum Propeller Diameter (inches): - []
- 4. Maximum Propeller Blade Angle (degrees): - []
- 5. Drive Type: - [direct]
- 6. Minimum Horsepower Rating: - []
- 7. Maximum Shaft Horsepower (Clear Water): - []
- 8. Maximum Power Input (kw): - []
- 9. Voltage, Phase, Hertz: - []
- 10. Maximum Full Load Current (amp): - []
- 11. Maximum Locked Rotor kVA: - []
- 12. Minimum Number of Poles: - []
- 13. Maximum NEC Code Letter: - []
- 14. Minimum Motor Efficiency at Full Load (percent): - []
- 15. Minimum Power Factor at Full Load (percent): - []

2.2 MIXER

A. General

- 1. Type: Each mixer shall be submersible with the motor close-coupled, directly connected to the propeller. Gear box designs shall not be acceptable. The propeller shall be capable of handling solids, fibrous materials, heavy sludge, and other matter found in sanitary sewage applications.
- 2. Submergence: All components of the mixer, including motor, shall be capable of continuous underwater operation in both of the following conditions: (1) mixer blade completely submerged, and (2) mixer blade partly submerged in an unbalanced hydraulic loading condition. In addition, all components of the mixer, including motor, shall be capable of continuous operation in air, completely unsubmerged, for 2 hours minimum.

B. **Materials:** Mixer components in contact with the liquid shall be of Type 316 stainless steel with smooth surfaces devoid of blow holes and other irregularities. All exposed nuts, bolts, fasteners, and hardware shall be of Type 316 stainless steel.

C. **Mating Surface Seals:** All mating surfaces where watertight sealing is required shall be machined and be fitted with a double set of nitrile rubber or Viton O-rings. No other sealing mechanism will be accepted.

D. **Propeller:** The propeller shall be of Type 316 stainless steel, dynamically balanced, non-clogging backward curved design. The propeller shall have three vanes and be of the diameter and of the blade angle, in degrees, as indicated. Each blade shall be laser cut and welded to the hub to

ensure that the propeller is properly balanced. The propeller shall be secured to the shaft by friction clutch which shall act to prevent damage to the propeller or shaft in the event an object becomes jammed in the propeller. The shaft shall be Type 420 stainless steel.

- E. **Bearings:** The shaft shall rotate on three permanently lubricated bearings. The outboard, propeller end, bearing shall be an angular contact bearing. The inboard, motor end, bearings shall be an angular contact to take up the axial loads and a radial bearing to take up the radial loads. The bearings shall be pre-loaded by a bearing loading nut located on the motor end of the shaft in order to reduce shaft deflection and increase bearing and seal life. Mixers without pre-loaded bearings shall not be accepted. All bearings shall have a minimum L-10 rated life of 100,000 hours.
- F. Shaft Seals
1. Each mixer shall be provided with two sets of lapped end face type mechanical seals running in an oil chamber for cooling and lubrication. The mechanical seals shall contain a stationary face ring of silicon carbide and a positively driven rotating face ring of tungsten carbide. The seals shall require neither maintenance nor adjustment, but shall be easy to check and replace. Shaft seals without positively driven rotating members shall not be accepted. Only the seal faces of the outer seal assembly shall be exposed to the mixed media. All seal faces shall be capable of relapping.
 2. Each mixer shall be provided with an oil chamber for the shaft sealing system. The oil chamber shall be designed for oil pressure compensation. The drain and inspection plugs, with positive anti-leak seal, shall be easily accessible from the outside.
- G. **Shroud:** Each mixer assembly shall be provided with a Type 316 stainless steel shroud a full 360 degrees around the propeller. A maximum clearance of 1-1/2 inch shall be maintained between the propeller tip and the shroud.

2.3 MOTOR

- A. **General:** The multi-pole motor shall be directly connected to the propeller. The motor shall be a squirrel cage, induction, shell type design, housed in an air filled, watertight chamber. The motor shall be designed for continuous duty, capable of sustaining a maximum of at least ten evenly spaced starts per hour. The motor shall be suitable for service in a Class 1, Division 2 environment and bear UL approval. The stator winding shall be insulated with moisture resistant Class F insulation which will resist a temperature of 155 degrees C (311 degrees F). The stator shall be dipped and baked three times in Class F varnish. The rotor bars and short circuit rings shall be made of aluminum.
- B. **Cable:** Provide pump cable of sufficient length to connect to terminal junction box where indicated. Pump cable shall be sized according to the NEC and ICEA Standards, suitable for submersible service. The cable shall be rated for 600-volt and 90 degrees C with a 40 degrees C ambient temperature and shall be FM approved.
- C. **Cable Entry:** Cable entry seal design shall provide a watertight submersible seal.

