

SECTION 44 42 56.14
LOBE PUMPS

EQUIPMENT AND COMPONENT NUMBER(S)

PMP-3312: Permeate Pump 1.

PMP-3412: Permeate Pump 2.

PMP-3512: Permeate Pump 3.

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Bearing Manufacturers' Association (ABMA).
2. American Iron and Steel Institute (AISI).
3. American National Standards Institute (ANSI).
4. ASTM International (ASTM):
 - a. A48/A48M, Standard Specification for Gray Iron Castings.
 - b. D2240, Standard Test Method for Rubber Property—Durometer Hardness.
5. Hydraulic Institute (HI) Standards:
 - a. 3.1-3.5, Rotary Pumps for Nomenclature, Definitions, Application and Operation.
 - b. 3.6, Rotary Pump Tests.
6. National Electrical Manufacturers' Association (NEMA): MG 1, Motors and Generators.

B. Refer to Section 43 32 56, Membrane Equipment System (Membrane Bioreactor), for permeate/filtrate pumping requirements.

C. Refer to the following sections for electrical requirements:

1. Section 26 05 02, Basic Electrical Requirements.
2. Section 26 05 04, Basic Electrical Materials and Methods,
3. Section 26 05 10, Network Communication Systems.
4. Section 26 05 26, Grounding and Bonding for Electrical Systems.
5. Section 26 20 00, Low-Voltage AC Induction Motors.
6. Section 26 24 19, Low-Voltage Motor Control.
7. Section 26 29 23, Low-Voltage Adjustable Frequency Drive System.
8. Section 26 43 00, Surge Protective Devices.

1.02 DEFINITIONS

- A. Terminology pertaining to pumping unit performance and construction shall conform to ratings and nomenclature of the Hydraulic Institute Standards.

1.03 SYSTEM DESCRIPTION

- A. Rotary lobe pump system to extract treated water through the membranes. Water is conveyed through the ultraviolet disinfection system and transferred to the reclaimed water tank. Rotary lobe pumps are located in Building 32, Process Building, in the lower level, Room 32001.
- B. Provide rotary lobe pump system within the scope of supply by the Membrane Equipment System Supplier in accordance with Section 43 32 56, Membrane Equipment System (Membrane Bioreactor).

1.04 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:

- a. Make, model, weight, and horsepower of each equipment assembly.
- b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction, including cable seal details.
- c. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over entire operating range of pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at guarantee point.
- d. Detailed mechanical and electrical drawings showing equipment dimensions, size, and locations of connections and weights of associated equipment.
- e. Power and control wiring diagrams, including terminals and numbers.
- f. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including motor modifications.
- g. Factory finish system.
- h. Anchorage and bracing drawings and cut sheets, as required by Section 01 88 15, Anchorage and Bracing.

B. Informational Submittals:

- 1. Anchorage and bracing calculations as required by Section 01 88 15, Anchorage and Bracing.

2. Manufacturer's Certification of Compliance that factory-applied coating system(s) is identical to requirements specified herein.
3. Factory Functional and Performance Test Reports.
4. Source quality control test reports in accordance with Article Quality Assurance.
5. Field quality control test reports in accordance with Section 01 43 33, Manufacturer's Field Services.
6. Special shipping, storage and protection, and handling instructions.
7. Manufacturer's printed installation instructions.
8. Suggested spare parts list to maintain equipment in service for a period of 1 year and 5 years. Include list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
9. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
10. Operation and Maintenance Data: As specified in Section 01 78 23, Operation and Maintenance Data.
11. Manufacturer's Certificate of Proper Installation, in accordance with Section 01 43 33, Manufacturers' Field Services.

1.05 QUALITY ASSURANCE

- A. Rotary lobe pump manufacturer shall be ISO 9001 certified.

