

RECOMMENDED SCREW PUMP SPECIFICATION

SECTION

OPEN SCREW PUMP

PART 1 GENERAL

1.01 SUMMARY

A. Section Includes: Open screw pump assemblies and appurtenances.

B. Related Sections:

1. Section - FRP Screw Pump Covers
2. Section -
3. Section -
4. Section -

1.02 REFERENCES

A. Antifriction Bearing Manufacturers Association (AFBMA).

B. American Gear Manufacturer's Association (AGMA)

C. American Society of Testing and Materials (ASTM).

1. A 36 / DIN ST-37- Specification for Structural Steel.
2. A 325 - Specification for High-Strength Bolts for Structural Steel Joints.

D. American Welding Society (AWS).

1. D1 .1 - Structural Welding Code - Steel.

E. National Electrical Manufacturers Association (NEMA)

1.03 DEFINITIONS

A Lift: The vertical distance measured from the filling point to the liquid delivery point.

B. Touch Point: The lowest point in the screw pump trough where the first flights make contact with the liquid being pumped.

- C. Chute Point: The upper level of the bottom of the screw pump trough. This chute prevents the water from flowing backwards into the trough if the screw pump is off.

1.04 SYSTEM DESCRIPTION

- A. Open Screw Pump and Components: Each screw pump shall be furnished complete with spiral steel lighted screw, upper and lower stub shafts, upper and lower bearing assemblies, flow deflection plates, shaft-mounted or base mounted gear reducer, coupling (s) if applicable, V-belts and sheaves, drive motor, automatic lower bearing lubrication system, and all necessary anchorage parts for operation in a concrete trough as indicated on the Drawings.

- B. The Screw Pump Supplier shall also provide FRP Screw Pump Covers as specified in Section _____ for each Screw Pump

- C. Performance Requirements:
 - 1. Number of pumps
 - 2. Minimum rated capacity per pump - GPM
 - 3. Angle of Inclination
 - 4. Screw pump diameter
 - 5. Torque tube diameter
 - 6. Number of flights
 - 7. Minimum torque tube wall thickness
 - 8. Minimum flight thickness
 - 9. Touch point elevation
 - 10. Fill point elevation
 - 11. Chute point elevation
 - 12. Maximum pumping point elevation
 - 13. Drive unit floor elevation
 - 14. Screw speed –RPM
 - 15. Motor nameplate horsepower
 - 16. Minimum gear reducer HP rating
 - 17. Minimum coupling HP rating (if applicable)

1.05 SUBMITTALS

- A. Submit as specified in Section.

- B. Shop Drawings and Product Data: A complete set of drawings, specifications, catalog cut-sheets, and detailed descriptive material. This information shall identify all technical and performance requirements stipulated on the drawings and in the specification.
 - 1. General arrangement drawings of the pumping equipment.
 - 2. Drawings of the upper and lower bearing assemblies.
 - 3. Gear reducer dimensional drawings and rating data.
 - 4. Motor drawings and performance characteristics.
 - 5. Low speed coupling drawings and rating data, if applicable.
 - 6. Lubrication system drawings, component descriptions, and operating data.
 - 7. Screw pump painting schedule.
 - 8. Bearing life calculations.
 - 9. Screw pump deflection calculations shall be at maximum capacity and lift.
 - 10. Screw Pump performance curves showing: capacity, efficiency, and screw shaft HP.

- C. Screw Pump Calculations:
 - 1. Screw Pump design calculations shall be certified by the manufacturer and signed by a Professional Engineer or equal.

1.06 QUALITY ASSURANCE

- A. The Screw Pump supplier shall be ISO 9001 Certified.
- B. Provide pumps and all equipment called for in this section from same screw pump supplier.
- C. Require pump supplier to furnish and coordinate pump, motor, and pump components as specified and scheduled below and to provide written installation and check out requirements.
- D. Manufacturer Qualifications: Demonstrate minimum 80 years experience in manufacture of open screw pumps which have successfully utilized in domestic wastewater.
 - 1. References: Provide a reference list of at least 5 different installations in wastewater treatment plants of not less than 5 million gallons per day, where

the manufacturer has supplied equipment substantially similar in design and characteristics to that proposed here. The installations listed must:

- a. Have been in operation for 5 years.
 - b. Include in the list the name, address, and telephone number of the person responsible for the equipment.
- E. The equipment manufacturer's shop welds and welding procedures shall be in accordance with the requirements of AWS D1.1 Structural Welding Code – Steel or equal.

