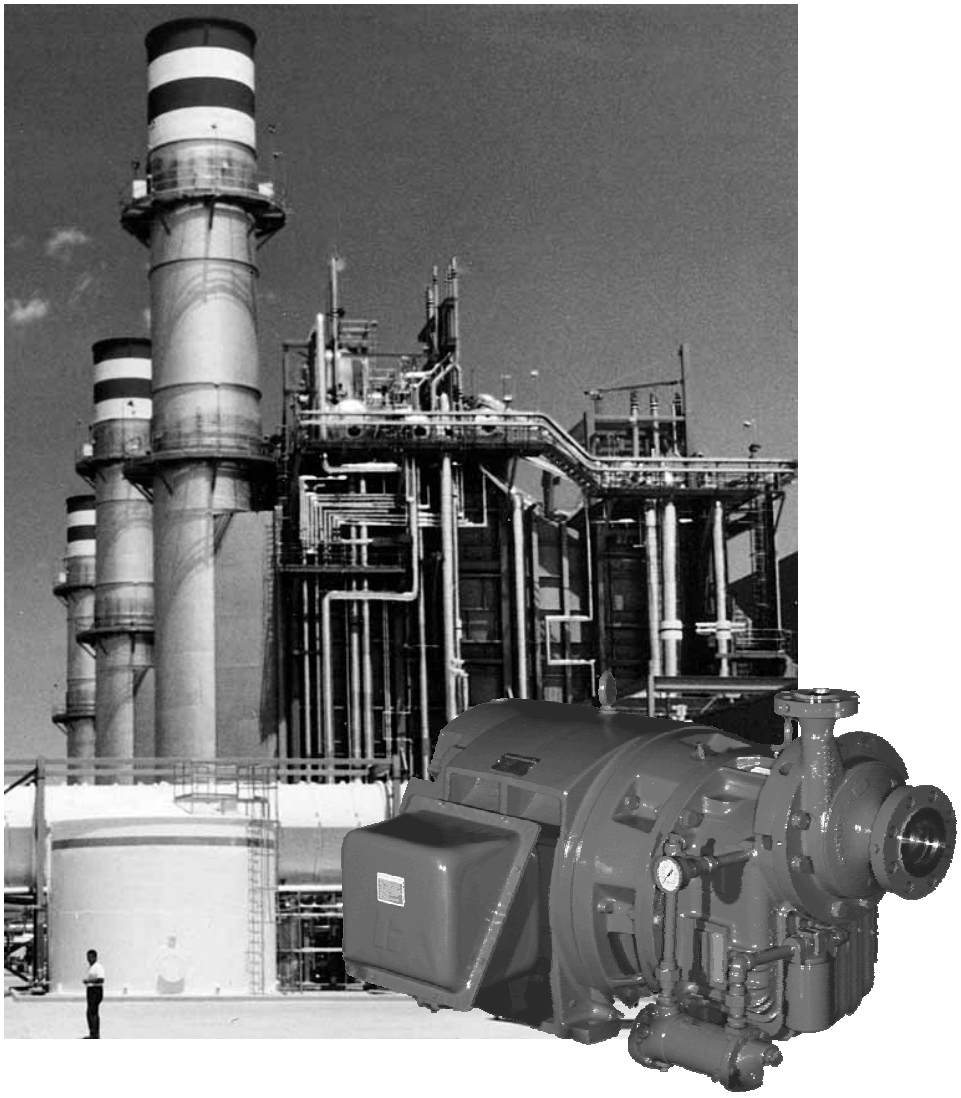
SUNFLO

P-3000

with Journal Bearings
Instruction & Operation Manual



Sundyne CORPORATION®

02.10.02E, 6/2000
Effective: 6/2000
Supersedes: 6/97

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WARRANTY

Sundyne Corporation warrants to Buyer for a period of twelve (12) months from the date of being placed in service (but not to exceed eighteen (18) months after the date of shipment) that the equipment at the time of shipment will be free from defects of design, material and workmanship. If any defects or malperformance occur during the warranty period, Sundyne's sole obligation shall be limited to alteration, repair or replacement at Sundyne's expense, F.O.B. Factory, of parts or equipment, which upon return to Sundyne and upon Sundyne's examination prove to be defective. Equipment and accessories not manufactured by Sundyne are warranted only to the extent of and by the original manufacturers' warranty. Sundyne shall not be liable for damage or wear to equipment caused by abnormal conditions, vibration, failure to properly prime or to operate equipment without flow or caused by corrosives, abrasives or foreign objects. THE FOREGOING WARRANTY IS EXCLUSIVE AND IN LIEU OF ALL OTHER WARRANTIES, WHETHER EXPRESSED OR IMPLIED INCLUDING ANY WARRANTY OF MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE. In no event shall Sundyne be liable for consequential or incidental damages.

Icons Used in this Manual

The following icons (symbols) are used to indicate specific types of information.

Good ideas to use. A reminder to do something.

Equipment use alert. Unless you follow these procedures correctly, the equipment may be damaged.

Safety alert. Failure to follow these procedures can endanger the safety of you or others.

Electrical hazard. Failure to follow these procedures can endanger the safety of you or others.

NOTES:

Sunflo P-3000 = High Speed Centrifugal Pumps

USING THIS MANUAL:

This manual presents installation, servicing, starting, pump control, troubleshooting, maintenance, and spare parts information for the Sunflo P-3000 centrifugal pump.

Parenthetical numbers included in the text correspond to item numbers located on the illustrated figures. Information that may be required and is not included herein may be obtained from your Sundyne Corporation distributor, or directly from the factory.

10. Pump Disassembly
Provides a detailed disassembly procedure for the gearbox and pump

11. Pump Assembly
Provides a detailed re-assembly procedure for the gearbox and pump

12. Tool Drawings

13. Parts List
General, Recommended Spares

i. Introduction to the Sunflo P-3000 Pump

The Sunflo P-3000 pump is a high pressure/high speed centrifugal pump which provides multi-stage performance from a single-stage unit. The frame mounted configuration offers a greater degree of performance diversity and added driver flexibility such as the use of standard electric motors, steam turbines, and internal combustion. The close-coupled design incorporates the proven Sunflo design in an integral pump and motor package. This configuration provides a compact lightweight unit that does not utilize bedplates, couplings or belts. Installation is simplified and alignment of the pump and motor is not necessary. Close-coupled pumps are ideal for OEM packages and other industrial applications where a frame unit is not desired.

Common uses include pollution control, chemical, petrochemical, power system services, pulp and paper, vehicle manufacturing, mining, food and beverage, and oil products.

ii. Safety Precautions

Safety Warning

Sundyne Corporation manufactures centrifugal pumps to exacting International Quality Management System Standards (ISO 9001 - 1987) as certified and audited by Lloyd's Register Quality Assurance Limited. Genuine parts and accessories have been specifically designed and tested for use with these products to ensure continued product quality and performance. As Sundyne Corporation cannot test all parts and accessories sourced from other vendors, incorrect design and/or fabrication of such parts and accessories may adversely affect the performance and safety features of these products. Failure to properly select, install or use authorized Sunflo pump parts and accessories is considered misuse and damage or failure caused by misuse is not covered by Sundyne's warranty. Additionally, modification of Sunflo products or removal of original components may impair the safety of these products and their effective operation.

Suggested Safety Instructions:

During installation, maintenance, or repair operations of a Sunflo pump, systems for safety shall be applied before the commencement of work. Failure to take responsibility for safety may lead to injury of operator or others.

Personal Protective Equipment (PPE): Safety glasses with side shields, as a minimum, shall be worn by all personnel installing or performing maintenance or repair on the equipment. If equipment is over 15 pounds (7 kg) and is to be manually lifted, or if pallet jacks or forklifts are to be used, steel-toed safety shoes shall be worn. When testing the equipment, hearing protection is highly recommended if noise levels exceed 85 dB during an eight (8.0) hour period. Chemical resistant gloves shall be used if chemical use is required (see Chemical Use below for additional information). If chemicals have warnings regarding fumes and/or dust/mists, a dust mask respirator shall be worn as a minimum.

When selecting one piece of PPE to be used with another, consider the compatibility between them. For example, safety glasses should not interfere with the seal from hearing protection. Be sure to clean the PPE after each use.

Use of Forklifts: All forklift drivers must have a current recognized license. If using a forklift, first ensure that the lift is in a safe operating condition.

Electrical Safety: During installation, service, or repair ensure all electrical sources are off and it is safe to operate the equipment. A recognized Lock-out/Tag-out program should be followed - Locks and/or tags should be provided warning employees that the equipment is being installed, serviced, and/or repaired. Once the work is complete, the person installing the lock and/or tag shall remove it following your company's procedure for Lock-out/Tag-out and inform others of start-up.

Testing Equipment: Persons in the immediate area shall be warned when a test is to be performed.

Tools: Tools shall be insulated from electrical shock. Ensure all tools are clean and free of oil and the insulation is not damaged in any way.

Chemical Use: Any chemicals to be used shall be accompanied by a relevant material safety data sheet (MSDS), in accordance with your government legislation. If applicable, chemical proof gloves shall be used. An eye wash station (or equivalent) should be available in the event of injury. Should any hazardous or flammable chemicals have passed through the equipment a complete decontamination of the equipment is required.

Fall Protection: When working over six feet from the ground, fall protection is required.

Machine Guards: Guards shall remain in place on all equipment. Only during maintenance/repair can the guards be removed, and prior to start-up, the guard must be replaced.

Lock-Out/Tag-Out Guidelines:

Follow Your Company's Lock-Out / Tag-Out Procedure When Servicing Sunflo Pumps.

iii. Critical Startup Checklist

Know Your Machine

Before servicing and starting up the Sunflo P-3000 pump, carefully review the specification sheet, the outline drawings, performance curves, and this instruction manual. It is important you become familiar with the pump configuration before starting and operating the pump.

Driver Instructions

Carefully follow the installation and starting instructions provided by the manufacturer of the driver. This is included in the final data package.

Auxiliaries

1. Check the utility connections.
2. Verify that the auxiliary piping conforms to Sundyne's drawings.
3. Verify the connections of the switches, the instruments, and their settings.
4. Calibrate all measurement equipment (Flow meters, Current or Ampere meters, Pressure meters, etc.).

Environmental Control System

Install a system to control the environment of the seal, if required, and verify that Port 1 is properly vented.

If required install overhead drain piping.

Pressurized Fluid Loop:
Pressurize double seal buffer loop or external seal flush, if required, prior to admitting fluid into pump casing.

Check Driver Rotation
Rotation must be in the same direction as the arrow stamped or cast on the pump casing.

Gearbox Servicing:
Where applicable, operate auxiliary lube pump to fill heat exchanger and filter. Add oil as necessary through fill fitting until oil level stabilizes in sight glass. The gearbox alone requires approximately eight U.S. quarts (7.5 liters).

Starting Pump
Start pump with suction valve completely open while throttling discharge valve, to bring pump to design operating point.

Heat Exchanger
If a heat exchanger for the gearbox is installed, adjust the cooling flow to keep the temperature of the gearbox sump at 120°-170°F (49°-77°C).

Check
Check total head, flow rate, and power consumption against pump specification sheet. Check that specific gravity, viscosity and NPSH are in accordance with specification sheet. These conditions will significantly alter performance of the pump.

Process Conditions
Do process conditions; suction pressure, suction temperature, discharge pressure, agree with specification sheet information? Check with your Sunflo representative if you must test or run a different fluid/specific gravity than shown on the specification sheet.

Auxiliary Lube Pump
If you have an auxiliary lubrication pump, unlock the electrical circuit and start it in the “hand” position. Check for oil leaks and recheck the oil level.

Piping Connections
Are the following bolted/threaded connections tight:
a. Pump flange bolts?
b. Seal environment piping and port connections?
c. Cooling water connections to heat exchanger? (if applicable)
d. Gearbox oil drain plug?
e. Pump case drain plug?

1. Installation

This section contains the following:

Introduction: Provides a brief description of the pump and how it is used.

Inspection: Important items to inspect as soon as you receive your pump.

Short-term Storage: Procedure for units installed within 6 months.

Long-term Storage: Procedure for units installed after 6 months.

Mounting

Final Alignment

Suction and Discharge Piping: Procedures to set up the suction and discharge piping.

Auxiliary Piping and Seal Environment: Procedures to set up the seal environment controls, even if you use the standard system supplied by the factory. Gas buffer system procedures are included.

Baseplate Mounting and Grouting: Use this information for grouting the baseplate.

Driver and Coupling: Procedures to align the driver and pump. Do this after grouting, and before connecting the piping for suction and discharge. Once the suction and discharge piping is connected, confirm the final alignment.

Inspection

1. When you receive the Sunflo P-3000 Pump, check for any damage. If you find any, inform the carrier and Sundyne Corporation promptly.

2. Use Outline drawings in the last section of final data package, and reference the Pump and Gearbox bill of material to ensure that all auxiliary items are properly included.

3. Check the gear shaft carefully. Seal drag may cause it not to turn freely at first; this is normal. If the gear shaft binds, it may be damaged, or may need adjusting.

Short-term Storage - 1 day to 6 months

1. If the pump is to be stored near strong chemicals or salt water, protect it immediately. To do this, follow steps 5 through 10 from the long-term storage procedures below.

2. Protect the unit from moisture and dust.

3. Make sure that the factory's shipping covers for the housing flanges and the seal ports are securely in place.

4. Carefully follow the storage instructions provided by the manufacturer of the motor or turbine driver.

Long-term Storage - 6 months or more

If you store the Sunflo P-3000 Pump for a long period of time, the following methods are very important. If you require further instructions, please contact Sundyne Corporation at (303)-425-0800 USA and ask for the Field Service Department.

1. Be sure the storage area is indoors and has: Humidity below 65%; and temperature range from 45°F to 85°F (7°C to 29°C).

