

SECTION

POSITIVE DISPLACEMENT TWO-STAGE DOUBLE BEARING ROTARY LOBE PUMPS

PART 1--GENERAL

1.01 DESCRIPTION

A. SCOPE:

This section specifies positive displacement two-stage double bearing lobe type pumps, complete with electric motors and all specified appurtenances. The Contractor shall assign unit responsibility as specified to the pump manufacturer for the equipment specified in this Section.

B. TYPE:

The pumping units shall be of the two-stage double bearing positive displacement, convoluted rotor type, specifically designed for pumping primary and thickened waste secondary sludge containing organic solids and small inorganic particles. The rotor lobes shall be of a convoluted design to provide uniform pulsation-free flow. The pump shall have not less than four rotor tips to provide the maximum sealing lines, bearings on both sides of the lobes, and have two stages of pumping provided for high pressure.

C. EQUIPMENT LIST:

Item	Equipment No.

D. PERFORMANCE AND DESIGN REQUIREMENTS:

Equipment shall be designed and selected for continuous duty pumping of concentrated solids derived from the treatment of wastewater. Pumps shall be suitable for exposure to thickened primary sludge and aerobically digested thickened secondary sludge containing grit, small particles of wood, metal, industrial solvents, greases, detergents, petroleum products, and organic particles in concentrations as great as 7 percent. The pumped fluids are expected to range in temperatures between 60 degrees F and 140 degrees F, and the pH may vary between 6 and 9.

The pumps, along with associated drive appurtenances, shall be mounted on a common fabricated steel baseplate. The baseplate shall be hot dip galvanized after fabrication.

1.02 QUALITY ASSURANCE:

A. REFERENCES

Design, manufacturing and assembly of elements of the equipment herein specified shall be accordance with the standards of the below listed organizations. Where reference is made to a standard of one of the following or other organizations, the version of the standard in effect at the time of the bid opening shall apply.

1. American Gear Manufacturing Association (AGMA)
2. American Institute of Steel construction (AISC)
3. American Iron and Steel Institute (AISI)
4. American Society of Mechanical Engineers (ASME)
5. American National Standards Institute (ANSI)
6. American Society for Testing Materials (ASTM)
7. American Water Works Association (AWWA)
8. American Welding Society (AWS)
9. Anti-Friction Bearing MANUFACTURERS Association (AFBMA)
10. Hydraulic Institute Standards
11. Institute of Electrical and Electronics Engineers (IEEE)
12. National Electrical Code (NEC)
13. National Electrical MANUFACTURERS Association (NEMA)
14. Occupational Safety and Health Administration (OSHA)
15. Steel Structures Painting Council (SSPC)
16. Underwriters Laboratories, Inc. (UL)

1.03 QUALIFICATIONS

To assure unity of responsibility, the pumps and motors, shall be furnished and coordinated by the pump manufacturer (MANUFACTURER). The CONTRACTOR shall assume full responsibility for the satisfactory operation of the entire pumping systems including pumps, motors, and controls as specified.

The equipment covered by these Specifications shall be standard units of proven ability as manufactured by competent organizations having long experience in the production of such equipment. The pumps shall be the standard cataloged product of the MANUFACTURER. The pumps furnished shall be designed, constructed and installed in accordance with the best practice and methods, and shall operate satisfactorily when installed. Pumps shall be manufactured in accordance with the Hydraulic Institute Standards, except as otherwise specified herein.

All Equipment furnished under this Specification shall be new and unused and shall be the standard product of MANUFACTURERS showing a successful record of manufacturing and

servicing the equipment and systems specified herein for a minimum of five (5) years, and be ISO 9001 2000 compliant.

The MANUFACTURER shall be fully responsible for the design, arrangement and operation of all connected rotating components of the assembled pumping unit to ensure that neither harmful nor damaging vibrations occur within the specified operating range. Design shall include fabricated steel base plate for mounting the units.