1.07 DELIVERY, STORAGE, AND HANDLING

- A. General: As specified in Section
- B. Packing and Shipping:
 1. All materials shall be suitably packaged and braced to protect against damage during transit, handling, and unloading.
 2. Manufacturer shall package equipment, be responsible for, and make good, any and all damage until the equipment is delivered to the job site.
 3. Accessories shall be packaged separately in containers clearly marked "ACCESSORIES ONLY".
 4. A packing list, listing the contents of each container, shall be placed in a moisture proof envelope and securely fastened to the outside of the container.
 5. Provide written storage procedures for all equipment.
- C. Acceptance at Site:
- D. Storage and Protection: Protect the system components at the site and during installation prior to project completion. As a minimum, provide cover, ventilation, and proper stacking to prevent warping of any equipment stored on-site.

1.08 PROJECT CONDITIONS

- A. Environmental Requirements: As specified in Section:

1.09 WARRANTY

- A. The screw pump is warranted to be free of mechanical defects for twelve (12) months after installation or fifteen (15) months after shipping date, whichever comes first.

1.10 EXTRA MATERIALS

- A. Special Tools Required - None
- B. Optional Spare Parts: For size of pump specified, provide the following spare parts packed and labeled for warehouse storage:
 - 1. Drive Belts and Sheaves: One (1) set of matched belts and sheaves for each different size provided.
 - 2. Pump Bearings: One (1) set of radial and thrust bearings for each size upper bearing provided.
 - 3. One (1) bronze sleeve for each size lower bearing provided.
 - 4. One (1) set seals for each size upper bearing provided.
 - 5. One (1) set seals for each size lower bearing provided.

PART 2 PRODUCTS

2.01 MANUFACTURER

- A. EPIC INTERNATIONAL, Inc. with General Offices in:
Ashland, Virginia, 23005, USA (804) 798-3939

2.02 MATERIALS:

2.03 SPIRAL SCREW

- A. Material: Spiral screw shall be fabricated of ST 37 steel and end flanges of the torque tube shall be ST-44 steel.
- B. Outside Diameter: Each spiral screw shall have an outside diameter and number of flights as scheduled.
- C. Flights: Flights shall be die formed and shall have a minimum thickness as scheduled.
 - 1. Flights shall be helical shaped and continuously welded to the torque tube on both sides of the flight. The leading edge of each flight shall be

provided with steel reinforcement from the torque tube to the outside diameter of the screw and shall be attached with continuous welds.

2. All welds between torque tube segments and between flight segments shall be in accordance with AWS, DIN, ASTM, or API.
3. All welds shall be ground smooth and flush on both sides.
4. The flight to torque tube welds shall be shot blasted prior to factory applied painting
5. The screw shall be statically balanced in the factory
6. The screw shall be placed in a lathe and the flights shall be machined to a true radius.

D. Torque Tube:

1. Each torque tube shall have a minimum diameter with a minimum wall thickness as scheduled.
2. The upper and lower ends of the torque tube shall be equipped with internal watertight bulkheads, inboard of the flanges.
3. All welds between torque tube segments and at torque tube end flanges shall be full penetration welds as per AWS, DIN, ASTM, or API.
4. The end plates shall be provided with tapped boltholes and indexes to fit the flange of the shaft extensions. The shaft extensions shall consist of a flange with index to fit the tube end plate and matching bolt holes.
5. A solid steel upper drive shaft and lower stub shaft shall be fastened to the upper and lower ends of the fabricated spiral screw with Grade 8.8 high-strength bolts.
6. The spiral screw shall be designed for minimum deflection. Such deflection not to exceed of $L/2,500$ of bearing center distance when calculated as a simple horizontal beam uniformly loaded with the dead load of the screw. For calculation purposes, the horizontal beam length shall be the distance between bearings. The weight of the flights shall be included in the calculations. However, the moment of inertia of the flights shall not be included in the calculation.
7. Torque tubes shall be air pressure tested at the factory prior to shipment.
8. Maximum design stress shall not exceed 20 N/mm^2 - 2850 psi.