1.06 EXTRA MATERIALS

- A. Furnish for this set of pumps:

1. Two complete set of bearings.
2. Complete set gaskets and O-ring seals.
3. Two shaft sleeves, if used.
4. Complete set keys, dowels, and pins.
5. Two complete mechanical seals.
6. One set wear plates.
7. One set housing segments or radial liners.
8. Two pairs of rotors or rotor tips for two rotors.
9. One complete set of special tools required to dismantle pump.
10. Two sets of drive belts.
11. One set of pump shafts.

- B. Delivery: In accordance with Section 01 61 03, Equipment – Basic Requirements.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Börger.
2. Or equal.

2.02 ROTARY LOBE POSITIVE DISPLACEMENT PUMP

A. General:

1. Coordinate pump requirements with drive manufacturer and be responsible for pump and drive requirements.
2. Where variable frequency drives are required, furnish a coordinated operating system complete with pump, drive, and speed controller.
3. Pumping units required under this section shall be complete.

B. Physical Characteristics:

1. Some specific requirements are attached to this section as Data Sheets.
2. Provide mechanical equipment, including drives and electric motors in accordance with applicable OSHA regulations. Unless otherwise specified, provide rigid painted steel or stainless-steel guards on rotating assemblies. Guards shall be removable only by use of a tool.
3. Pump Casings:
 - a. Material in accordance with Pump Data Sheet.
 - b. Pump Rotor Housing: Multi-piece to allow adjustment of rotor running clearance at least twice or shall include radial liners that can be replaced to restore running clearance.
4. Wear Plates:
 - a. Rear of pump rotor casing and front cover shall be protected with replaceable wear plates having a minimum Brinell hardness in accordance with Pump Data Sheet.
 - b. Front cover wear plate shall be reversible.
 - c. Wear Plate Bolts: Bolts that secure wear plates to castings inside pump assembly shall be in accordance with Pump Data Sheet.
5. Rotors:
 - a. Driven through positive timing gears running in oil.
 - b. Material and durometer hardness in accordance with Pump Data Sheet.
 - c. Geometry:
 - 1) Rotor core shall be same as that of finished rotor.
 - 2) Number of helical lobes in accordance with Pump Data Sheet, to provide near pulseless flow.

6. Shafts and Shaft Sleeves: Material in accordance with Pump Data Sheet.
7. Mechanical Seals:
 - a. Single mechanical style with seal faces material per pump data sheet. Cartridge style or component type mechanical seals that use bushings to permanently place seals are acceptable.
 - b. Seal Holders: Fabricated of materials that are suitable for prolonged corrosion and chemical resistance.
 - c. Pumps that utilize packing glands or require external flushing for lubrication and cooling are not acceptable.
8. Quench/Blocking Chamber:
 - a. Oil-filled quench/blocking chamber located behind mechanical seal, and in front of bearing housing lip seal shall be molded into casing of pump.
 - b. Chamber shall be suitable for fill, from side of pump, through nipples and have an external sight glass or oil bottle for visual inspection of status of mechanical seal operation.
9. Flanges:
 - a. Port connection rating in accordance with Pump Data Sheet.
 - b. Inlet and outlet ports shall be constructed of grey iron, fittings and flanges bolted to rectangular ports on pump casting.
 - c. Ports shall be oriented horizontally without offset unless otherwise shown on the Drawings.
10. Pump Front Cover:
 - a. Provide access to pump chamber without disconnecting pipe work or bearings.
 - b. When opened shall provide unhindered access to rotors, wear plate, and mechanical seals.
11. Bearings: Sized to withstand maximum radial or axial load carried by shafts for continuous duty.
12. Timing Gears and Gear Housing: Gear box housing material in accordance with Pump Data Sheet. Oil-filled, fitted with built-in sight glass to monitor oil level.
13. Gear Reducer, as Required:
 - a. In-line gear reducer designated for continuous duty at moderate shock load.
 - b. Meet AGMA Class II, with service factor of 1.4 minimum for pump applications with moderate shock, continuous duty and AGMA Class III, with service factor of 2.0 minimum for heavy shock, continuous duty operation.
 - c. C-face, mounted with C-face drive motor to form integral gearmotor combination.
14. V-Belt Drive, as Required:
 - a. Motor shall be mounted above pump on adjustable base that allows adjustment of belt tension.
 - b. Drive shall consist of pulleys with separate hubs attached to shafts with keys.