1.04 SUBMITTALS

Copies of all materials required establishing compliance with the specifications shall be submitted in accordance with the provisions of Section 0. The submittal format shall be in the form of a booklet, suitably tabbed and divided to cover at least the areas noted below for each major equipment item. The submittal booklet shall include adequate detail and sufficient information for the ENGINEER to determine that all of the equipment proposed meets the detailed requirements of the Specifications. Incomplete or partial submittals will not be reviewed. Submittals shall include at least the following:

1. A copy of this specification section, with addendum updates included, and all referenced and applicable sections, with addendum updates included, with each paragraph check-marked to indicate specification compliance or marked to indicate requested deviations from specification requirements. Check marks (✓) shall denote full compliance with a paragraph as a whole. If deviations from the specifications are indicated, and therefore requested by the Contractor, each deviation shall be underlined and denoted by a number in the margin to the right of the identified paragraph, referenced to a detailed written explanation of the reasons for requesting the deviation. The Engineer shall be the final authority for determining acceptability of requested deviations. The remaining portions of the paragraph not underlined will signify compliance on the part of the Contractor with the specifications. Failure to include a copy of the marked-up specification sections, along with justification(s) for any requested deviations to the specification requirements, with the submittal shall be sufficient cause for rejection of the entire submittal with no further consideration
2. Certified shop and erection drawings showing all, important details of construction, dimensions and anchor bolt locations.
3. Descriptive literature, bulletins and/or catalogs of the equipment.

4. Data on the characteristics and performance of each pump. Data shall include guaranteed performance curves, based on actual shop tests of similar units, which show that they meet the specified requirements for head, capacity and horsepower. Curves shall be submitted on 8 ½" by 11" sheets, at as large a scale as is practical. Catalog sheets showing a family of curves will not be acceptable.
5. A complete total bill of materials of all equipment (may be furnished with Operation and Maintenance manuals specified under paragraph 1.05).
6. A list of the MANUFACTURER'S recommended spare parts, in addition to those specified in paragraph 1.06. with the manufacturer's current price for each item, shall be supplied. Include gaskets, packing, etc. on the list. List bearings by the bearings manufacturer's numbers only.
7. Complete motor and control systems data.
8. Warranty as described in paragraph 1.08.
- A. TEST REPORTS:
 1. A schedule of the date of shop testing and delivery of the equipment to the job site.
 2. Description of pump factory test procedures and equipment.
 3. Copies of all tests results, as specified.

Complete operating and maintenance instructions shall be furnished for all equipment included under these specifications. The maintenance instructions shall include trouble shooting data and full preventative maintenance schedules and complete spare parts lists with ordering information.

Submit the MANUFACTURER'S Certificate of Installation, Testing and Instruction.

In the event that it is impossible to conform with certain details of the specifications due to different manufacturing techniques, describe completely all non-conforming aspects.

1.05 OPERATING INSTRUCTIONS:

- A. Operating and maintenance manuals shall be furnished. The manuals shall be prepared specifically for this installation and shall include all required cuts, drawings, equipment lists, descriptions, etc., that are required to instruct operation and maintenance personnel unfamiliar with such equipment.

- B. A trained instructor, with complete knowledge of proper operation and maintenance for all major components, shall be provided for two days to instruct representatives of the OWNER and the ENGINEER on proper operation and maintenance. With the OWNER'S permission, this work may be conducted in conjunction with the inspection of the installation and test run as provided under PART 3. If there are difficulties in operation of the equipment due to the MANUFACTURER'S design or fabrication, additional service shall be provided at no cost to the OWNER.

1.06 TOOLS AND SPARE PARTS

One set of special tools shall be provided for servicing all pumps. In addition, the following spare parts shall be provided for each size and type of pump:

- 2 sets cartridge mechanical seals
- 2 spare rotor sets, as specified, for each size pump
- 2 - set of front and back wear plates

Spare Parts shall be properly bound and labeled for easy identification without opening the packaging and suitably protected for long term storage.