- E. Shaft Extensions: Provide flanged shaft extensions. Construct the shaft extensions from one piece forging or casting. A weldment consisting of a flange plate and shaft is not acceptable. Provide indexes and matching bolt holes

2.04 LOWER BEARING ASSEMBLIES

USA TYPE - FULLY SELF-ALIGNING

- A. Lower bearings shall be bronze sleeve type with a designed load not to exceed 175 psi at the designed pumping load.
- B. Lower bearings shall be lubricated by an automatic lubrication system consisting of a motor driven pump providing continuous lubrication during the screw pump operation.
- C. The lower bearing shall be designed such that the grease feed line and bronze sleeve shall permit the grease to pass over the entire bearing surface before exiting the bearing housing through a grease waste line.
- D. Lower bearing housing shall be suitable for continuous or intermittent operation when submerged in water or running in air.
- E. The lower bearing housing shall be fitted with a cardan suspension so as to be fully self-aligning in all axis to the deflection of the screw pump under any pumping condition or when running dry. The bearings shall be arranged to permit axial movement of the shafts. Bearings with fixed or rigid shafts and housings shall not be acceptable.
- F. The bottom of the bearing housing shall be fitted with an inspection plate that can be removed for inspection of the lower bearing without disassembly of the lower stub shaft or bearing housing.
- G. The use of roller or ball bearings will not be acceptable.
- H. There shall be a flow through grease system with grease entering the lower part of the housing and passing across the full face of the bearing sleeve to the upper seals, then to a grease collection container for confirmation the bottom bearing is receiving grease from the automatic lubrication system.
- I. The lower bearing housing shall be specifically designed to exclude water and shall contain not less than two lip seals.
- J. The lip seals shall be protected from stringy and abrasive materials by a seal cover that has a maximum of $3/16$ " clearance between the stationary and rotating parts.
- K. The lower bearing housing shall be suitably designed and anchored to the concrete foundation to resist all loads including buoyant forces as would occur under maximum wet well conditions.

OPTIONAL – ECO-FRIENDLY LOWER BEARING ASSEMBLY

- A. Eco-friendly lubricated for lifetime of the bearing.
- B. Fully self-aligning in all three (3) axis.
- C. No grease pump or grease lines required.

- D. Lower bearing housing shall be suitable for continuous or intermittent operation when submerged in water or running in air.
- E. The lower bearing housing shall be specifically designed to exclude water and shall contain not less than two lip seals.
- F. The lower bearing housing shall be suitably designed and anchored to the concrete foundation to resist all loads including buoyant forces as would occur under maximum wet well conditions.

2.05 UPPER BEARING ASSEMBLY

- A. The upper bearing assembly shall consist of spherical roller bearings which shall be fully self-aligning in all axis.
- G. The bearings shall be mounted in a split cast iron housing designed such that all the reaction loads are exerted on and into the pump station floor.
- H. The thrust from the pump shall be carried by a spherical roller thrust-type bearing assembly and the radial load shall be carried by a spherical roller bearings. A single dual purpose bearing will not be allowed.
- I. Bearings shall have a minimum life of 100,000 hours B-10 as defined by DIN _ ISO under maximum pumping loads.
- J. Bearing housings shall have lip seals to exclude contamination and shall be provided with grease fittings for manual greasing.
- K. The upper bearing shall be removable without removing the screw pump.

2.06 DRIVE ASSEMBLY

- A. The drive assembly shall be designed in accordance with the latest AGMA standards and constructed for a maximum screw rotational speed as scheduled.
- B. The reducer shall be designed for 24 hour continuous operation in the angular mounting position corresponding to the inclination angle of the screw pump without leaking oil. The output shaft shall be furnished with a double seal.
- C. The reducer shall have a mechanical rating of not less than 1.25 times the nameplate horsepower of the motor or 1.50 times the brake horsepower of the screw shaft, whichever is greater.
- D. The thermal capacity shall be sufficient for a continuous maximum oil sump temperature rise of 80⁰ F above 110⁰ F ambient when operating at maximum pumping load. The use of heat exchangers or motor driven fans will not be permitted.