2. Do not allow contact of airborne chemicals with the internal components of the unit.

3. If the unit is being stored near strong chemicals or salt water, protect it immediately.

4. Protect the unit from moisture and dust.

5. Make sure that the factory's shipping covers for housing flanges and seal ports are securely in place.

6. Prevent corrosion to the components of the gearbox and the fluid-end.

7. Use desiccant bags to absorb moisture.

8. Purge the internal components with an inert gas.

9. Flood component internals with oil.

10. After long-term storage, have an authorized Sundyne service engineer inspect all components and supervise any necessary repair to be sure that they work properly. Any components not made by Sundyne (except mechanical seals) must be inspected or replaced as determined by the manufacturer's authorized personnel, at the purchaser's expense. Any Field Service work must be clearly stated at the time of purchase to validate an Extended Warranty.

    Because storage location and unknown factors at the site or storage are beyond our control, Sundyne does not accept any liability for damage to the equipment during storage, nor do we guarantee the quality of the equipment during and after the storage period. An Extended Warranty will be null and void if the proper equipment preparation is not maintained.

Mounting

A. During pump installation, ensure that adequate surrounding space is available for inspection, operation, and maintenance requirements.

B. The pump and driver for both the close-coupled and the frame mounted units should be bolted to a concrete foundation or an adequately supported structure substantial enough to absorb any vibration and to form a rigid support. If the pump and driver are mounted on a bedplate, the bedplate should be mounted on a concrete foundation and grouted.

    1. Choose a solid ground location and build the foundation form 3 inches larger overall than the bedplate.

    2. Use bedplate anchor bolts of the same size specified in the outline drawing. Provide pipe sleeves with an I.D. 2.5 to 3.0 times the bolt diameter. Provide flat washers between the bolt head and pipe sleeve to keep the bolt from slipping through the pipe sleeve.

3. Bolts should be of sufficient length so that they will project at least one-fourth inch above the nuts after allowing for bedplate, shim, and nut thickness. Locate the bolts accurately according to the outline drawing.

4. Pour concrete and tamp or vibrate during the pouring process to ensure no hollow spot forms. This is especially important around the anchor bolts. Do not allow any concrete to fall inside the pipe sleeves.

5. Level off the concrete surface. Leave a rough finish to provide a good base for grout. Allow the foundation to cure for one week before installing.

6. Hoist the bedplate above the foundation and lower into position over the anchor bolts. Anchor bolts can be moved laterally in the hollow of pipe sleeve for ease of alignment with the holes in the baseplate.

7. Using a precision level across the bedplate (front to rear and side to side), insert steel shims as required next to each bolt until the bedplate is level in all directions. Secure the anchor bolt nuts finger tight only.

8. Provide a wood dam around the base perimeter of the bedplate and thoroughly wet the top surface of the foundation. The use of non-shrink grout is recommended. Grout should be of a consistency to flow out under the bedplate against the wood dam. Grout should be puddled continuously as it is poured to expel air and to completely fill the space under the bedplate. Fill to the level of the grout hole.

9. Allow the grout to harden for at least 48 hours. Tighten the anchor bolts.

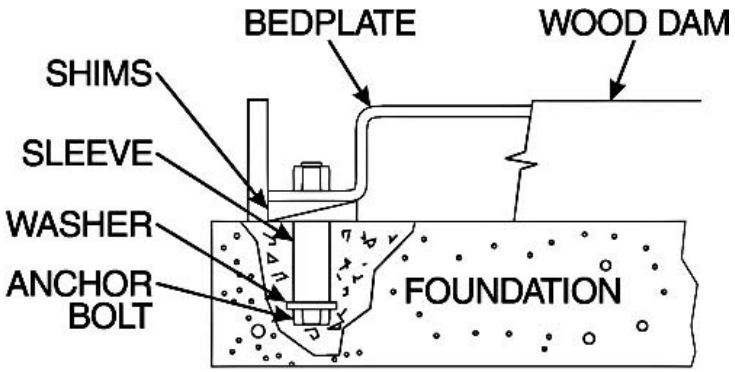


Figure 1

FRAMEMOUNT DRIVE UNIT INSTALLATION

A. Pumps supplied from the factory with a driver, base, and coupling are rough aligned prior to shipment. However, stresses caused by lifting and shipment may cause minor distortion which will alter the factory alignment. Check the coupling alignment after the baseplate has been leveled and prior to grouting.

B. If the coupling alignment has been disturbed by improper leveling of the base-plate, correct prior to grouting. After the base has been grouted and the piping connected, make a final pre-startup alignment check. Additionally, a hot alignment check should be made once the pump has reached normal operating temperature.

C. Coupling alignment should be verified only after the suction and discharge piping has been connected.

If a coupling is being used that was not supplied by Sundyne, it must be a flexible type, vibration- damping coupling. Refer to the coupling manufacturer's recommendations for installation and alignment.

To prevent personnel injury, lock-out the starting switch on the driver.

D. Alignment of the pump and driver is vital to trouble-free mechanical operation. The following are suggested steps to establish initial alignment of the unit using Sundyne stocked flexible couplings.

1. Clean all parts using a nonflammable solvent. Lightly coat the seal with grease and place on the shafts before the mounting hubs.

2. Mount hubs on their respective shafts so the hub is flush with the end of its shaft. Tighten the set screws when furnished.

3. Align the coupling. On the initial alignment, set the motor 0.003 to 0.004 inches (0.076 to 0.101 mm) higher than the pump to allow for thermal growth.

4. Tighten all hold down bolts on the pump and driver (and bedplate if used). Check the alignment and realign if necessary.

FINAL ALIGNMENT

The motor shaft height should be equal to the pump input shaft height at operating temperature.

The final alignment should be re-checked after a week of operation

A. Final alignment can only be accomplished after the unit has been run under actual operating conditions. The unit must be run for a sufficient period of time to bring the unit up to operating temperature. After the warm up period has elapsed, stop the unit, disconnect the coupling, and check the alignment. Repeat the alignment procedure and run the pump through another warm-up procedure to verify the alignment.

B. Recheck the alignment after the pump has been running for about a week. This check must be made immediately after the pump has been shut down and before it has a chance to cool.

Installing The Suction And Discharge Piping - Guidelines

A. Good installation practice dictates that there should be a minimum straight length of pipe on the suction of the pump equal to ten (10) times the suction pipe diameter. This is to allow the liquid to flow into the pump casing/impeller without turbulence. Furthermore, good installation practice dictates the use of suction piping at least one or two sizes larger than the pump flange and reduction of the pipe diameter at the pump flange. Use an eccentric reducer with the "Belly" side down. **Do NOT** install with "Belly" side up. Never use suction piping of a smaller diameter than the pump suction inlet.

B. Both the suction and discharge piping should have no unnecessary elbows, bends, and fittings as they increase friction losses in the piping. The size of pipe and fittings should be selected carefully to keep the friction losses as low as practical.

C. Suction and discharge block-and-bleed valve designs are recommended to isolate the pump during shutdown and to drain the process piping when removal of the pump is necessary.

The rotation of the pump casing without a modification to the journal bearing orientation will cause the pump to fail. Contact the factory or your authorized Sunflo sales representative for assistance on how to modify the journal bearings.

D. The pump casing can be rotating in increments of 90° to place the discharge connection in any of the four positions: horizontal right or left and vertical up or down.

E. Do not rotate the seal housing. The seal ports must always be as shown in Figure 2.

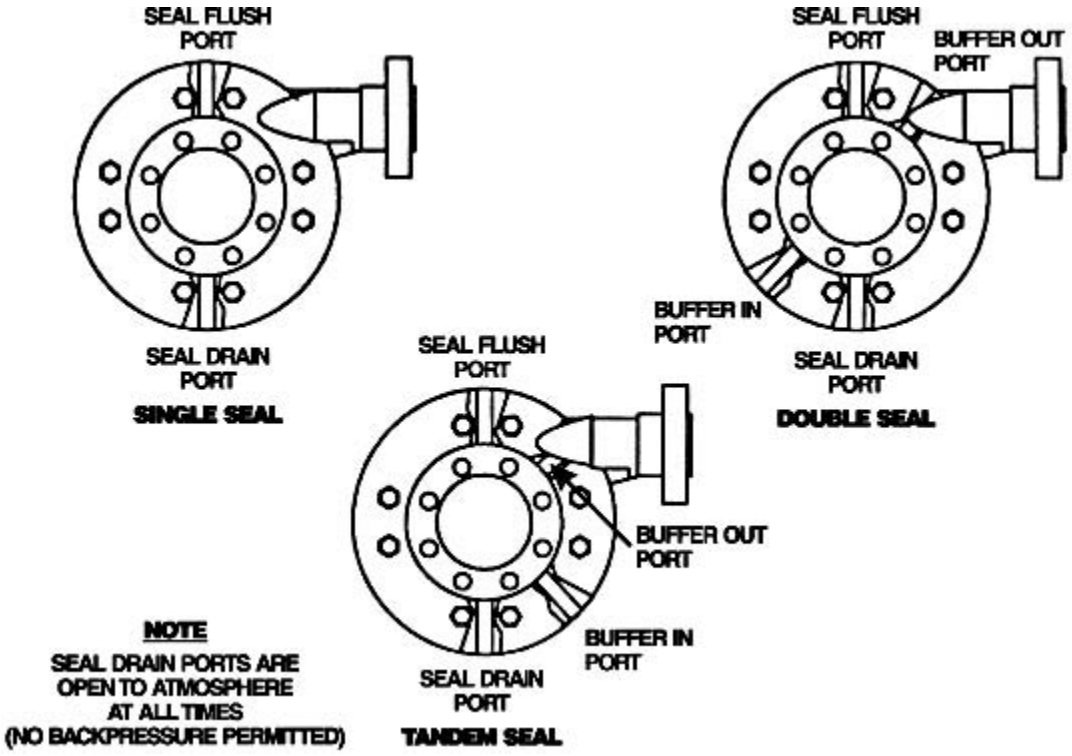


Figure 2

F. Under no circumstances should the suction pipe be forced in order to align it to the pump suction inlet. The flange bolts should slip into the aligned flange holes without straining the piping.

G. Gasket surfaces should be parallel and flange bolts should slip into the aligned flange holes without straining the pipe to fit the pump.

H. Piping layouts should be designed to provide sufficient support and flexibility to minimize forces and moments induced by the piping onto the pump.

I. All piping must be supported independently of the pump. Proper support for the suction and discharge piping is essential in order to avoid pipe strain on the pipe casing.

J. The suction line should be clean and a temporary suction strainer of approximately 40 mesh should be installed during initial startup to protect the impeller from damage by mill scale, welding slag, or other foreign particles during initial startup.

K. Always provide a suction pressure gauge on all installations to monitor suction conditions. Install the gauge as close as possible to the suction flange. When temporary suction strainers are used, ensure that the gauges are installed on both sides of the strainer.

L. Always provide a discharge pressure gauge on all installations to monitor discharge conditions. Install the gauge as close as possible to the discharge flange.

M. Check valves should be placed on all installations where back flow through the pump is possible. If a check valve is installed in the discharge line, provisions should be made to vent the space between the pump and the check valve or the pump may not prime.

Auxiliary Piping and Seal Environment

A. Depending upon the pump seal arrangement and application, a seal environment control system may be required. The pump seal environment must always be maintained as determined by the seal arrangement. There are three different seal arrangements available for your Sunflo P-3000 pump: The single seal, the double seal, and the tandem seal. It is important that the seal environment control system piping be connected as shown in Figure 2 and that the seal drain port is always left open.

B. For application data and available seal flush plans utilizing a process seal, please refer to Sunflo Field Engineering Bulletin 40.2.58, "Sunflo Pump Seal Plans". Contact your authorized Sunflo sales representative if you do not have this bulletin.

If a seal flush system is not in use, then the seal flush port should be plugged to prevent outside contamination of the seal cavity. The seal flush port is at the 12 o'clock position as shown in Figure 2.

Regardless of what seal arrangement is being used, the process drain on the seal housing must always remain open to atmosphere. Failure to leave the gearbox drain port open will cause process fluid to accumulate in the seal housing and to eventually leak past the gearbox seal into the gearbox oil sump.

Single Seal Flush System

C. A seal flush system utilizing the seal flush port is available for use with the single or tandem seal arrangement. The seal flush must be cool, clean, and compatible with the process fluid and pump materials of construction. When using an external seal flush, the seal must be flushed at 15 psi (1.05 kg/cm2) above the seal cavity pressure and at a controlled rate of 2.0 gpm (0.4 m^3/hr). Please refer to Paragraph G of this section for details concerning seal cavity pressure rise. Seal cavity pressure rise values are provided in Table 1.

Double Seal Liquid Buffer System

The buffer system must be in operation prior to flooding the pump suction. Failure to do so will cause reverse pressurization of the in-board seal and may result in contamination of the buffer system with the process fluid.

D. A liquid buffer system must be used with a double liquid seal arrangement to prevent process liquid leakage out of the pump. The buffer must be cool, clean, and compatible with the process fluid and pump materials of construction. The buffer is introduced into the "buffer in" port of the seal housing at a pressure of 15 psi (1.05 kg/cm^2) above the design seal cavity pressure rise. Please refer to Paragraph G of this section for details concerning seal cavity pressure rise. Seal cavity pressure rise values are provided in Table 1. A small portion of the buffer fluid flows across the inboard seal into the process fluid and a small portion flows across the outboard seal and is vented from the drain port. A buffer flow of 0.5 to 3 gpm (0.10 to 0.70 m^3/hr) must be maintained through the buffer cavity to properly lubricate and cool the seals. This flow should be regulated by a valve or orifice on the "buffer out" port of the seal housing.

TANDEM SEAL LIQUID BUFFER SYSTEM

E. A liquid buffer system is used with tandem seal arrangement to cool and lubricate the outboard seal and to contain process fluid leakage from the inboard seal. The buffer fluid must be cool, clean, and compatible with the process fluid and pump materials of construction. The buffer liquid is introduced into the "buffer in" port of the seal housing at atmospheric pressure and must maintain a flow of 0.5 to 3.0 gpm (0.10 to 0.70 m^3/hr) through the buffer cavity to properly lubricate and cool the outboard (secondary) seal.