1. **Housing:** The cable entry housing shall be an integral part of the back plate. The cable entry shall have a double set of elastomer grommets in order to ensure a redundant system in the event of a cable entry failure. Single sealing systems shall not be accepted. The cable entry shall be comprised of two cylindrical elastomer grommets, each flanked by washers and a ferrule designed with a close tolerance fit against the cable outside diameter and the entry inside diameter. The assembly shall bear against a shoulder in the stator casing opening and be compressed by a gland nut threaded into it. Interaction between the gland nut and the ferrule should move the grommet along the cable axially instead of with a rotary motion. The junction chamber and motor compartment shall be separated by a terminal board which shall protect the motor interior from foreign material gaining access into the mixer top. Connection between the cable conductors and the stator leads shall be made with threaded, leak-proof compressed type binding posts, permanently affixed to the sealed terminal board.

D. **Protection:** Provide each motor with an over temperature and moisture protection system meeting the requirements below:

1. Provide each motor with integral resistive thermal sensitive solid-state sensors, one in each phase, and with a leakage sensor in the motor housing to detect water and/or oil intrusion.
2. Control conductors for the sensors shall be integral with the motor power cable.
3. Sensors shall be wired to a control and status relay unit.
 - a. The control and status relay unit shall have the following maintained dry contact outputs rated no less than 4 amps and 12-volt, 60-Hz.
 - (1) OVERTEMP (OPEN on over temperature).
 - (2) OVERTEMP indicated (CLOSED on over temperature).
 - (3) MOISTURE (OPEN on moisture).
 - (4) MOISTURE indication (CLOSED on moisture).
4. The control and status relay unit shall be mounted in the [motor control center] and be connected as indicated on the [electrical drawings]. Relay unit supply voltage shall be 24V AC.

2.4 MOUNTING ASSEMBLY

- A. Each mixer shall be equipped with a mounting assembly and vertical support mast designed to secure the mixer while in operation. The vertical support mast shall be supported from the [basin floor], the [basin walkway] [channel floor] and [channel walkway] as appropriate, and at 10-foot vertical intervals along the basin wall.
- B. All components of the mounting assembly including mixer mounting base plate, vertical support mast, sliding bracket, and fastening hardware shall be Type 316 stainless steel.
- C. The vertical support mast section shall be a minimum of 4-inch by 4-inch by 3/16 inch. The assembly shall permit horizontal and vertical changing of the mixer axis. The assembly shall be designed and constructed to securely support the mixer, including providing adequate thrust resistance under all mixer operating conditions, including both submerged and unsubmerged

operation and over the full range of mixer axis positions. The mast shall be provided with a cable holder that prevents the electric cable from being entangled with the mixer propeller during operation. The mast shall be constructed with a position locking plate to work in conjunction with a lock pin in the upper guide holder to positively lock the mast in place at all operating positions.

2.5 Power Assisted Crane

- A. Each mounting assembly shall be provided with a power crane of sufficient capacity to raise and lower a 1500 pound weight 10 ft/min. at a maximum reach of 54 inches and ability to rotate the weight in a 270 degree arc. The motor shall be no less than 1 HP.

2.6 ACCESSORIES

- A. Lifting Cable: Provide a minimum 1/4-inch diameter stainless steel lifting cable, securely attached to the mixer. The top of the cable shall end in an eye of sufficient strength to develop the strength of the cable. Provide a hook to secure the cable at the top of the mast.
- B. Lifting Lugs: Equipment weighing over 100 pounds shall be provided with lifting lugs.
- C. Identification Plate: A 16-gauge stainless steel identification plate shall be securely mounted on the equipment in a readily visible location. The plate shall bear the 1/4 inch die-stamped equipment identification number and equipment data.
- D. Anchors: Concrete anchors shall be in conformance with Section 05500, minimum 5/8-inch diameter. Coordinate required size and location with Shop Drawings. The mixer manufacturer shall determine the proper location for anchors.

2.7 TOOLS AND SPARE PARTS

- A. **Spare Parts:** The WORK includes the following spare parts for each mixer:
 - 1. One set motor shaft bearings.
 - 2. One set seals, gaskets, and O-rings.
 - 3. One set special tools (if required).

2.8 MANUFACTURERS

- A. Mixers shall be as manufactured by the following, (or equal):
 - 1. Flygt Corporation, Series 4600.

PART 3 -- EXECUTION

3.1 INSTALLATION

- A. Mixers shall be installed in strict accordance with manufacturer's recommendations and the installation shall be certified by the manufacturer as proper before testing.

- END OF SECTION -