- E. The housing of the gear reducer shall be close-grained cast iron of a minimum Class 30, with removable top inspection covers, oil breathers and oil level indicators. Removal of the gasketed inspection covers shall not necessitate draining of the lubrication oil or re-aligning of the bearings. Oil breathers and level indicators shall be readily accessible and designed to prevent oil leakage and entry of dirt, water and foreign matter into the reducer.
- F. The helical gears shall be high quality alloy steel with an AGMA quality grade 10 minimum. Precise alignment of gear, bearings and seals shall be maintained under all loading conditions.
- G. The gears shall have a minimum L-10 life rating of not less than 100,000 hour rating based on the reducer horsepower rating.
- H. The bearings shall have a minimum B-10 life rating of not less than 100,000 hours based on the reducer mechanical horsepower rating.
- I. Gears and bearings shall be splash lubricated or pressure lubricated by an internal shaft driven pump to effectively carry oil to all gears and bearings. A sight gauge or dipstick shall be provided to verify the oil level.
- J. The reducer shall have a minimum efficiency rating of 96%.
- K. The reducer shall be furnished with an anti-reverse rotation backstop to prevent reverse rotation of the screw during shutdown or inadvertent power failure.
- L. SHAFT MOUNTED GEAR REDUCER:
 - 1. A shaft-mounted, double reduction reducer, suitable for outdoor operation, shall be keyed to the screw pump stub shaft.
 - 2. The screw pump stub shaft shall be supported by the upper bearing assembly and extend through the reducer's hollow bore. The reducer shall be centered and held firmly in place on the shaft by a tapered bushing. Use of set screws and collar to lock gear reducer to shaft will not be acceptable.
 - 3. Reducer shall be held in position by a torque arm and torque arm bracket.
 - 4. Torque arm bracket shall be fastened with cast-in-place anchors. Expansion anchors will not be acceptable.
- M. FLOOR MOUNTED GEAR REDUCER:
 - 1. The gear reducer shall be a parallel-shaft double or triple reduction, foot mounted unit suitable for outdoor operation.
- N. FLEXIBLE COUPLING: (Not required for Shaft Mounted Gear Reducers)
 - 1. The upper stub shaft of the screw pump shall be connected to the floor mounted gear reducer by a flexible coupling designed to compensate for small offset angular misalignments.
 - 2. Coupling shall be designed for a 1.50 service factor, based on brake horsepower and shall be keyed and bored to suit the reducer slow speed shaft and the screw pump upper stub shaft.

3. The flexible coupling shall be covered with a removable guard in accordance with OSHA standards.

2.07 BELTS AND SHEAVES

- A. The gear reducer unit shall be connected to the drive motor by means of belts and sheaves with the same service factor as the reducer.
- B. Sheaves shall be two section units for both drive and driven sheaves and shall consist of a tapered split shaft bushing with three tapped holes to which the sheave is attached by three cap screws. Changing sheaves shall not require a wheel puller.
- C. Belts and sheaves shall be covered with a fabricated belt guard in accordance with OSHA standards.

2.08 MOTOR

- A. Each unit shall be driven by an 1,800 rpm, 3 phase, 60 Hertz, 480 volt, horizontal, ball bearing, continuous duty, constant speed, Design B, normal starting torque, Totally Enclosed Fan Cooled, cast iron, severe duty, foot-mounted motor with leads to gasketed conduit box for outdoor operation. Motors shall have class "F" non-hygroscopic insulation and a 1.15 S.F. at 40⁰ C ambient.
- B. Motor nameplate horsepower shall be:
- C. Motor Mounting:
 1. Shaft mounted gear reducers shall have an adjustable motor mount that allows the motor to be mounted on top of the gear reducer and to provide proper belt tensioning.
 2. Floor mounted gear reducers shall have a common fabricated base plate on which the gear reducer and the motor are mounted and secured to the equipment pedestal by anchor bolts to provide adjustment of belt tension. A permanently attached jack bolt arrangement shall be provided to facilitate initial alignment and realignment of either the gear reducer or the motor for repair.
 3. Where appropriate, floor mounted gear reducers may be equipped with top mounted adjustable motor mounts.

2.09 DEFLECTION PLATES

- A. Flow deflection plates shall be provided to curve around the uptake side of the screw to deflect the liquid back into the screw as the screw rotates.

- B. The flow deflection plate shall be fabricated of not less than 3 mm _____ T304 SS, _____ 316 SS, or _____ ST-37 steel plate, complete with stiffeners, and stainless steel anchors on a maximum of 2 meters on center. *Please Specify*
- C. The deflection plates shall extend to an elevation equal to an angle of at least 40°.