PROCESS SEAL DRAINS

F. Piping may connect to the seal port drain. However, the piping should be arranged to prevent any back pressure. Failure to prevent back pressure will cause a failure of the gearbox seal resulting in the leakage of process fluid into the gearbox.

SEAL CAVITY PRESSURE RISE

G. Whenever a single seal with external flush, double, or tandem seal arrangement is used, the seal cavity pressure rise must be known to determine the seal flush or buffer pressure. The area behind the impeller, near the seal, is referred to as the seal cavity. Suction pressure plus the seal cavity pressure rise plus a safety margin of 15 psi (1.05 kg/cm2) equals the required double seal buffer pressure or the single seal flush pressure.

The required seal flush/buffer pressure may be determined for your pump model by using the values in Table 1 and the method provided below:

1. Find the pump model that is applicable to your pump.
2. Determine the seal cavity pressure rise (based on water with a specific gravity of 1.0).
3. Multiply this seal cavity pressure rise value by the specific gravity of the process fluid.
4. Specify the seal flush/buffer pressure to equal the sum of the suction pressure, the specific gravity corrected seal cavity pressure rise determined in Step G-3, and 15 psi (1.05 kg/cm^2).

EXAMPLE:

Model:	Sunflo P3-AJG
Suction Pressure:	19 psig
Seal Cavity Pressure Rise:	20 psig (From Table 1)
Process Specific Gravity:	0.95

Required Seal Flush/Buffer Pressure
(RSFBP) = Suction Pressure + Seal Cavity Pressure Rise + 15 psig

RSFBP = 19 psig + (20 psig)(0.95) + 15 psig
RSFBP = 53 psig

Table 1. Seal Cavity Pressure Rise (Based on Water: SG = 1.0 and 60 Hz) *SCPR in psi (bar)									
Model	**SCPR***	**Model**	**SCPR***	**Model**	**SCPR***	**Model**	**SCPR***	**Model**	**SCPR***
P3-AJG PE-AKG P3-ALG P3-AMG P3-ANG P3-APG	20 (1.4)	P3-AJH P3-AKH P3-ALH P3-AMH P3-ANH P3-APH	20 (1.4)	P3-AMJ P3-ANJ P3-APJ	20 (1.4)	P3-AMK P3-ANK P3-APK P3-AQK P3-ARK P3-ASK P3-ATK P3-AVK P3-AWK	20 (1.4)	P3-ARL P3-ASL P3-ATL P3-AVL	20 (1.4)
P3-ARM P3-ASM	25 (1.7)	P3-BNE P3-BPE P3-BQE P3-BRE P3-BSE P3-BTE P3-BVE P3-BWE	25 (1.7)	P3-BLF P3-BMF P3-BNF P3-BPF P3-BQF P3-BRF P3-BSF P3-BTF P3-BVF P3-BWF	25 (1.7)	P3-BMG P3-BNG P3-BPG P3-BQG P3-BRG P3-BSG P3-BTG P3-BVG P3-BWG	25 (1.7)	P3-BLH P3-BMH P3-BNH P3-BPH P3-BQH P3-BRH P3-BSH P3-BTH P3-BVH P3-BWH	25 (1.7)
P3-BLJ P3-BMJ P3-BNJ P3-BPJ P3-BQJ P3-BRJ P3-BSJ P3-BTJ P3-BVJ P3-BWJ	25 (1.7)	P3-BMK P3-MNK P3-BTK P3-BVK P3-BWK	30 (2.1)	P3-BRL P3-BSL	30 (2.1)	P3-CMD P3-CND P3-CPD P3-CQD P3-CRD P3-CSD P3-CTD P3-CVD P3-CWD	30 (2.1)	P3-CJE P3-CKE P3-CLE P3-CME P3-CNE P3-CPE P3-CQE P3-CRE P3-CSE P3-CTE P3-CVE P3-CWE	35 (2.4)
P3-CJF P3-CKF P3-CLF P3-CMF P3-CNF P3-CPF P3-CQF P3-CRF P3-CSF P3-CTF P3-CVF P3-CWF	35 (2.4)	P3-CHG P3-CJG P3-CKG P3-CLG P3-CMG P3-CNG P3-CPG P3-CQC P3-CRG P3-CSG	40 (2.8)	P3-CJH P3-CKH P3-CLH P3-CMH P3-CNH P3-CPH P3-CQH P3-CRH P3-CSH	40 (2.8)	P3-CMJ P3-CNJ P3-CPJ P3-CQJ	45 (3.1)	P3-CMK P3-CNK	45 (3.1)
P3-DGB P3-DHB P3-DJB P3-DKB P3-DLB P3-DMB P3-DNB P3-DPB	50 (3.4)	P3-DFC P3-DGC P3-DHC P3-DJC P3-DKC P3-DLC P3-DMC P3-DNC P3-DPC	50 (3.4)	P3-DED P3-DFD P3-DGD P3-DHD P3-DJD P3-DKD P3-DLD P3-DMD P3-DND P3-DPD	50 (3.4)	P3-DDE P3-DEE P3-DFE P3-DGE P3-DHE P3-DJE P3-DKE P3-DLE P3-DME	50 (3.4)	P3-DFF P3-DGF P3-DHF P3-DJF P3-DKF P3-DLF P3-DMF	50 (3.4)
P3-DGG P3-DHG P3-DJG P3-DKG	60 (4.1)	P3-DJH	60 (4.1)	P3-EDB P3-EEB P3-EFB P3-EGB P3-EHB P3-EJB P3-EKB P3-ELB P3-EMB P3-ENB	70 (4.8)	P3-ECC P3-EDC P3-EEC P3-EFC P3-EGC P3-EHC P3-EJC P3-EKC P3-ELC	70 (4.8)	P3-ECD P3-EDD P3-EED P3-EFD P3-EGD P3-EHD P3-EJD P3-EKD	70 (4.8)
P3-EEE P3-EFE P3-EGE P3-EHE P3-EJE	70 (4.8)	P3-EGF P3-EHF	70 (4.8)	P3-FCB P3-FDB	75 (5.2)	P3-FEB P3-FFB P3-FGB P3-FHB P3-FJB	80 (5.5)	P3-FCC P3-FDC P3-FEC P3-FFC P3-FGC P3-FHC	80 (5.5)
P3-FCD P3-FDD P3-FED P3-FGD	80 (5.5)	P3-FEE P3-FFE	80 (5.5)						

Table 1. Seal Cavity Pressure Rise (based on Water: SG = 1.0 and 50 Hz) *SCPR in bar (psi)									
Model	**SCPR***	**Model**	**SCPR***	**Model**	**SCPR***	**Model**	**SCPR***	**Model**	**SCPR***
P3-HJG P3-HKG P3-HLG PE-HMG P3-HNG P3-HPG	1.2 (17)	P3-HJH P3-HKH P3-HLH P3-HMH P3-HNH P3-HPH	1.2 (17)	P3-HMJ P3-HNJ P3-HPJ	1.2 (17)	P3-HMK P3-HNK P3-HPK P3-HQK P3-HRK P3-HSK P3-HTK P3-HVK P3-HWK	1.4 (20)	P3-HRL P3-HSL P3-HTL P3-HVL	1.4 (20)
P3-HRM P3-HSM	1.4 (20)	P3-JNE P3-JPE P3-JQE P3-JRE P3-JSE P3-JTE P3-JVE P3-JWE	1.7 (25)	P3-JLF P3-JMF P3-JNF P3-JPF P3-JQF P3-JRF P3-JSF P3-JTF P3-JVF P3-JWF	1.7 (25)	P3-JMG P3-JNG P3-JPG P3-JQG P3-JRG P3-JSG P3-JTG P3-JVG P3-BWG	1.9 (27)	P3-JMH P3-JNH P3-JPH P3-JQH P3-JRH P3-JSH P3-JTH P3-JVH P3-JWH	1.9 (27)
P3-JLJ P3-JMJ P3-JNJ P3-JPJ P3-JQJ P3-JRJ P3-JSJ P3-JTJ P3-JVJ P3-JWJ	2.1 (30)	P3-JLK P3-JMK P3-JTK P3-JVK P3-JWK	2.1 (30)	P3-JRL P3-JSL	2.1 (30)	P3-KMD P3-KND P3-KPD P3-KQD P3-KRD P3-KSD P3-KTD P3-KVD P3-KWD	2.4 (35)	P3-KJE P3-KKE P3-KLE P3-KME P3-KNE P3-KPE P3-KQE P3-KRE P3-KSE P3-KTE P3-KVE P3-KWE	2.5 (36)
P3-KJF P3-KKF P3-KLF P3-KMF P3-KNF P3-KPF P3-KQF P3-KRF P3-KSF P3-KTF P3-KVF	2.5 (36)	P3-KHG P3-KJG P3-KKG P3-KLG P3-KMG P3-KNG P3-KPG P3-KQC P3-KRG P3-KSG P3-KTG	2.8 (40)	P3-KJH P3-KKH P3-KLH P3-KMH P3-KNH P3-KPH P3-KQH P3-KRH P3-KSH	2.8 (40)	P3-KLJ P3-KMJ P3-KNJ P3-KPJ P3-KQJ	3.3 (48)	P3-KMK P3-KNK	3.3 (48)
P3-LGB P3-LHB P3-LJB P3-LKB P3-LLB P3-LMB P3-LNB P3-LPB	3.5 (50)	P3-LFC P3-LGC P3-LHC P3-LJC P3-LKC P3-LLC P3-LMC P3-LNC P3-LPC	3.5 (50)	P3-LED P3-LFD P3-LGD P3-LHD P3-LJD P3-LKD P3-LLD P3-LMD P3-LND P3-LPD	3.5 (50)	P3-LDE P3-LEE P3-LFE P3-LGE P3-LHE P3-LJE P3-LKE P3-LLE P3-LME P3-LNE	3.5 (50)	P3-LFF P3-LGF P3-LHF P3-LKF P3-LLF P3-LMF	3.5 (50)
P3-LGG P3-LHG P3-LJG P3-LKG	4.9 (70)	P3-LJH	4.9 (70)	P3-MDB P3-MEB P3-MFB P3-MGB P3-LHB P3-LJB P3-LKB P3-LLB P3-LMB P3-LNB	4.9 (70)	P3-MCC P3-MDC P3-MEC P3-MFC P3-MGC P3-MHC P3-MJC P3-MKC P3-MLC	4.9 (70)	P3-MCD P3-MDD P3-MED P3-MFD P3-MGD P3-MHD P3-MJD P3-MKD	4.9 (70)
P3-MEE P3-MFE P3-MGE P3-MHE P3-MJE	4.9 (70)	P3-MGF P3-MHF	4.9 (70)	P3-NCB P3-NDB	5.3 (77)	P3-NEB P3-NFB P3-NGB P3-NHB P3-NJB	5.6 (81)	P3-NCC P3-NDC P3-NEC P3-NFC P3-NGC P3-NHC	5.6 (81)
P3-NCD P3-NDD P3-NED P3-NFD P3-NGD	5.6 (81)	P3-NEE P3-NFE	5.6 (81)						

Pre-Startup

Gearbox Oil Fill

Refer to Table 2 for lube oil system specifications.

Refer to Table 3 for gearbox lubricant specifications.

Overfilling the gearbox will cause excess foaming, increased power consumption, and oil leakage.

Make up oil can be added through the fill plug (P3-8) during operation.

A. Prior to initial startup and after any disassembly, the following oil fill procedure must be followed to ensure proper priming of the high speed shaft journal bearings. Please refer to Figure 3.

B. Remove the plug (Item P3-214) on the lube oil manifold for use as an air vent.

C. Ensure that the gearbox oil sump drain plug is installed.

D. Remove the fill plug (Item P3-8) and fill the gearbox until the fluid level reaches the designated level on the sight glass. Approximately 8 quarts (7.5 liters) are required.

E. Replace the fill plug and air vent plug.

F. Remove the oil filter, fill with oil, and reinstall.

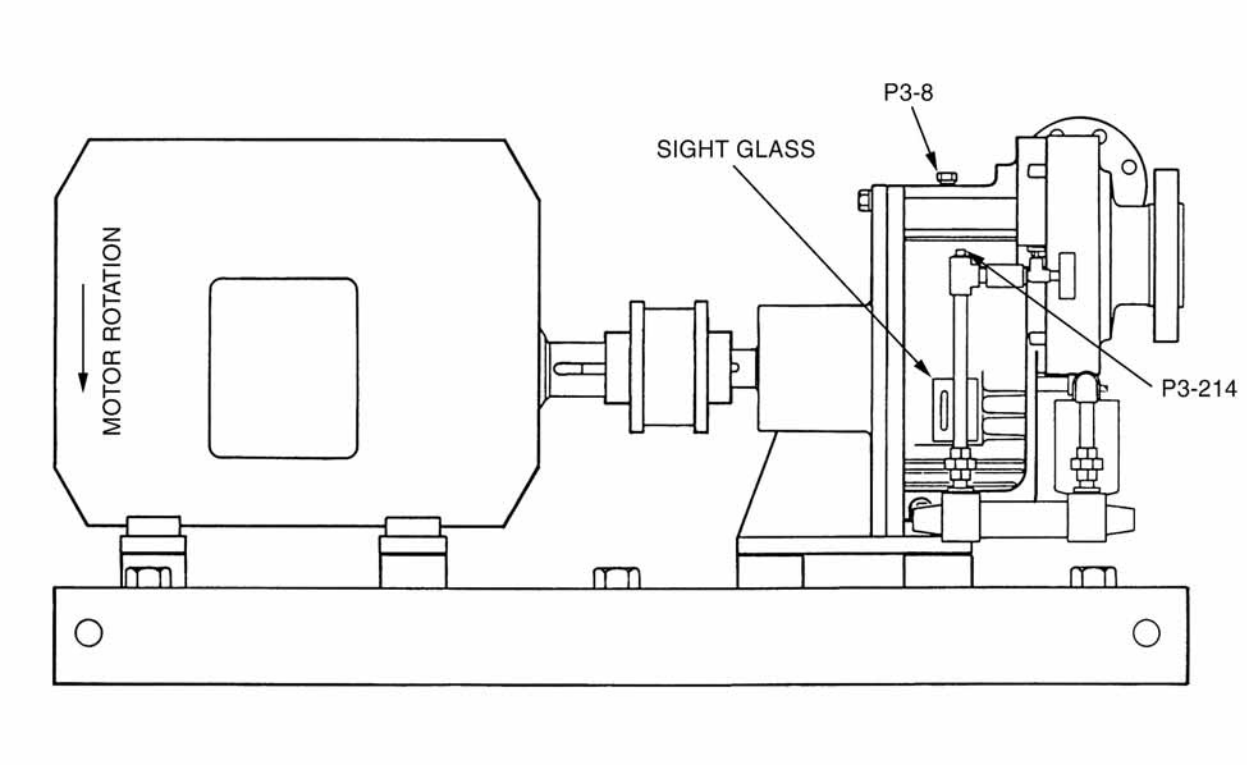


Figure 3.