1.07 PRODUCT HANDLING:

- A. All parts shall be properly protected so that no damage deterioration will occur during a prolonged delay from the time of shipment until installation is completed and the units and equipment are ready for operation.
- B. All equipment and parts must be properly protected against any damage during a prolonged period at the site. Pumps shall be rotated 2 revolutions every 30 days of storage time.
- C. Factory assembled parts and components shall not be dismantled for shipment unless permission is received in writing from the ENGINEER.
- D. Finished surfaces of all exposed pump openings shall be protected by wooden blanks, strongly built and securely bolted thereto.
- E. Finished iron or steel surfaces not painted shall be properly protected to prevent rust and corrosion.

- F. After hydrostatic or other tests, all entrapped water shall be drained prior to shipment, and proper care shall be taken to protect parts from the entrance of water during shipment, storage and handling.
- G. Each box or package shall be properly marked to show its net weight in addition to its contents.

1.08 WARRANTY

The equipment shall be warranted to be free from defects in workmanship, design and materials for a period of two (2) years. If any part of the equipment should fail during the warranty period, it shall be replaced in the machine(s) and the unit(s) restored to service at no expense to the OWNER.

The manufacturer of the positive displacement pump, shall provide a two year, 100% parts and labor warranty, including wear and tear to the pump. This warranty shall include, but not be limited too mechanical seals, wear plates, housing segments, and lobes. Non-manufacturer warranty will be unacceptable, and all warranties must be in writing, at the time of the bid.

The MANUFACTURER'S warranty period shall run concurrently with the CONTRACTOR'S warranty period. No exception to this provision shall be allowed.

PART 2--PRODUCTS

2.01 ACCEPTABLE PRODUCTS

The Owner and Engineer believe the following candidate manufacturer is capable of producing equipment and/or products that will satisfy the requirements of this Section. This statement, however, shall not be construed as an endorsement of a particular manufacturer's products, nor shall it be construed that named manufacturers' standard equipment or products will comply with the requirements of this Section. Candidate manufacturer include Vogelsang, or pre approved equal, modified to provide the specified features and to meet specified operating conditions.

2.02 MATERIALS

Component	Material
Casting and casing cover plates	Cast iron ASTM A48 GG20, 230 to 260 Brinell hardness, 700 Brinell on end cover plate
Rotors	Cast iron core with Buna-N covering as specified
Shafts	Carbon steel, ASTM A293, 85 mm Diameter

Component	Material
Shaft sleeve	Stellite coated stainless steel

2.04 EQUIPMENT

A. OPERATING CONDITIONS:

Primary Duty Point	70 gpm
Differential Pressure	15.0 psi
Suction Conditions	15 ft. flooded
Medium	Sludge
Percent of Solids	1%
Maximum HP at Duty Condition	5 HP
Suction and Discharge Flange Size	4 in.
NPSHR shall not exceed	5.56
Shaft Deflection Shall Not Exceed	.0034 inches
Maximum RPM shall be	379 RPM
Minimum volumetric efficiency shall be	82.4%
Minimum number of lobe tips	4

B. PERFORMANCE REQUIREMENTS:

1. There shall be no significant change in vibration and noise level over the entire listed range of operating conditions of the pumping system.
2. Maximum motor speed shall not exceed 1800 rpm on in-line mounted units, and 1200 RPM on overhead or piggy back mounts.
3. A motor sizing shall provide a minimum of 25 % reserve hp as evidenced by specific requirements at maximum design condition on the certified performance curve.

C. PUMPS:

The pumps shall utilize at a minimum, HiFlo four tip rotors which are driven through positive timing gears running in oil. Solid grey cast iron cores of GG25 cast iron shall be covered with a layer of NBR 70, Durometer hardness 65-72. The geometry of the rotor cores shall be the same as that of the finished rotor. Rotor vane geometry shall be convoluted to provide pulsation-free operation throughout the entire operating range. Designs with rotor vanes parallel to the shaft centerline will not be accepted. Pumps utilizing lobe designs, with fewer than 4 tips will not be considered, due to the high potential for wear on the lobes, as a result of

fewer sealing lines. Designs with replaceable lobe tips shall not be acceptable. The pump shall incorporate a front outboard bearing support cover to prevent any shaft deflection from doing damage to the mechanical seals, lobes and bearings during operation. The front bearing support cover shall permit removal of the rotors without disturbing piping, bearings, or mechanical seals and can be hinge-mounted to the housing if available. Pumps not equipped with a removable wear plate that use the front door for its wear surface or require bolts that are recessed below the lobe path, are not acceptable for any wearing surface.