2.10 AUTOMATIC LUBRICATION SYSTEM – Not Applicable with Optional Eco-Friendly Lower Bearing Assembly

- A. Each screw pump shall be furnished with an automatic lubrication system to provide EP00 grease to the lower bearing.
- B. The automatic lubrication pump system shall have provisions at the pump to manually charge the grease line.
- C. The system shall include a lube pump, drive motor, gear reducer, coupling, coupling cover, supply reservoir, feed lines to and return lines from the lower bearing assembly and necessary fittings for a complete installation.
- D. The lube pump, drive motor and supply reservoir shall be mounted on a common steel base plate.
- E. The lubrication pump drive motor shall be $\frac{1}{3}$ HP totally enclosed fan cooled _____ 230/460 – 3 phase or _____ 115/230 volt – 1 phase 60 hertz. *Please Specify*
- F. A centrifugal switch shall be furnished as an integral component of the grease pump and interlocked with the screw pump drive system. When the screw pump is required to operate, the lubrication pump motor shall switch on. As the lubrication pump motor reaches full speed, the centrifugal switch shall close, energizing the screw pump drive motor. If the grease pump motor stops the centrifugal switch shall open, de-energizing the screw pump drive motor. The centrifugal (N-O) switch shall be rated for not less than 3 amps at 120 VAC, resistive.
- G. The grease supply reservoir shall have a capacity of not less than 12 lb. and shall be designed to give a visual indication of the grease level in the reservoir.
- H. The grease feed lines from the reservoir shall be 10 mm stainless steel, the grease return lines from the lower bearing to a suitable grease waste container shall be 10 mm in #304 stainless steel.
- I. NO LUBE PUMP OR GREASE LINES ARE REQUIRED WHEN ECO-FRIENDLY LOWER BEARING ASSEMBLIES ARE SPECIFIED.

2.11 GROUTING MATERIALS

- A. Equipment manufacturer shall furnish a radius screed for the CONTRACTOR to place the finishing grout in the trough with the screw after the unit has been installed.
- B. Equipment manufacturer shall loan to the CONTRACTOR additional sheave(s) and belts as required to operate the screw at a reduced speed for grouting the trough with the screw pump drive.

2.12 ANCHOR BOLTS

- A. Equipment manufacturer shall furnish all anchor bolts of ample size and strength required to securely anchor each item of equipment. Anchor bolts, hex nuts, and washers shall be 304 stainless steel unless noted otherwise. Anchor bolts shall be threaded rods with washers and nuts embedded. Expansion-type anchors will not be acceptable.
- B. Anchor bolts shall be set by the CONTRACTOR. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

2.13 RECOMMENDED PAINTING –

Full Factory Painting in Environmentally Controlled Conditions

- A. The screw pump, bearing assemblies and water deflectors shall be SHOT blasted to SP-10 (or Swedish SA2.5) near white metal finish before factory application of two coats of finish coal tar epoxy.
- B. Minimum coating thickness shall be 300 microns / 12 mils.
- C. Electric motors, speed reducers, and other self-contained or enclosed components shall be supplied with the manufacturer's standard finish coating.
- D. Manufacturer shall supply an appropriate amount of touch-up paint.

2.14 SOURCE QUALITY CONTROL

- A. The Screw Pump shall be manufactured according to ISO-9001 standards.

PART 3 EXECUTION

3.01 EXAMINATION

- A. Verification of Conditions: Inspect all components for shipping damage and conformance to specifications.

3.02 INSTALLATION

- A. Install products in accordance with manufacturer's instructions and as specified in this Section.

3.03 TESTING

- A. After complete installation of the pump(s), the unit(s) shall be field tested to confirm the following:
 1. Equipment has not been damaged in transport and installation.
 2. Equipment is properly installed.
 3. All components are properly connected and established tolerances are observed.
 4. Equipment is free of objectionable vibrations and overheating parts.
 5. The screw pump is operating freely.
 6. Equipment is not overloading any part.
 7. Equipment has no electrical or mechanical defects.

3.04 MANUFACTURER'S FIELD SERVICES

- A. The manufacturer shall schedule two (2) trips to the project site of a factory-trained, qualified representative to provide technical assistance to the contractor during erection of the equipment, placement of the grout and including start-up and operator training.

3.05 OPERATOR TRAINING

- A. Training: As specified with start up.
- B. Provide operator training for OWNER'S personnel after the system is operational. Training shall take place while manufacturer's representative is at the job site for equipment inspection.

END OF SECTION