Table 2. Lube Oil system Specifications		
	English	**Metric**
Sump Capacity	8 quarts	7.5 liters
Oil Pressure	40 – 60 psig	2.8 – 4.2 kg/cm^2
Oil Temperature (Sump)	120° – 160°F	50 – 70°C
Cooling Water Required	5 – 10 at 90°F max.	1.2 – 2.3 m^3/hr at 32°C max.
Cooling Water Pressure	150 psi max.	11 kg/cm^2 max.

Table 3. Sunflo Gearbox Lubricants	
Gravity, API	29.5 nominal
Viscosity, SUS	
100°F (38°C)	200 maximum
210°F (100°C)	38 minimum
Viscosity Index, ASTM D2270	90 minimum
ISO Viscosity Grade	32, 46
Flash Point, °F, ASTM D92	360 minimum (182°C)
Pour Point, °F, ASTM D97	-20 maximum (-29°C)
Rust Test, ASTM D-665, Procedure B	Pass
Oxidation Test, ASTM D-943, hours to 2.0 neutralization number	2000
EP Additive	Present
Foam Limits, ASTM 892, milliliters maximum, Sequence 1	25/0 2 50/0 3 25/0

Note: No additives are recommended.

In general, ISO VG 32 turbine oils or most synthetic oils will meet these specifications. The properties of your oil should be verified by the oil manufacturer prior to use.

Dextron III type ATF is not recommended for use in Sunflo gearboxes. Problems with foaming may occur and the additional additives compared to Dextron II could compromise the mechanical integrity and reliability of your Sunflo pump.

Startup

Perform the following steps to start your Sunflo pump.

A. Review the pump specification sheet noting design parameters and possible seal system requirements.

B. Check to ensure that the driver has been serviced per the instructions supplied by the driver manufacturer.

C. Check to ensure that the screen has been installed in the temporary suction strainer.

D. If a buffer fluid or external seal flush is required, ensure that this system is pressurized prior to flooding the suction. Failure to pressurize the buffer system will allow the process fluid to contaminate the buffer fluid and may also allow contaminants in the process stream to damage the seal face.

E. Check the oil level in the gearbox. If the oil level is low, fill the sump to the proper level indicated on the sightglass.

Starting your Sunflo pump against a completely closed discharge valve will dead-head the pump and may damage the process seal and bearings.

F. Fully open the suction and discharge valves to flood the suction. If there is a check valve in the discharge piping, ensure that the space between the pump and check valve is vented.

G. Purge or vent all high points in the suction and discharge lines.

H. After the suction is flooded, adjust the control valve to approximately 25% open. This is necessary to prevent overloading of the driver and to prevent the pump from operating off the end of the curve at startup.

Reverse rotation of your Sunflo pump may damage the unit. The driver shaft and pump impeller rotate in opposite directions. Ensure that the motor shaft rotation is in the same direction as the arrow on the gearbox marked "motor rotation".

I. Determine that the motor is wired for the correct rotation by "jogging" the motor for 1 second intervals. The motor direction can be verified by observing the motor shaft or fan.

J. If the motor rotation is in the incorrect direction, reverse the rotation by changing any 2 of the motor leads.

K. Ensure that there is cooling water flow to the heat exchanger. Once the unit is started, adjust the cooling water flow through the heat exchanger to regulate the gearbox lube oil between 120°F and 160°F (49°C to 71° C). Approximately 1 hour is required for the gearbox oil temperature to stabilize.

L. On startup or after gearbox assembly, the motor should be jogged once or twice and the oil pressure checked to ensure that the lube pump is developing oil pressure.

During startup, pay close attention to the discharge pressure gauge. The pressure should rise quickly and remain steady. If the pressure rise is sluggish and drops back to a lower level, stop the pump. The erratic pressure behavior is a sign that air and/or vapors are being purged from the pump.

M. Start the driver. Adjust the control valve to the desired flow and check the head, flow, and motor horsepower against the anticipated conditions.

N. Pay close attention to the discharge pressure gauge. The pressure should rise quickly and remain steady. If the pressure rise is sluggish and drops back to a lower level, even momentarily, stop the pump. The erratic pressure behavior is a sign that air and/or vapors are being purged from the pump.

O. Verify that the lube oil pressure is stable. At startup with cold oil, the oil pressure should be about 50 to 60 psig (3.52 to 4.22 kg/cm^2). As the lube oil warms up, the pressure will decrease to 40 to 50 psig.

P. Continually check the pressure drop across the suction strainer. Never allow the suction pressure to drop below the minimum design pressure that would ensure adequate NPSHr. This minimum suction pressure should be established before commissioning.

Q. When the pressure drop across the strainer increases, the temporary screen is becoming clogged with particles and must be cleaned out. The pump should be shutdown and the discharge and suction valves blocked in to isolate the pump and screen. After the strainer has been cleaned and reinstalled, the pump must be primed just as during the initial start up.

R. Examine the debris and/or particles removed from the strainer each time it is cleaned. Hopefully, the strainer contents will be matter foreign to the process and it will take longer and longer for the strainer to clog up. If no new debris shows up for a reasonable period of time the temporary strainer and pressure gauge can be removed.

S. If the temporary strainer keeps clogging up at a relatively steady pace and the clogging material is process oriented particles, such as undissolved crystals, “high boiler” compounds or other entrained particles which are expected to continue forming in the pumpage at about the same constant rate, some permanent modification in the pumping system may be required.

Pump Operation

A. While the application of the Sunflo pump in any particular system is not within the scope of this instruction manual, the importance of proper application to successful pump operation cannot be ignored. Several factors must always be considered. For additional information concerning Sunflo pump control methods, please refer to Sunflo Pump Control Bulletin 01.14.00. Contact your authorized Sunflo sales representative if you need this bulletin.

Suction Conditions

B. The most common reasons for improper centrifugal operation are those relating to proper flow of liquid into the impeller. To avoid turbulence at the eye of the impeller, the suction pipe should be straight for at least 10 pipe diameters beyond the suction inlet of the casing. Another rule of thumb is that the suction piping should be at least one pipe size larger than the pump suction inlet. Eccentric reducer must be used with “Belly” side on bottom.

Sunflo recommends that the margin between the required and available NPSH be at least 3 feet (1 meter).

C. The pressure of the liquid reaching the impeller eye has a sufficiently high pressure to prevent flashing in the impeller. The result of this liquid flashing is a phenomenon called cavitation. Cavitation can cause damage to the impeller and inducer and is caused by insufficient Net Positive Suction Head (NPSH). Cavitation is sometimes noticeable as a “pumping gravel” noise in centrifugal pumps. In high speed, single-stage pumps such as the Sunflo, this noise may not be discernible. The easiest way to prevent cavitation is to maintain suction pressure at a high enough level to overcome the effects of high vapor pressure and excessive friction losses in the suction piping. Careful design of the pump suction conditions will ensure that the available NPSH exceeds the NPSH required by the Sunflo pump.

Discharge Conditions

D. Ensure that the pipe system is not over pressurized and that the discharge pressure of the pump does not exceed the design rating of the equipment.

E. Care must be exercised in the fitting of non-return valves to discharge pipe work as this may prevent correct venting of the pump prior to start up.

F. **When operating your Sunflo pump, always vary the flow with a valve installed in the discharge line. NEVER** throttle flow from the suction side. Attempting to throttle flow from the suction side may result in **FAILURE** of the pump due to inadvertent dry run of the seals or cavitation.

Minimum Flow Conditions

G. Centrifugal pumps can also experience vibrations from internal flow separation and recirculation at low flow conditions. The user should be aware of the minimum flow recommendations for the Sunflo pump. While a pump can operate without harm with some noise due to recirculation, excessive noise and vibration are signs that the pump may be subject to damage if operation is continuous.

H. The minimum flow of a Sunflo pump can be determined two ways as shown below. The minimum flow should be limited to the higher of the calculated flow conditions:

1. Minimum flow should be limited in flow 20% of BEP flow. Consult your pump performance curve to determine the BEP condition for your model.

2. The minimum flow corresponding to the allowable bulk fluid temperature rise across the pump should be calculated as follows:

$$dT = \frac{H * (\frac{1}{Eff} - 1)}{(778) * (Cp)}$$

Where

H = Head at Operating Condition (ft)
Cp = Specific Head of Pumped Fluid (BTU/lb/°F)
Eff = Efficiency at Operating Point (expressed as a decimal) and calculated as follows:

$$Eff = \frac{(H) * (Q) * (sg)}{(3960 * (bhp)}$$

Where
Q = Flow at Operating Point (gpm)
sg = Specific Gravity of Pumped Fluid
bhp = Brake Horsepower at Operating Point

I. Protection against operation below minimum flow is possible by use of either a continuous bypass or by a flow controlled bypass. Any bypass designs must return the liquid to the suction tank or to a location with a similar heat sink capability. If a bypass design is used, part of the total flow through the pump is never pumped to the process. Therefore, one must consider the combined process flow and bypass flow requirements when specifying the pump for an application.

J. Noise and vibration may be accentuated by resonance in the discharge line, especially when a control valve is located well down-stream from the pump. Optimum performance will be achieved when the control valve is located within 5 feet (1.5 meters) from the pump discharge.

Maximum Flow Conditions

K. Maximum flow of the Sunflo pump should be limited to 120% of BEP. This maximum flow limitation assumes that the driver horsepower and NPSH requirements of the unit are not exceeded.

DRIVERS

L. The equipment should only be used with the driver specified at the time of order. The driver horsepower rating has been specifically designed for the design conditions. An engineering review is recommended before making any changes. The driver size should not be changed without consulting your authorized Sunflo sales representative.

M. The driver bearings should be greased in accordance with the bearing lubrication recommendations provided by the driver manufacturer.

Entrained Gases

N. Entrained gases in the fluid will reduce the head and capacity of a centrifugal pump. Entrained gases in the process stream may also damage the process seals. Entrained gases above 2 to 3 percent are considered to be the limits for a Sunflo pump.

O. During the design of the suction vessel and piping, ensure that sufficient submersion of the pipe work is maintained and that air entrainment and vortices do not occur. Failure to do so will allow vapors and undissolved gases into the pump and may cause a seal failure. Tanks should be designed to allow sufficient residence time for the gases and vapors to disengage from the liquid.

Pump Control

A. Proper operation of any centrifugal pump requires that the pump be operated in the following manner:

1. A range where the system head curve and pump performance curve intersect at a significant angle.

2. The pump is not operated below the recommended minimum flow. Minimum flow considerations for the Sunflo pump are provided in the PUMP OPERATION section of this document.

3. The pump is not operated beyond the recommended maximum flow. Maximum flow considerations for the Sunflo pump are provided in the PUMP OPERATION section of this document.

B. The flow at which a centrifugal pump operates depends upon the point of intersection of the system head and pump characteristic curves. In order for control to be steady, the system curve must intersect the pump characteristic curve at a significant angle. Examples of satisfactory and unsatisfactory angles of intersection are shown in Figures 4 and 5.

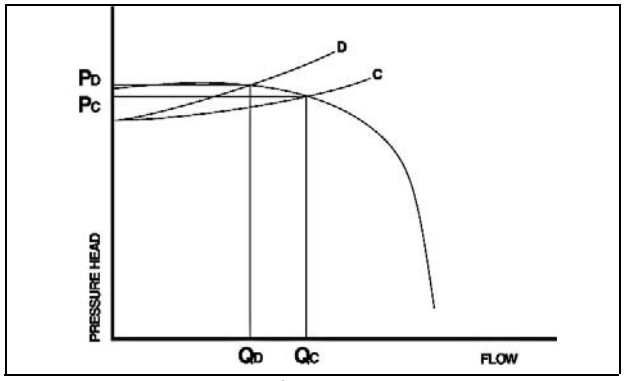


Figure 4

In Figure 4, the angle of intersection between the system curve and the pump performance curve is small. Note that System Curve C intersects the pump performance curve resulting in Pressure Pc and Flow Qc. System Curve C could represent a system curve in which the control valve is wide open. As the control valve is closed, the additional pressure moves the system curve to that of System Curve D resulting in Pressure Pd and Flow Qd. Note that for a very small change in pressure, there is a large change in flow.

In Figure 5, the angle of intersection between the system curve and the pump performance curve is much larger than that shown in Figure 4. The pump performance curve shown in Figures 4 and 5 are identical. In this example, note that System Curve A intersects the pump performance curve resulting in Pressure Pa and Flow Qa. As was the case in Figure 4, Curve A could represent a system curve in which the control valve is wide open. As the control valve is closed, the additional pressure moves the system curve to that of Curve B resulting in Pressure Pb and Flow Qb. Since the angle of intersection between the system curve and the performance curve is much larger, a larger change in pressure is required to provide the same change in flow as shown in Figure 4.