The pumps shall have two stages of pumping, moving the fluid from one stage to the other to develop the maximum discharge head. The two stages shall be connected by an external 180 degree pipe that connects to the second stage of the pump. Designs shall be able to split the maximum pressure between each stage to reduce wear on pump, and keep internal slip through the pump to a minimum. The two stages shall be separated by an intermediate sealing plate with rubber sleeves and o-rings, to keep slippage from passing between stages. Wear plates, with a minimum Brinell hardness of 700 shall be equipped on each side of the sealing plate.

Both front and rear rotor case cover plates shall be fitted with a renewable hardened wear surfacing, with a minimum Brinell hardness of 700. Rotors shall be positioned on the shaft by replaceable hardened key ways, and secured to the shaft by internal/external expansion bolt that is tightened from the outside of the front bearing support cover.

The shafts shall be of carbon steel ASTM A293 fitted with replaceable stainless steel sleeves where passing through the seal area. They shall be timed in their rotation by straight cut timing gears running in a separate oil chamber which also contains the ball and roller bearings for each shaft. Pumps requiring external re-timing in the event of blockage will not be considered. The pump shaft shall be supported on both sides of the lobes by bearings to eliminate shaft deflection. Shaft diameter shall be a minimum of 85 mm where the lobes, bearings, and mechanical seals contact the shaft. The use of step-down, angular v-notch cut, threaded shafts, or designs that don't incorporate outboard bearings shall not be accepted, due to high shaft deflection and potential of shaft breakage and fatigue. The outboard portion of the shaft shall be tapered to provide easy removal of the front bearing support cover, and shall not disturb the bearings or mechanical seals during a simple lobe change. Maximum shaft deflection at operating pressure shall be .0034 inches.

Cartridge mechanical seals shall be provided of Blockring in TC / Duronite for each positive displacement pump. The cartridge shall include the mechanical seal faces, the seal holder and carrier, all applicable o'rings, the mechanical seal faces, and stainless steel shaft sleeve. A blocking chamber located behind the mechanical seal, and in front of the bearing housing lip seal shall be fitted into the cartridge seal of the pump to prevent contamination of the bearings on the event of a seal failure. This chamber shall be suitable for fill, from the top of the pump, and have an external pressurized oil bottle to review the status of the mechanical seals operation, mounted on the top of the pump, located in easy view of the operator. Pumps with open to air cavities located behind the mechanical seal housing, those that require water flush or

quench, or those without oil bottles, will not be accepted, due to their potential for product spill failure on the surrounding areas of the pump, and the added maintenance and cost associated with mechanical seal water flushing systems.

Port connections shall be ANSI Class 150 raised face, 4 in. gooseneck designed flanges to reduce the chance of vapor locking, and increase the reliability, and suction lift capability, through its unique design. They shall be hot dipped galvanized steel, for long life, and abrasion resistance.

The removable end cover shall be sealed with NBR 70 O-ring and provide complete access to the pump chamber without disconnecting pipe work glands or bearings. The removable front cover is to be mounted to the pump with 8 individual bolts, to provide unhindered access to the rotors to facilitate ease of maintenance and operator safety.

The pump and motor shall be mounted on a steel base plate complete with necessary, guards, and mounting hardware.

Pumps and motors shall operate at any point within their operating range without undue noise and vibration. Vibration at any point in the operating range shall not exceed the limits allowed by the Hydraulic Institute.