- c. For motors larger than 3 hp, provide a minimum of two belts.
 - d. Belts and pulleys shall be enclosed in removable metal guard that meets OSHA requirements. Guard shall allow measurement of pump rpm with strobe or contact meter without removing guard.
15. Structural Base: Rotary lobe pump, gear reducer, motor or gearmotor shall be mounted on a structural baseplate material per pump data sheet, with structural channel supports as necessary, complete with couplings, guards, and mounting hardware.

C. Functional Characteristics:

- 1. Lubrication fitting shall be brought to outside of equipment, so they are readily accessible from outside without necessity of removing covers, plates, housings, or guards.
- 2. Mechanical seals, wear plates and rotors shall be replaceable by removing front cover of rotor housing without disassembly of pump unit or pipe system.
- 3. Rotors:
 - a. Designed for pumping membrane permeate.
 - b. Designed for forward and reverse flows as required by Membrane Equipment Supplier.

D. Performance Characteristics:

- 1. Designed and fabricated for membrane permeate pumps within specified range of operation, without overheating and without excessive vibration or strain.
- 2. Parts shall be designed and proportioned to have liberal strength, stability, and stiffness and to be especially adapted for service to be performed. Provide space for inspection, repairs, and adjustment.
- 3. Working parts of pumps and motors, such as bearings, wearing rings, shaft, sleeves shall be interchangeable between like units and such that Government may, at any time in future, obtain replacement and repair parts for those furnished in original equipment.
- 4. Nameplate ratings of motors shall not be exceeded, nor shall design service factor be reduced when pump is operating at point on its characteristic curve up to maximum flow specified herein.
- 5. Noise level of pump system, unless otherwise noted, shall not exceed limits established by HI 3.1-3.5 under paragraph for Airborne Noise.
- 6. Bearings: Minimum ABMA L10 Bearing Life in accordance with Pump Data Sheet.
- 7. Timing Gears and Gear Housing:
 - a. Meet AGMA Class 8 quality minimum.
 - b. Keyed and timed to prevent contact between rotors and provide smooth and quiet transmission of load.

2.03 ACCESSORIES

A. Equipment Identification Plate:

1. 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location giving name of manufacturer, rated capacity, head, speed and other pertinent data. Attach to each pump, motor, and gear reducer.
2. Additionally, pump serial number, model, gear reduction and motor horsepower shall be cut or stamped into steel plate and welded to skid for permanent identification.

B. Lifting Lugs: Equipment weighing over 100 pounds.

2.04 FACTORY FINISHING

A. Physical Characteristics: Prepare and prime and finish coat in accordance with Section 09 90 00, Painting and Coating, System No. 4.

B. Functional Characteristics: None.

C. Performance Characteristics: None.

2.05 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments: Test all equipment actually furnished.

C. Functional Test: Perform manufacturer's standard on equipment.

D. Performance Test:

1. Conduct on each pump.
2. Perform under simulated operating conditions.
3. Test for continuous 3-hour period without malfunction.
4. Test Log:
 - a. Record the following:
 - 1) Total head.
 - 2) Capacity.
 - 3) Horsepower requirements.
 - 4) Flow measured by factory instrumentation and storage volumes.
 - 5) Driving motor voltage and amperage measured for each phase.

- 5. Performance Test Logs: Adjust, realign, or modify units and retest in accordance with Hydraulic Institute Standards, if necessary.
- E. Hydrostatic Test: Pump casing tested at 150 percent of shutoff head. Test pressure maintained for not less than 5 minutes.
- F. Motor Test: See Section 26 20 00, Low-Voltage AC Induction Motors.
- G. Factory Test Report: Perform manufacturer's standard performance test on each pump actually furnished to verify acceptable operation across specified range of flows. Include test data sheets.

2.06 MOTORS

- A. Comply with requirements of Section 26 20 00, Low-Voltage AC Induction Motors.