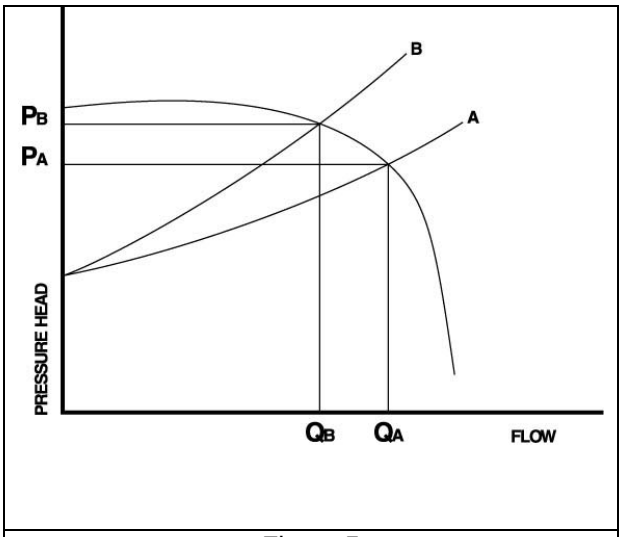


Figure 5

C. Because of the characteristic flat pump performance curve shape of Sunflo pumps, flow control rather than pressure control is recommended. Pressure and flow control schemes both operate by throttling a discharge flow valve. The control signal to the valve comes from either a flow or pressure controller. When trying to operate the Sunflo pump in the flat area of the performance curve, a small change in pressure will result in a large change in flow. Since a flow controller responds to changes in flow rather than pressure, pump control is more stable in this region of the curve.

D. As the pump is operated closer to BEP, the Sunflo pump performance curve provides a more responsive change in flow for a given change in pressure. Either pressure or flow control of the Sunflo pump is suitable in this area. However, flow control is still recommended because of the problems associated with pressure control that were discussed in the previous paragraph.

E. In the portion of the performance curve beyond BEP, the Sunflo pump performance curve shape provides for small changes in flow for large changes in pressure. Operation in this portion of the performance curve is discouraged because of control problems and the potential to exceed the driver capabilities and to exceed the NPSH requirements.

F. If the user requires that the pump be operated on pressure control, contact Sunflo or your local sales representative. It is possible to modify the pump to steepen the pump performance curve so that pressure control is more practical.

Parallel Operation

G. When centrifugal pumps are operated in parallel, their control becomes more critical because one pump may tend to "overpower" the other pump in terms of head at total lower flows. If pumps are connected together at discharge by a simple, unrestricted manifold, the discharge head of one pump is upon another; all pumps see the same discharge head at any given moment in time. This situation is shown on the following curves in Figure 6.

Figure 6 shows that the characteristic curves of two duplicated pumps designated as Pump A and Pump B. Since no two pumps will have exactly the same performance, the curves in Figure 6 show that Pump A produces slightly more head than Pump B. The pumps arranged with a manifold having a common control valve are as shown in Figure 7.

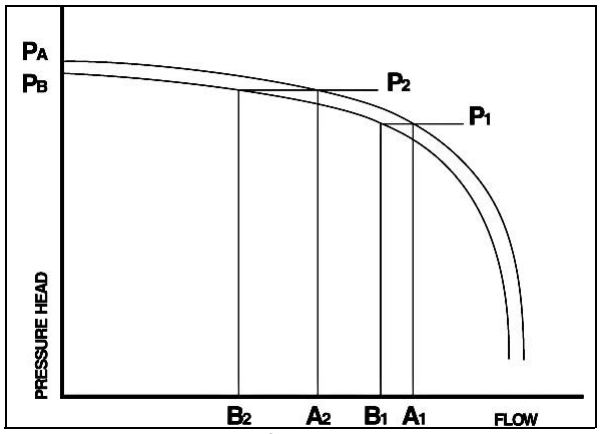


Figure 6

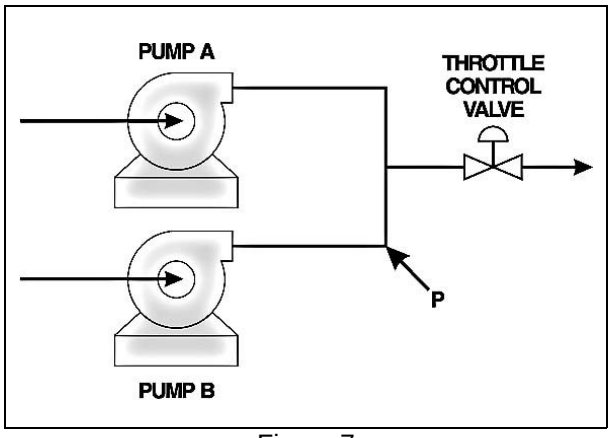


Figure 7

With the manifold pressure set at P1, the flow through Pump A is indicated as A1 and the flow through Pump B is indicated as B1. If the throttle valve is closed to set the manifold pressure at P2, the flow through pumps A and B are A2 and B2 respectively. If the control valve were closed even further, then Pump B would cease to flow entirely resulting in damage for dead-heading the unit. This situation can be avoided through the proper selection of the control system.

H. The best way of ensuring that one of the pumps in a parallel pump system is not deadheaded is to provide a separate control valve for each pump as Shown in Figure 8. Sunflo also recommends that individual minimum flow lines be installed for each pump operated in parallel.

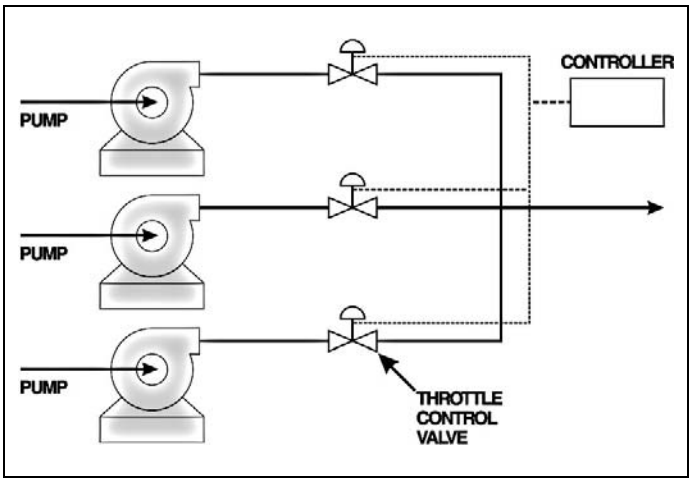


Figure 8

I. If individual throttle control valves on each pump as shown in Figure 8 are not available, Sundyne can modify the steepness of the Head-Flow curve by using a discharge orifice plate installed on the discharge of each pump, to assure proper parallel operation. Contact Sundyne for the proper orifice sizing and pump modifications.

Troubleshooting

Table 4. Pump and Gearbox Troubleshooting		
Problem	**Possible Cause**	**Investigative/Corrective Action**
No flow, no pressure at startup.	Pump not completely primed.	Bleed all vapors and gases from system. Also bleed vapor or air from the seal flush port.
		Allow more cool-down time if pumping a low temperature fluid
		Verify that pump and suction line are full of liquid.
	NPSH available actually lower than requirement specified on specification sheet.	Suction line blocked. Check suction strainer and valves.
		Excessive pressure drop through suction piping.
		Flow restricted by vapor pockets in high points of suction and discharge piping.
		Inability to vent past a check valve in the discharge piping.
		Suction tank level or pressure too low.
		Entrained gases in pumped liquid.
		NPSH reduced by a more volatile process fluid.
	Failure of drive component such as missing drive gear, sheared or missing impeller key, or failed high speed shaft bearing.	Replace as necessary with Genuine Sundyne Parts.
	Wrong direction of rotation on motor.	Direction of driver shaft rotation is as shown by arrow on gearbox housing. Note: Impeller and driver rotate in different directions. Rotation can be checked by viewing driver fan or input shaft on frame-mounted units. Reverse any two leads on motor to change direction of rotation.
Pump starts and then stops pumping.	Improperly primed pump.	Attempt to prime pump. If priming is not possible, inspect suction piping for obstructions.
		Determine if there is a check valve on the discharge. If so, determine if the vapors between the pump and the check valve are being vented.
	Suction screen plugged.	Suction line blocked. Check suction strainer and valves.
	Air or vapor pockets in suction line.	Vent suction piping at the highest point. Determine if the piping must be redesigned to eliminate the formation of air or vapor pockets. An eccentric reducer with “Belly” side on top will create a vapor pocket.

Table 4. Pump and Gearbox Troubleshooting		
Problem	Possible Cause	Investigative/Corrective Action
Insufficient flow or pressure.	Flow rate is higher than pump design allows.	Check head rise and flow rate against performance curve.
	Wrong direction of driver shaft rotation.	Direction of driver shaft rotation is as shown by arrow on gearbox housing. Note: Impeller and driver rotate in different directions. Rotation can be checked by viewing driver fan or input shaft on frame-mounted units. Reverse any two leads on motor to change direction of rotation.
	Air trapped in pump or pumping entrained vapors or gases.	Check shutoff pressure. If deficient, vent pump.
		Determine if there is a check valve on the discharge. If so, determine if the vapors between the pump and the check valve are being vented.
	Available NPSH actually lower than required NPSH listed on pump specification sheet.	Refer to solutions provided under “No Flow, No Pressure at Startup”.
	Flow too low, causing overheating of fluid and loss of NPSH after a short period of satisfactory operation.	Increase pump flow rate.
		Increase bypass flow rate or use seal cavity bypass to continuously increase inlet flow rate. Vent to the highest point of the pump.
		Install bypass to recirculate part of pump discharge back to the supply tank.
	Impeller damage by passage of solid particles.	Inspect impeller for nicked, bent, or worn blades. Replace impeller if damaged.
	Process fluid specific gravity or viscosity different from what was specified.	Check actual viscosity and specific gravity at the operating temperature. A viscosity higher than 5 centipoise will cause reduced head and slow and increased power consumption. A specific gravity higher than what was specified will cause increased power consumption.
	Pressure gauges or flow meters in error.	Remove and replace with calibrated instrument.
	Corrosion pitting on pump casing.	Minor pitting may be polished with emery cloth. Major pitting indicates a failed part and should be replaced.
		Inspect remainder of pump to determine if other areas of pump are damaged from corrosion. Replace damaged parts.
		Establish corrosion mechanism. Determine if process conditions can be changed. Consult your authorized Sunflo sales representative for assistance on different pump materials of construction.

Table 4. Pump and Gearbox Troubleshooting		
Problem	**Possible Cause**	**Investigative/Corrective Action**
Insufficient flow or pressure (cont'd)	Corrosion and/or erosion of diffuser throat (may also be accompanied by corrosion and/or erosion of diffuser surface adjacent to the impeller).	If edge of throat has opened in size, head rise may be reduced. Opening of the throat will result in higher flow rate and horsepower consumption. Corrosion and/or erosion of the diffuser and cover surfaces will also result in a significant increase in horsepower consumption.
	Pump discharge throat partially plugged.	Disassemble pump and inspect pump casing for any obstructions. Replace hardware with Genuine Sundyne Parts if necessary.
	Driver speed too low.	Check driver speed against value provided on the pump specification sheet.
Driver Overloaded.	Fluid specific gravity or viscosity is higher than what the pump was initially designed for.	Decease specific gravity and/or viscosity.
		Reduce pump flow to the level that will reduce driver power consumption to an acceptable level.
	Electrical failure in motor.	Check circuit breaker heater size and setting.
		Check motor voltage.
		Check motor current in each phase. The current should be balanced within 3%.
	Mechanical failure in driver, gearbox, or pump.	Remove casing and check for impeller rub on cover plate and pump casing.
		Rotate high speed shaft assembly and check for ease of rotation.
		Inspect ball bearings and journal bearings. Replace failed parts with Genuine Sundyne Parts.
	Pump operating beyond design flow.	Check actual pump flow and head against the values provided on the pump specification sheet.
	Corrosion pitting on surface of diffuser adjacent to impeller blades.	Disassemble pump and inspect. Rough or pitted surfaces can cause additional friction losses which will significantly increase driver horsepower consumption. Clean these areas of all obstructions and use emery cloth to restore all surfaces to a smooth, polished finish. Check the diffuser throat. Erosion and corrosion will cause roughness that will increase horsepower consumption. Note: A larger than designed diffuser throat will allow for a higher flow and horsepower consumption for a given head rise.

Table 4. Pump and Gearbox Troubleshooting		
Problem	Possible Cause	Investigative/Corrective Action
Excessive discharge pressure pulsations (may be associated with a “hammering” sound or may sound like “gravel” being pumped).	Flow rate too low	Increase flow through pump. Add bypass if required.
	Insufficient NPSH	Refer to solution for insufficient NPSH under “No Flow, No Pressure at Startup”.
	Defective flow control valve.	Repair or replace valve.
Change of gearbox oil from normal color to milky pink or yellow.	Gearbox lubricant is contaminated with water or process fluid.	Check for excessive pump or seal leakage. Change gearbox oil and replace all worn or damaged parts with Genuine Sundyne Parts.
		Inspect shaft sleeve o-rings. Replace if necessary.
		Check for restricted seal drain port. Change gearbox oil and remove restriction.
Shaft sleeve rubs on inside diameter of seal.	Gearbox bearing failure.	Inspect and replace damaged hardware with Genuine Sundyne Parts.
Excessive gearbox oil consumption.	Gearbox seal leakage.	Check for fluid leakage from drain port. Disassemble and replace worn or damaged hardware.
High lube oil temperature	Heat exchanger fouled or no coolant flow to heat exchanger.	Clean heat exchanger.
		Check coolant flow.
Excessive oil foaming.	High oil level	Check oil level. If too high, shut down the unit and drain the oil to the correct level.
		Incorrect lubricant.
Excessive noise and vibration.	Rotation incorrect.	Direction of driver shaft rotation is as shown by arrow on gearbox housing. Note: Impeller and driver rotate in different directions. Rotation can be checked by viewing driver fan or input shaft on frame-mounted units. Reverse any two leads on motor to change direction of rotation.
	Worn or damaged bearings.	Disassemble pump and replace damaged components with Genuine Sundyne Parts.
	Insufficient NPSH	Refer to solution for insufficient NPSH under “No Flow, No Pressure at Startup”.
	Damaged impeller or shaft.	Replace as required with Genuine Sundyne Parts.
	Partially clogged impeller causing imbalance.	Back-flush pump to clean impeller. Determine cause of clogging.
	Foundation not rigid.	Tighten down hold-down bolts of pump and motor.