The top and bottom housing segments of the pump shall be constructed of gray cast iron, hardened to a minimum of 750 brinell, and be adjustable based on wear. The adjustment shall be accomplished by simply moving steel shims from one hole to the next in the pump housing, allowing for the closing of tolerance around the rotors. This adjustment must be available a minimum of two times from factory tolerance. Renewable 750 Brinell wearing surfaces shall be provided on the top and bottom adjustable castings. The use of single piece, block, cast housings or the use of radial wear plates will not be accepted; due to there ability to be hardened is limited and frequent replacement when a rebuild is required due to wear.

Bearings shall be B-10 Life, 100,000 hours. Bearings and timing gears for all pump sizes shall run in an oil chamber provided with a bolt to show the level with the centerline of the lower shaft.

The pump timing gears shall run in oil and shall be mounted in a gear case contiguous with the pump case. The gear case shall be fitted with oil fill and drain connections on the top and bottom. Designs that use side drains will not be acceptable, due to the inability to completely drain the fluids on the pump.

The manufacturer shall be ISO 9001 2008 compliant, as evidenced with a current ISO certificate at the time of bid. Manufacturers that are ISO compliant, but not certified to ISO 9001 2008 will not be considered.

2.04 MOTORS

A. General:

1. The motors shall be suitable for wash down and extreme outdoor duty.
2. All motors shall be built in accordance with latest NEMA, IEEE, ANSI and AFBMA standards where applicable.
3. Motors shall conform to all requirements stipulated in the motor section of this specification.
4. The motors supplied shall be specifically designed for inverter duty to allow for the potential of future variable frequency drives. The motors shall be compatible with the pumps provided by the MANUFACTURER.

2.05 PUMP DISCHARGE GAUGES

- A. Pump Suction and Discharge Gauges: The CONTRACTOR shall furnish and install for each pump in tapped holes in the discharge and suction piping piping to accommodate the gauges which shall be supplied by the CONTRACTOR as shown on the Drawings.

2.06 PRESSURE RELIF CONTROL

- A. Pump discharge pressure switch: The CONTRACTOR shall furnish and install for each pump pressure switches on the pump discharge line. The pressure switches shall be set at the MANUFACTURES recommendations.

PART 3 EXECUTION

3.01 INSTALLATION:

- A. Installation in strict accordance with the MANUFACTURER'S instructions and recommendations in the locations shown on the Drawings. Installation shall include furnishing the required oil and grease for initial operation. The grades of oil and grease shall be in accordance with the MANUFACTURER'S recommendations. Anchor bolts shall be set in accordance with the MANUFACTURER'S recommendations.
- B. Upon completion of the installation, the CONTRACTOR shall submit a certificate from the MANUFACTURER stating that the installation of the equipment is satisfactory, that the equipment is ready for operation, and that the

operating personnel have been suitably instructed in the operation, lubrication and are of each unit.

3.02 SHOP PAINTING

- A. Before exposure to weather and prior to shop painting all surfaces shall be thoroughly cleaned, dry and free from all mill-scale, rust, grease, dirt and other foreign matter.
- B. All exposed portions of the pumps and motors shall be shops primed, with primer compatible with field painting as specified.
- C. All nameplates shall be properly protected during painting.

3.03 FIELD PAINTING

- A. Field painting is specified under Painting Section of this specification. The primer and paint used in the shop shall be products of the same MANUFACTURER as the field paint to assure compatibility.
- B. All nameplates shall be properly protected during painting.

3.04 INSPECTION AND TESTING

- A. General:
 - 1. The ENGINEER shall have the right to inspect, test or witness tests of all materials or equipment to be furnished under these specifications, prior to their shipment from the point of the manufacture.
 - 2. The ENGINEER shall be notified in writing prior to initial shipment, in ample time so that arrangements can be made for inspection by the ENGINEER.
 - 3. Field tests shall not be conducted until such time that the entire installation is complete and ready for testing.
- B. FACTORY PUMP TESTS:
 - 1. Factory testing in accordance with the standards of the Hydraulic Institute shall be required for all pumps. All pumps shall be witness tested by the pump MANUFACTURER in the presence of the ENGINEER. All

witness travel and out-of-pocket expenses shall be included in the CONTRACTOR'S bid price.