PART 3 EXECUTION

3.01 INSTALLATION

- A. Install in accordance with manufacturer's printed instructions.
- B. Level base by means of steel wedges (steel plates and steel shims). Wedge taper not greater than 1/4 inch per foot. Use double wedges to provide level bearing surface for pump and driver base. Accomplish wedging so there is no change of level or springing of baseplate when anchor bolts are tightened.
- C. Adjust pump assemblies so driving units are properly laser aligned, plumb, and level with driven units and interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.
- D. After pump and driver have been set in position, aligned, and shimmed to proper elevation, grout space between bottom of baseplate and concrete foundation with a poured, nonshrinking grout of the proper category, as specified in Section 03 62 00, Grouting. Remove leveling wedges after grout is set and pack void left with grout.
- E. Connect suction and discharge piping without imposing strain to pump flanges.
- F. Anchor Bolts: Accurately place using equipment templates and as specified in Section 05 50 00, Metal Fabrications.
- G. Pipe pump drain to floor drain.

3.02 FIELD FINISHING

- A. Touchup damaged areas in accordance with and as specified in Section 09 90 00, Painting and Coating.

3.03 FIELD QUALITY CONTROL

- A. Perform the following field testing in coordination with the installing contractor.
- B. Functional Tests: Conduct on each pump.
 - 1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
 - 2. Operating Temperatures: Monitor bearing areas on pump and motor for abnormally high temperatures.
- C. Performance Tests for Individual Units:
 - 1. Conduct on each pump.
 - 2. Perform under simulated operating conditions.
 - 3. Test for a continuous 3-hour period without malfunction.
 - 4. Test Log:
 - a. Record the following:
 - 1) Total head.
 - 2) Capacity.
 - 3) Horsepower requirements.
 - 4) Flow measured by plant instrumentation and storage volumes.
 - 5) Average distance from suction well water surface to pump discharge centerline for duration of test.
 - 6) Pump discharge pressure converted to feet of liquid pumped and corrected to pump discharge centerline.

3.04 MANUFACTURER'S SERVICES

- A. Manufacturer's Representative:
 - 1. Present at Site or classroom designated by Government, for the following minimum person-days listed below, travel time excluded:
 - a. 1 person-day for installation assistance and inspection.
 - b. 1 person-day for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
 - c. 1 person-day for facility startup.
 - d. 1 person-day for post-startup training of Government's personnel. Training shall not commence until an accepted detailed

lesson plan for each training activity has been reviewed by the Contracting Officer.

B. See Section 01 91 14, Equipment Testing and Facility Startup.

3.05 SUPPLEMENTS

A. The supplements listed below, following “End of Section,” are a part of this specification:

1. Permeate Pump Data Sheet.
2. Pump Drive Induction Motor Data Sheet.

END OF SECTION

PERMEATE PUMP DATA SHEET	
Service: _____ Pump Name: <u>Permeate Pump</u> Pump Tag Number(s): <u>PMP-3312, PMP-3412, PMP-3512</u> No. Pumps Required: <u>3</u> Pump A Mfr.: _____ Model No.: _____ Pump B Mfr.: _____ Model No.: _____ Pump C Mfr.: _____ Model No.: _____	
LIQUID PUMPED AND SERVICE CONDITIONS	PERFORMANCE REQUIREMENTS
Liquid Pumped: Membrane permeate, membrane permeate with membrane cleaning agent. Pumping Temperature (°F): Normal: _____ Max: _____ Min: _____ Specific Gravity @ 60°F: _____ Viscosity Range (CP) @ 60°F: _____ Vapor Press. @ 60°F (psia): _____ Liquid pH: _____ TSS (mg/L): _____ Max Diam Solid Pump Can Pass (in): _____ Min NPSH Available (psig): _____ Suction Pressure (psig): Max: _____ Rated: _____ Erosion/Abrasion/Corrosion: ☐ Yes ☐ No Caused by: _____ Scale Buildup: ☐ Yes ☐ No Caused by: _____ Ambient Temp (°F): Max: _____ Min: _____ Altitude (ft above MSL): _____ Location: ☐ Indoor: ☐ Heated ☐ Unheated ☐ Outdoor Area Classification: _____	Capacity Rated (U.S. gpm): <u>As determined by membrane equipment supplier</u> TDH Rated (psig): <u>As determined by membrane equipment supplier.</u> Maximum shutoff pressure (psig): <u>As determined by membrane equipment supplier.</u> Maximum continuous flow (gpm): <u>As determined by membrane equipment supplier.</u> Maximum pump speed at design point (rpm): <u>500</u> ☐ Constant ☒ Adjustable Speed Range of Rated Speed (%): _____ Constant Torque: ☐ Yes ☐ No
Remarks: _____ _____ _____	