Table 4. Pump and Gearbox Troubleshooting		
Problem	Possible Cause	Investigative/Corrective Action
Excessive noise and vibration (cont'd.)	Suction or discharge piping not anchored or properly supported.	Anchor piping per the Hydraulic Institute Standards Manual recommendations.
	Damaged drive or pinion gear.	Disassemble pump and replace damaged gear with Genuine Sundyne Parts.
	Improper pump and driver alignment.	Align pump and driver shafts.
	Resonance of pump foundation.	Perform vibration testing to determine if there is a natural frequency of the installation close to that of the driver. Modify installation to dampen the natural frequency.
	Improper location of discharge control valve.	Install discharge control valve within 5 feet of the pump discharge.

Pump Mechanical Seals

Table 5. Mechanical Seal Troubleshooting		
Problem	**Possible Cause**	**Investigative/Corrective Action**
Sudden Increase in Seal Leakage.	Severe cavitation or loss of suction pressure causing vibration and bouncing of seal face.	Correct pump suction condition causing cavitation. Bleed vapor from seal cavity and restart pump. Install double seal system if loss of suction cannot be prevented.
		Replace seal and rotating face with Genuine Sundyne Parts if either part is shown to be worn or damaged
	Seal icing on low temperature pumps or icing when handling fluids which have high vapor pressures at a temperature of less than 32°F (0°C)	Use purge of dry nitrogen gas into seal drain area. Install double seal system and use a compatible, nonaqueous, nonvolatile external seal flush.
	Solid particles in seal cavity or seal spring area.	Replace seal and rotating face.
		Supply clean, external seal flush or install double seal system if particles cannot be removed by a separator or filter.
	Seal stationary spring action is rough and sticky.	If parts are corroded, check for material compatibility.
		Check for the accumulation of solids in the seal retainer area. If solids are found, consider the installation of a double seal system.
	Worn or damaged seal.	Disassemble high speed shaft assembly and replace worn or damaged components with Genuine Sundyne Parts.

Table 5. Mechanical Seal Troubleshooting		
Problem	**Possible Cause**	**Investigative/Corrective Action**
	Wear pattern on seal rotating faces not uniform in the circular direction.	Inspect shaft sleeve and impeller hub for high spots. Replace if necessary. Install new seal and rotating face.
		Shaft sleeve not parallel causing rotating face to be cocked. Dirt or debris caught between sleeve, rotating face, or adjacent parts.
Sudden Increase in seal leakage (cont'd)	Wear pattern on stationary face of seal is smooth but not uniform.	Replace seal and rotating face.
	Edges of stationary face chipped and seal face is worn. (Usually caused by vapor formation in the seal cavity.	Prevent loss of pump suction. Install double seal system if loss of suction cannot be prevented.
		Supply cool seal flush. Consult with your authorized Sunflo sales representative to see if a heat exchanger is required.
	Seal rotating face is cracked or broken. This may be caused by damage during assembly or by thermal shock from running the seal dry.	Prevent loss of pump suction. Install double seal system if loss of suction cannot be prevented.
		Supply cool seal flush. Consult with your authorized Sunflo sales representative to see if a heat exchanger is required.
	Wear on seal rotating face near the area where the outside of the stationary face contacts. (Usually caused by icing from air in drain.)	Install nitrogen purge in drain area.
		Install a double seal system.
	Chemical attack of seal faces, seal parts, or o-rings	Investigate process fluid properties and change seal and o-ring materials if needed.

Maintenance

Servicing

A. The normal operating routine, including both minor and major overhaul intervals, depends to a great extent upon the pump service and duty cycle. The operating life of a piece of equipment is, under normal circumstances, determined by the action of the operator. All operating parameters should be frequently observed and recorded. Any deviation from normal range of operating values should be immediately investigated to determine the cause and to take corrective actions. The following items should be serviced at the intervals indicated.

Driver

1. Service the driver according to the manufacturer's recommendations.

Gearbox Oil Change

2. The oil in the gearbox and the filter should be changed every six months or 4000 hours. Should the oil become contaminated before the scheduled change-out, completely drain the gearbox. Depending on the nature and extent of the contamination, consider the disassembly and cleaning of the gearbox.

Seal Leakage

The seal drain ports should never be plugged unless a double or tandem seal arrangement is being used. The gearbox seal drain port should remain open at all times.

3. Seal leakage out of the seal drain port should be periodically checked. Seals should be replaced if leakage increases to an unacceptable level. With a double seal system, the buffer pressure and usage should be monitored to ensure that the seals are functioning properly.

Radial Ball Bearings

4. The ball bearings in the power frame of all frame-mounted units should be replaced every three years. These bearings are grease lubricated and are sealed off from the gearbox oil.

Coupling

5. If a flexible coupling is used, refer to the manufacturer's recommendations for service intervals.

Torque Values

Table 6. Sunflo P-3000 Torque Values			
Item	Description	Torque (Ft-Lbs)	Torque (Kg-M)
P3-17	Gearbox housing to motor or mounting frame	85	11.8
P3-42	Pump casing nuts	85	11.8
P3-57	Inducer	36 – 40	5.0 – 5.5
	Inducer with Teflon o-ring (re-torque after 30 min.)	50 – 54	6.9 – 7.5
P3-62	Drive gear screw	35	4.9
P3-179	Journal bearing cap screws in aluminum gearbox housing	5.5 – 6.1	0.7 – 0.8
	Journal bearing cap screws in steel aluminum gearbox housing and seal housing	8.0 – 8.5	1.1 – 1.2

Pump Disassembly

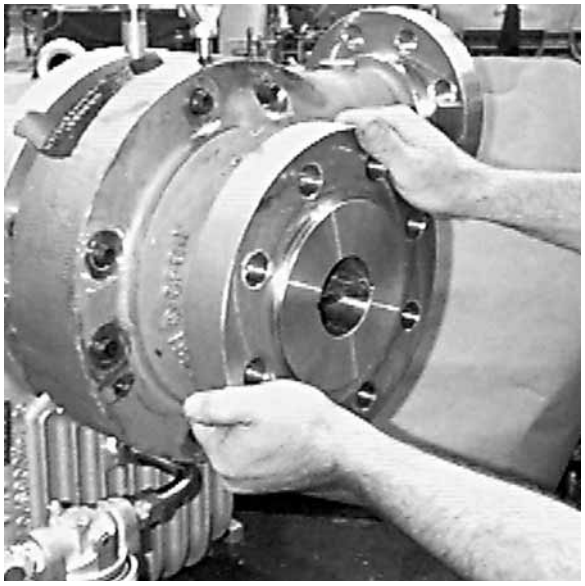
All o-rings and gaskets must be discarded and replaced during the assembly of the pump.

Step 1

Disconnect the driver energy source, depressurize the system, and disconnect the pump from the suction and discharge flanges.

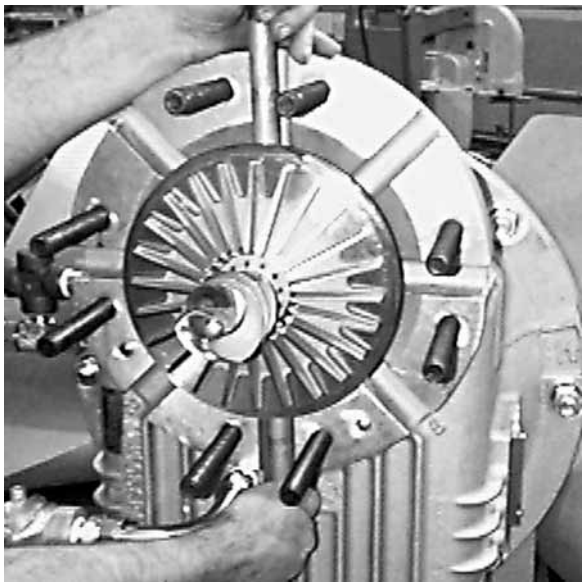
For those Sunflo P-3000models that use casing bolts instead of studs and nuts, remove the pump casing bolts from the 3 and 9 o'clock positions as shown. Install threaded rods in place of 2 of the bolts. These threaded rods are needed to help guide the pump casing so that the impeller and inducer are not damaged during removal.

Install an eye bolt to hold the casing with a hoist. Loosen and remove the remaining pump casing bolts.



Step 2

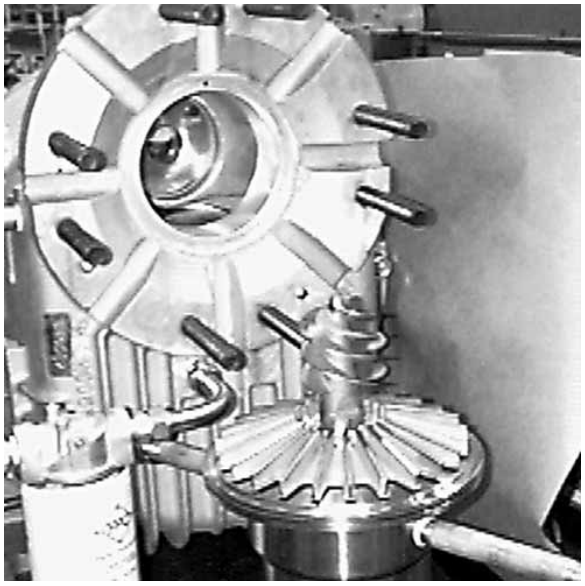
Remove the pump casing by lifting and gently pulling it away from the gearbox



Step 3

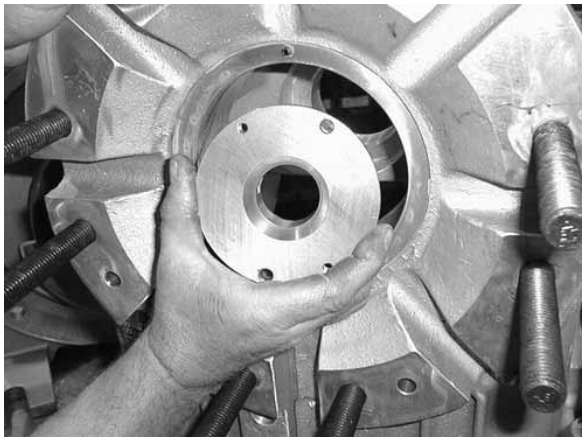
Do not let the high speed shaft assembly drop as damage can occur to the gears and inducer.

To disengage the high speed.



Step 4

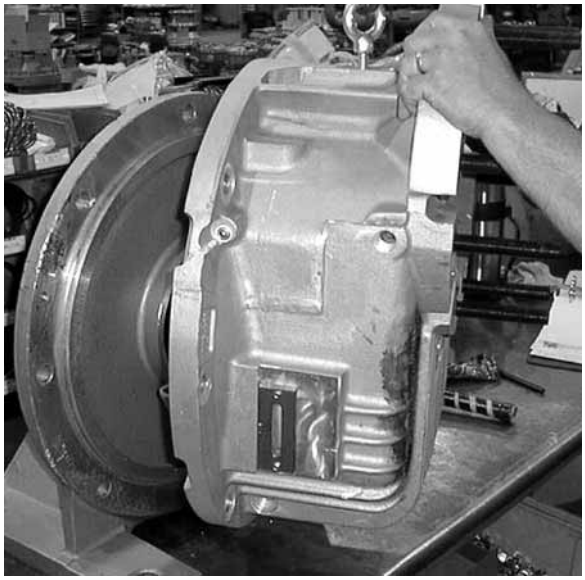
Place the high-speed shaft assembly on a clean work surface for disassembly.



Step 5

Use care when removing the cap screws from the outboard journal bearing to avoid dropping the screws into the gearbox. Failure to remove any dropped screws from the gearbox sump could result in equipment damage when the pump is restarted.

Remove the outboard journal bearing (Item P3-23) from the gearbox housing by removing the cap screws. The bearing has two ¼”-20 UNC tapped holes for the temporary installation of jacking bolts to facilitate the removal of the bearing.



Step 6

When draining the gearbox, a small amount of the oil will remain inside the sump.

Before removing the heat exchanger, filter assembly and external lube pump piping, make a sketch of the piping. There are many different arrangements of the P-3000 lube pump piping depending on the model and the customer requirements. Having a sketch will be beneficial during assembly.

Before further disassembly, drain the gearbox oil from the sump by removing drain plug (Item P3-14).

Place a pan under the heat exchanger to catch any oil that drips out. Loosen the fittings and remove the heat exchanger.

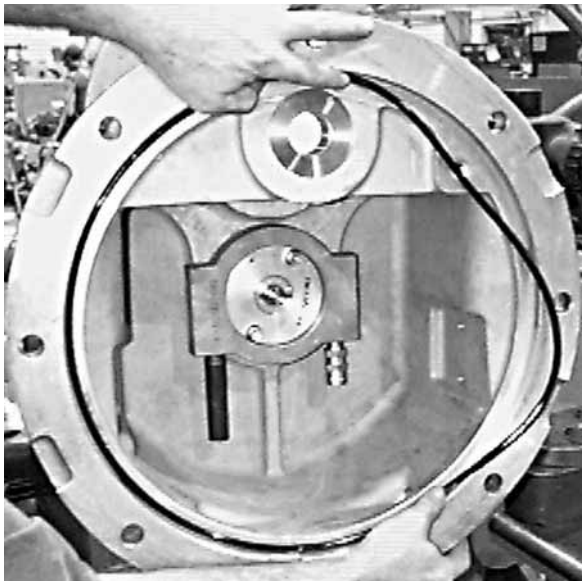
Unscrew and remove the oil filter element. Then remove all remaining lube pump system piping.

Install an eye bolt on top of the gearbox housing. Remove the 8 attaching nuts and bolts and lift the gearbox from either the mounting frame or the motor. A pry bar may be needed to separate the gearbox from its mating flange.

When the pilot on the gearbox mounting flange is free, raise the gearbox approximately 2 inches. This will allow the housing to clear the drive gear.