2. Certified pump performance curves shall be submitted, including head, capacity, and brake horsepower, for each pump supplied.
3. Prior to conducting a pump test, notification of such test and a list of test equipment and test procedures shall be forwarded to the Engineer at least ten working days before the schedule test date. All electronic transducers, meter, gauges, and other test instruments shall have been calibrated in accordance with the requirements of the Hydraulic Institute Standards. Copies of calibration data shall be provided.
4. All pumps shall be tested at full speed and complete staging through the specified range of flow, and head/capacity/efficiency curves plotted at maximum output speed. During each test, the pump shall be run at each head condition for sufficient time to accurately determine discharge, head, power input, and efficiency.
5. If any pump tested fails to meet any specification requirement it will be modified until it meets all specification requirements. If any pump tested fails to meet the efficiency requirements at any of the listed flow or head conditions listed and all reasonable attempts to correct the inefficiency are unsuccessful, the pump(s) shall be replaced with units(s) which meet the specified requirements.

C. FIELD INSPECTION AND OWNER INSTRUCTION:

1. The CONTRACTOR shall furnish the services of the MANUFACTURER'S field service technician, who has complete knowledge of proper operation and maintenance of the equipment, for a period of not less than two (2) days to inspect the installed equipment, supervise the initial test run, and to provide instruction to the plant personnel. The first visit shall be checking and inspecting the equipment after it is installed. The second visit will be to operate and supervise the initial field test.
2. At least one (1) of the two (2) days shall be allocated solely to instruction of plant personnel in operation and maintenance of the equipment. The instruction period shall be scheduled at least 14 days in advance with the OWNER and shall take place prior to start up and acceptance by OWNER. The final copies of operation and maintenance manuals specified must be delivered to the ENGINEER prior to scheduling the instruction period

with the OWNER with the permission of the ENGINEER, these services may be combined with those specified by Paragraph 1.05.

D. Field Pump Tests:

1. In the presence of the ENGINEER such tests as necessary to indicate that the pumps and motors conform to the operating conditions specified shall be performed. A 30-day operating period of the pumps will be required before acceptance. If a pump performance does not meet the specified requirements, corrective measures shall be taken. All test procedures shall be in accordance with factory test procedures specified above and certified results of tests shall be submitted. Provide, calibrate and install all temporary gauges and meters, make necessary tapped holes in the pipes, and install all temporary piping and wiring required for the field acceptance tests. Written test procedures shall be submitted to the ENGINEER for approval 30 days prior to testing.
2. Noise and vibration tests shall be conducted in conformance with the Hydraulics Institute Test Codes and OSHA Standards of Occupational Noise Exposure. Maximum allowable noise level, corrected for background sound, shall not exceed 85 dBA when measured at a horizontal distance of 3 meters from the equipment being tested, at a height of 3 meters above floor level. The actual natural frequency of the installed pumping units will be verified using industry accepted procedures.
3. All pumps operating settings, alarms, controls, and shutdown devices shall be calibrated and tested during the field tests.
4. The CONTRACTOR shall furnish all power, water, facilities, labor, materials, supplies and test instruments required to conduct field test.
5. Deliver to the ENGINEER, upon completion of satisfactory testing of the equipment, reports as specified in Part 1.

F. Field Electric Control System Tests:

1. The electric control system shall be test operated for proper functioning prior to the pump mechanical test. The control system shall be checked out using simulated operating signals as per pump MANUFACTURER'S recommendations.

2. The CONTRACTOR shall check all drives for correct clearances, alignment and lubrication in accordance with MANUFACTURER'S instructions. The CONTRACTOR shall check direction of rotation of all motors and reverse connections if necessary.
3. The CONTRACTOR shall meet all the testing requirements of Division 16.

G. Field Alarm System Testing:

1. Check each alarm and detection device for proper operation.

****END OF SECTION****