PERMEATE PUMP DATA SHEET (CONTINUED)

PHYSICAL CHARACTERISTICS (manufacturer to supply missing data)

Pump Type: ☐ Continuous Duty
☐ Other: _____

Nozzle size (inches):
 Suction: _____ Discharge: _____

Casing:
 Material: Cast Iron ASTM A48 Class 30 or higher

Wear Plates:
 Hardness: 500 minimum Brinell hardness
 Bolts: Stainless steel hex head type

Rotors:
 Material: Solid cast iron covered with nitrile
 Durometer/Hardness: 70 as per ASTM D2240
 Number of Lobes: Per Manufacturer

Shaft:
 Material: Alloy steel AISI A4140
 Sleeve: Ceramic coated stainless steel

Mechanical Seal:
 Face Material: ☐ Silicone Carbide
☐ Tungsten Carbide
☐ Other: _____
 Seal Lubrication: Oil

Flanges:
 Material: Grey Iron
 Flange Rating: ANSI 125 or 150-pound or greater

Bearings:
 ABMA L-10 Life (hrs): 100,000 hours running at steady or constant speed, load, pressure and temperature; 50,000 hours operated with Variable Frequency Drive.
 Lubrication: ☐ Grease ☐ Oil

Gear Housing:
 Material: Cast iron

Baseplate Material: _____

Drive Type: ☐ Direct-Coupled
☐ Belt
☐ Adjustable Speed
☐ Other: _____

Pump Coating System:
 Protective Exterior Coating: _____
 Protective Lining: _____
 (Per Section 09 90 00, Painting and Coating)

Remarks: _____

PUMP DRIVE INDUCTION MOTOR DATA SHEET

Pump Name: _____

Pump Tag Number(s): _____

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer.

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Hazardous Location: ☐ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Horsepower: _____

Voltage: _____

Phase: _____

Frequency: _____

Synchronous Speed (rpm): _____

Inverter Duty: ☐ Yes ☐ No

☐ Thermal Protection: _____

☐ Space Heater: _____ volts,
single-phase

☐ Moisture Detection Switches

☐ Thermal Protection Embedded in
Windings

Guaranteed Minimum Efficiency at Full Load: _____ percent

Guaranteed Minimum Power Factor at Full Load: _____ percent

Service Factor (@ rated max. amb. temp.): ☐ 1.0 ☐ 1.15

Enclosure Type: ☐ DIP ☐ EXP ☐ ODP ☐ TEFC
☐ CISD-TEFC ☐ TENV ☐ WPI ☐ WPIL ☐ SUBM

☐ Multispeed, Two-Speed: _____/_____ rpm

Winding: ☐ One ☐ Two

Mounting Type: ☐ Horizontal ☐ Vertical

☐ Vertical Shaft: ☐ Solid ☐ Hollow

☐ Vertical Thrust Capacity (lb): Up _____ Down _____

☐ Non-reverse Ratchet

☐ Adjustable Speed Drive: See Section 26 29 23, Low-Voltage
Adjustable Frequency Drive System.

Operating Speed Range: _____ min to: _____ max

☐ Variable Torque

☐ Constant Torque

Additional Motor Requirements: ☐ See Section 26 20 00, Low-Voltage AC Induction Motors.

Special Features:

Provide motor with isolated bearings and shaft grounding.