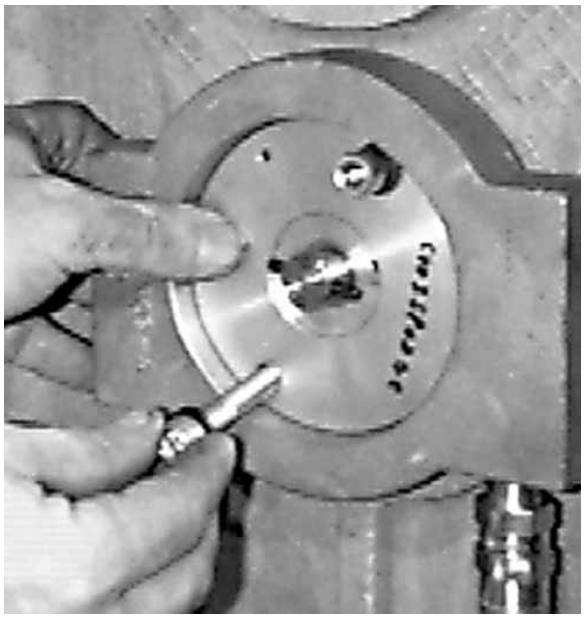
Remove and discard the gearbox o-ring (Item P3-121).

The lube pump described in this section applies to all units sold after September, 1996. For units purchased prior to this date, refer to the pump disassembly appendix at the end of this section for information on disassembly of the lube pump. If you are unsure which lube pump design your Sunflo pump uses, refer to the pictures.



Step 7

Once the gearbox has been removed, the lube pump and internal piping system will be exposed.

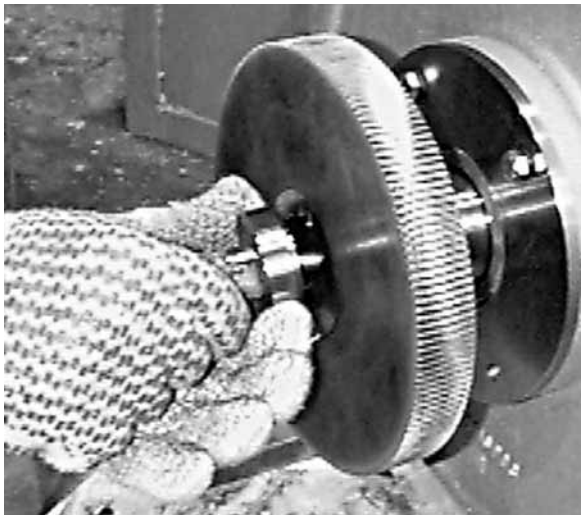


Step 8

The lube pump assembly is held in place by two 3/8” – 16 UNC socket head cap screws and lock washers. If the lube pump manifold must be removed, ensure that the gasket between the lube pump manifold and gearbox is also removed. With the lube pump manifold out of the gearbox housing, the standpipe and pressure relief valve can be removed if necessary.

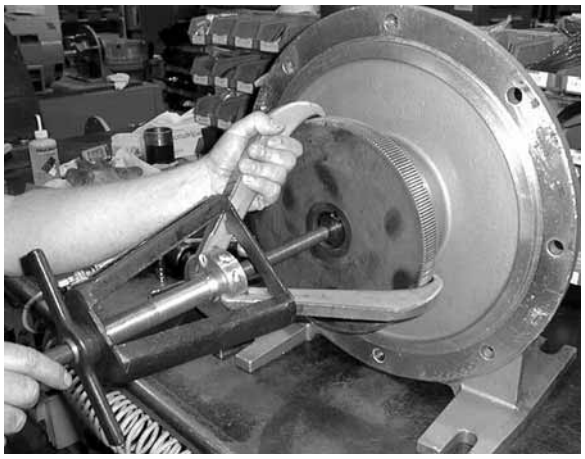
Step 9

The splash guard (Item P3-141) covering the drive gear must be removed prior to pulling the gear. Remove the two cap screws that hold the guard in place.



Step 10

To remove the lube pump driving lug (Item P3-35), remove the bolt and lock washer from the input or motor shaft.



Step 11

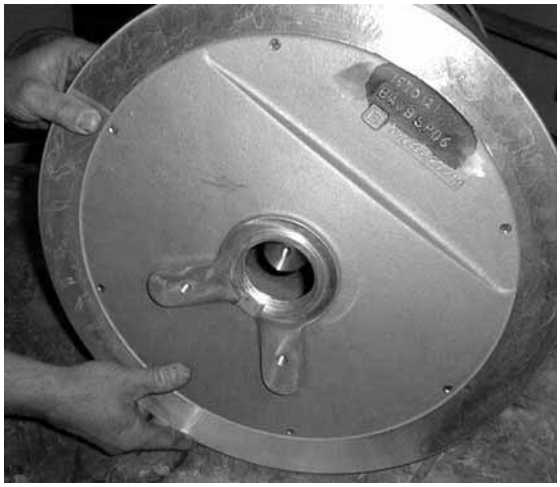
Failure to use a spacer when removing the gear may damage the gear teeth.

If a torch is needed to heat the gear, do not apply the flame to the gear teeth as this may permanently damage the gear. Uniformly heat the gear while keeping the flame close to the hub.

The Sunflo P-3000 gears can be quite heavy. Special care must be taken to prevent the gear being damaged from falling onto the ground. When removing the gear, place something soft on the ground below the gear such as a piece of wood.

Use a gear puller to remove the drive gear (Item P3-3). A spacer should be used under the puller jaws to protect the edges of the gear teeth. If the gear is difficult to remove, then a torch may be used to heat the gear. When using a torch, do not apply the flame to the gear teeth. Uniformly heat the gear keeping the flame close to the hub.

Steps 12 through 14 of the disassembly procedure apply only to close coupled configured units.

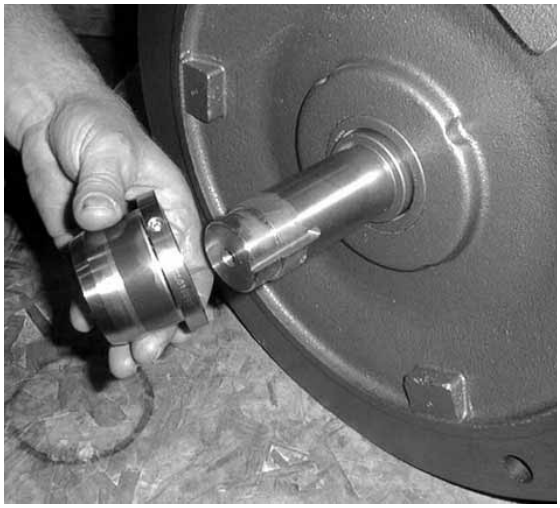


Step 12 (Close Coupled Units Only)

With the drive gear removed, slide off the baffle plate (Item P3-44).

Step 13 (Close Coupled Units Only)

Remove the lip seal (Item P3-85) from the baffle plate by tapping the seal retainer with a drift punch and hammer.



Step 14 (Close Coupled Units Only)

Loosen the 3 set screws (Item P3-83) and remove the shaft sleeve (Item P3-84) and o-ring (Item P3-82) from the motor shaft.

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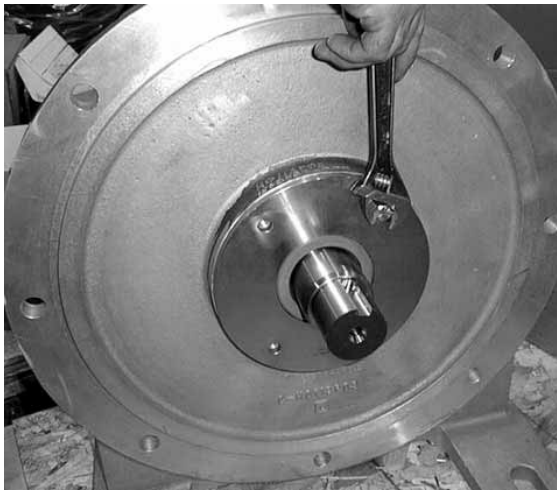
Note: Steps 15 through 17 of the disassembly procedure apply only to frame mounted units



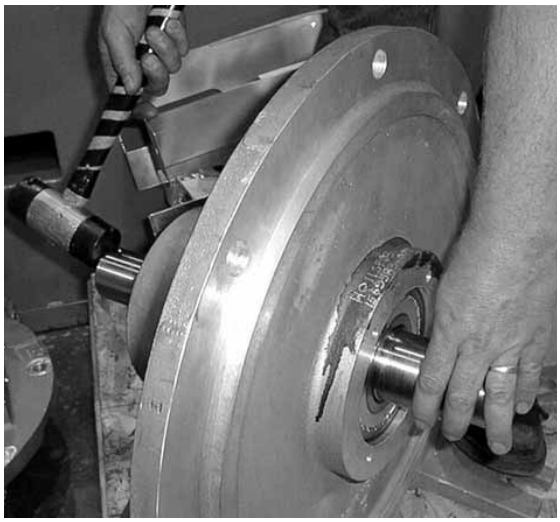
Step 15 (Frame Mounted Units Only)

Remove the mounting baffle plate socket head cap screws and washers.

Pull out the mounting frame baffle plate (Item P3-190) to expose the mounting frame bearings.

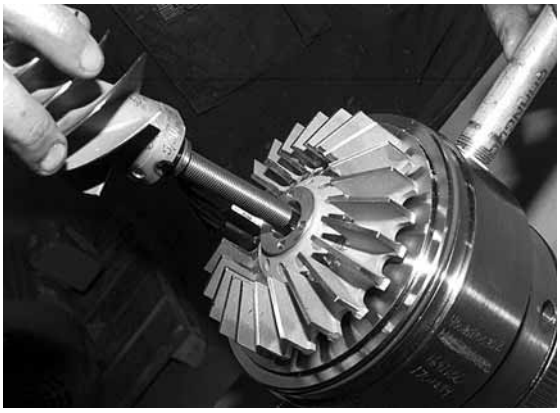
Step 16 (Frame Mounted Units Only)

Remove the lip seal (Item P3-239) from the baffle plate by tapping the seal with a drift punch and hammer.



Step 17 (Frame Mounted Units Only)

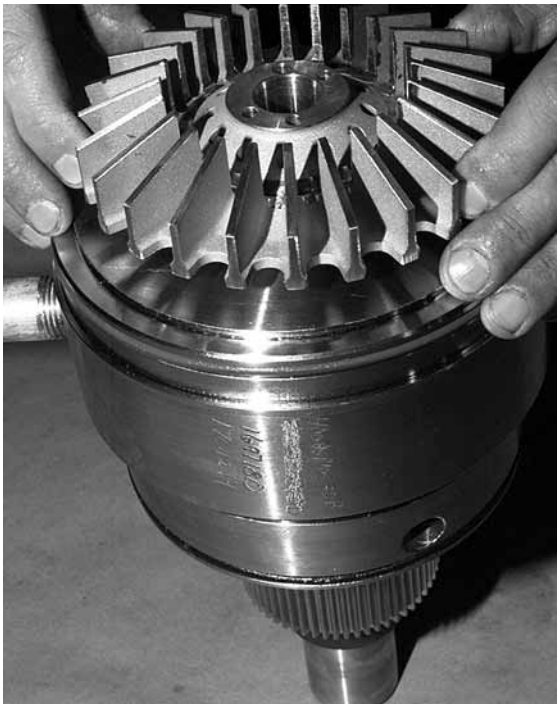
Using a soft hammer, gently tap on the driver end of the input shaft (Item P3-96) and remove the shaft and bearing assembly from the mounting frame.



Step 18 (All Models)

The inducer has left hand threads.

To remove the inducer (Item P3-57) and inducer stud (Item P3-102), an adjustable wrench is placed on one of the impeller blades and an open-end wrench is used on the inducer hub. If you cannot get the open-wrench onto the inducer hub, then use a strap wrench.



Step 19 (All Models)

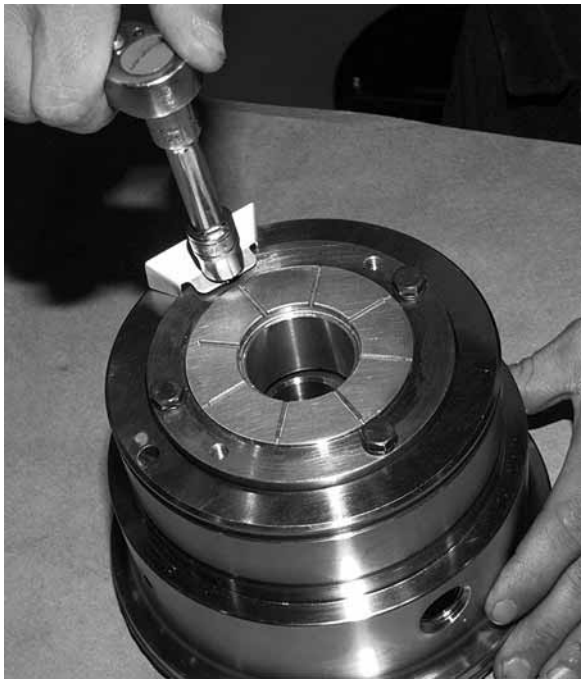
The impeller (Item P3-33) can now be removed.

In some instances, the impeller will not easily slide off the splined end of the high-speed shaft. This is normally caused by the accumulation of foreign debris in the fit between the impeller and shaft. If this is the case, try using two pry bars between the impeller and seal housing to slide the impeller off. Use extreme care to not damage the impeller blades.

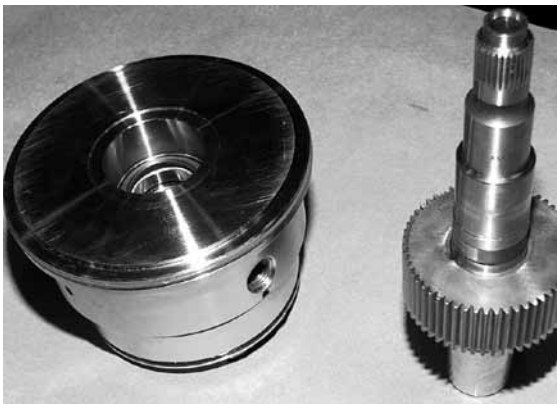
If using the pry bars to remove the impeller does not work, then try the following:

1. Remove the 4 cap screws and washers (Items P3-179 & P3-180) that fasten the journal bearing into the seal housing.

2. Use 2 of the cap screws as jacking bolts on the journal bearing. Removal of the journal bearing will push the shaft out of the seal housing.

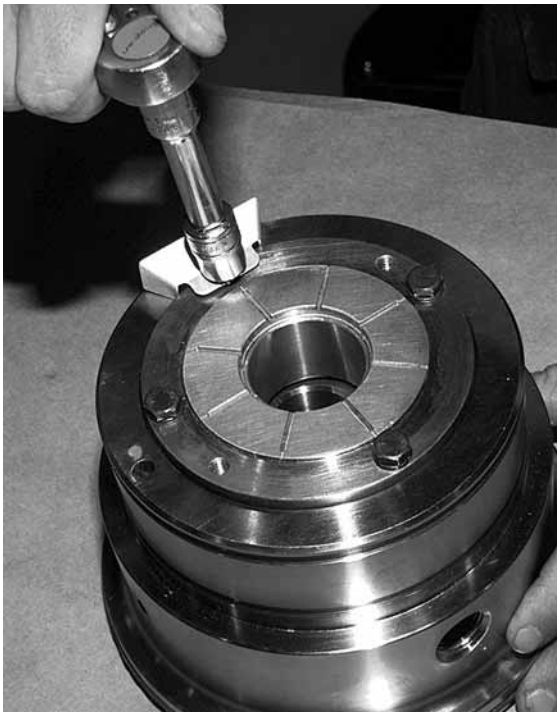


Steps 20 through 23 of the disassembly procedure apply to the P-3000 in the single seal configuration. Steps 24 through 27 apply to the P-3000 in the double seal configuration. Steps 28 through 33 apply to the P-3000 in the tandem seal configuration.



Step 20 (Single Seal Configuration Only)

The seal housing (Item P3-19) can now be separated from the high-speed shaft. Slide the housing from the shaft leaving the process seal (Item P3-77), process seal rotating face (Item P3-25), gearbox seal (Item P3-30), gearbox seal rotating face (Item P3-158), thrust runner (Item P3-151, and shaft sleeve (Item P3-22) inside the seal housing.



Step 21 (Single Seal Configuration Only)

Flip the seal housing so that the inboard journal bearing is facing up. Remove the 4 cap screws and lock washers (Item P3-179 & P3-180) that hold the bearing. There are two 1/4''-20 UNC tapped holes provided in the bearing flange for jacking screws that facilitate the removal of the bearing.

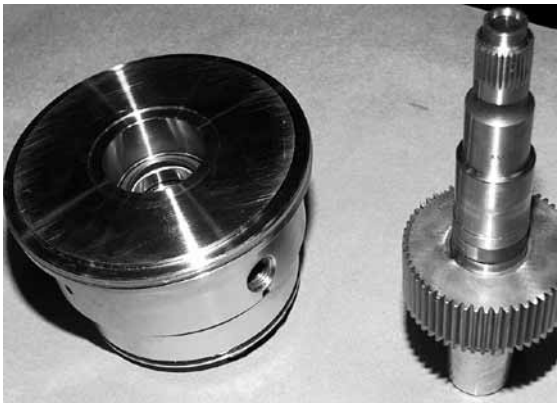
When the inboard journal bearing is removed, the oil deflector plate (Item P3-36) can also be removed.

Step 22 (Single Seal Configuration Only)

With the inboard journal bearing removed, the thrust runner and gearbox mechanical seal rotating face can now be removed.

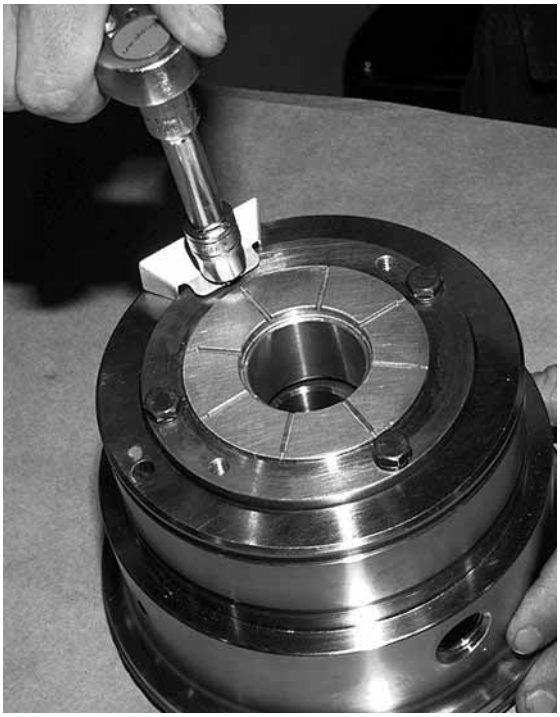
Step 23 (Single Seal Configuration Only)

To remove the gearbox mechanical seal (Item P3-30) and process mechanical seal (Item P3-77), tap the seal retainer using a drift punch and hammer. Once the seals have been removed, the shaft sleeve will come out.



Step 24 (Double Seal Configuration Only)

The seal housing (Item P3-19) can now be separated from the high speed shaft. Slide the housing from the shaft leaving the snap ring (Item P3-54), inboard process seal (Item P3-77), outboard process seal (Item P3-77), process seal rotating face (Item P3-25), gearbox mechanical seal (Item P3-30), gearbox seal rotating face (Item P3-158), thrust runner (Item P3-151), and shaft sleeve (Item P3-22) inside the seal housing.



Step 25 (Double Seal Configuration Only)

Flip the seal housing so that the inboard journal bearing is facing up. Remove the 4 cap screws and lock washers (Item P3-179 & P3-180) that hold the bearing. There are two 1/4''-20 UNC tapped holes provided in the bearing flange for jacking screws that facilitate the removal of the bearing.

When the inboard journal bearing is removed, the oil deflector plate (Item P3-36) can also be removed.

Step 26 (Double Seal Configuration Only)

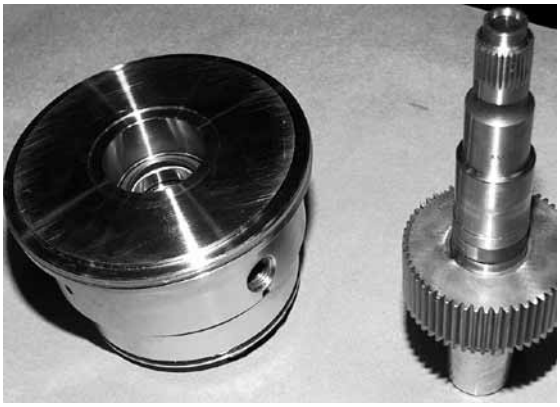
With the inboard journal bearing removed, the thrust runner and gearbox mechanical seal rotating face can now be removed.

Step 27 (Double Seal Configuration Only)

Flip the seal housing so that the inboard process seal is facing up. Using a hook-type device, remove the snap ring.

Remove the inboard process seal and rotating face.

Using a drift pin and hammer, remove the outboard process seal and gearbox mechanical seal.



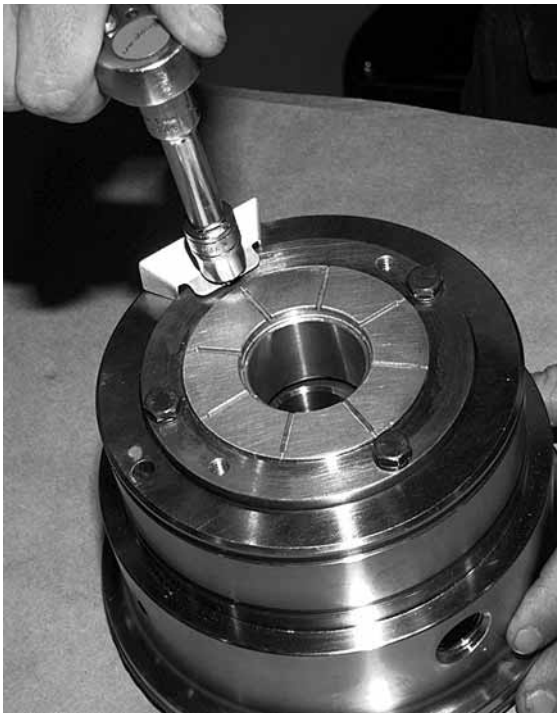
Step 28 (Tandem Seal Configuration Only)

The seal housing (Item P3-19) can now be separated from the high speed shaft. Slide the housing from the shaft leaving the seal snap rings (Item P3-108), inboard (primary) process seal (Item P3-77), inboard process seal rotating face (Item P3-25), outboard (secondary) process seal (Item P3-77), outboard process seal rotating face (Item P3-70), gearbox mechanical seal (Item P3-30), gearbox seal rotating face/thrust runner (Item P3-151), outboard sleeve (Item P3-64), inboard shaft sleeve (Item P3-22), throat bushing (Item P3-72), and throat bushing retaining ring (Item P3-74) inside the seal housing.

Step 29 (Tandem Seal Configuration Only)

Flip the seal housing so that the inboard journal bearing is facing up. Remove the 4 cap screws and lock washers (Items P3-179 & P3-180) that hold the bearing. There are two 1/4''-20 UNC tapped holes provided in the bearing flange for jacking screws that facilitate the removal of the bearing.

When the inboard journal bearing is removed, the oil deflector plate (Item P3-36) can also be removed.



Step 30 (Tandem Seal Configuration Only)

Place the seal housing on a work surface with the process seals facing up. Using a hook type device, remove the throat bushing retaining ring (Item P3-74).

Remove the throat bushing (Item P3-72).

Remove the inboard (primary) process seal rotating face (P3-77).

Step 31 (Tandem Seal Configuration Only)

Using a hook-type device, remove the first seal snap ring (Item P3-108).

Remove the inboard shaft sleeve (Item P3-22).

Remove the inboard (primary) process seal (P3-77).

Step 32 (Tandem Seal Configuration Only)

Using a hook-type device, remove the second seal snap ring (Item P3-108).

Remove the outboard (secondary) process seal rotating face (Item P3-70).

Using a hook-type device, remove the third seal snap ring (Item P3-108).

Step 33 (Tandem Seal Configuration Only)

Flip the seal housing over so that the gearbox mechanical seal is facing up.

Using a hook-type device, remove the fourth seal snap ring (Item P3-108).

Remove the outboard (secondary) process seal by pressing on the lower shaft sleeve (Item P3-64). The shaft sleeve slinger will engage on the seal retainer and push the seal out.

Remove the gearbox mechanical seal (Item P3-30).

Remove all remaining o-rings.

PUMP ASSEMBLY

All o-rings and gaskets must be discarded and replaced during the assembly of the pump.

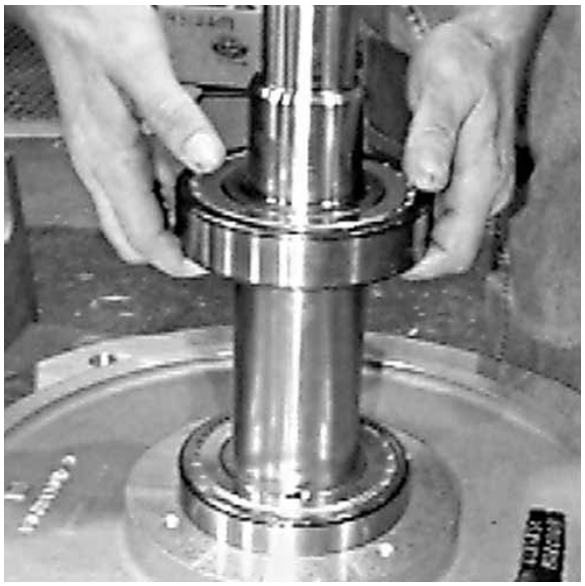
All o-rings should be lubricated prior to installation to prevent the o-ring from being damaged during assembly, ensure that a compatible lubricant is being used. Do not use petroleum-based lubricants on any o-rings made form EPDM (ethylene propylene).

Step 1 (Frame Mounted Units Only)

The mounting frame bearings are sealed grease lubricated bearings. Do not use a bearing heater to install the bearings onto the input shaft.

There is only one correct way to install the frame mount bearings onto the input shaft. Install the bearings onto the shaft so that the notched side of the inner races face each other.

Press new ball bearings (Item P3-95) onto the input shaft. Ensure that the notched side of the inner races face each other.



Step 2 (Frame Mounted Units Only)

Insert the bearing/input shaft assembly into the mounting frame (Item P3-100).

Step 3 (Frame Mounted Units Only)

There is only one correct way to install the lip seal into the retainer cap. Refer to figure 9 for the correct orientation of the seal.

Install a new lip seal (Item P3-239) into the baffle plate (Item P3-190) by placing an arbor over the seal and lightly tapping the seal in with a hammer.

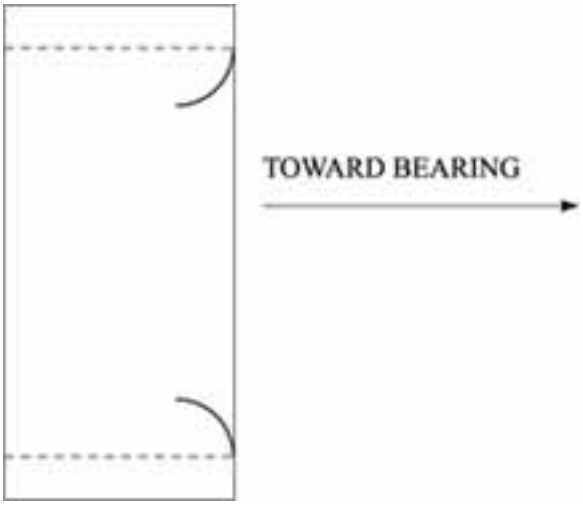
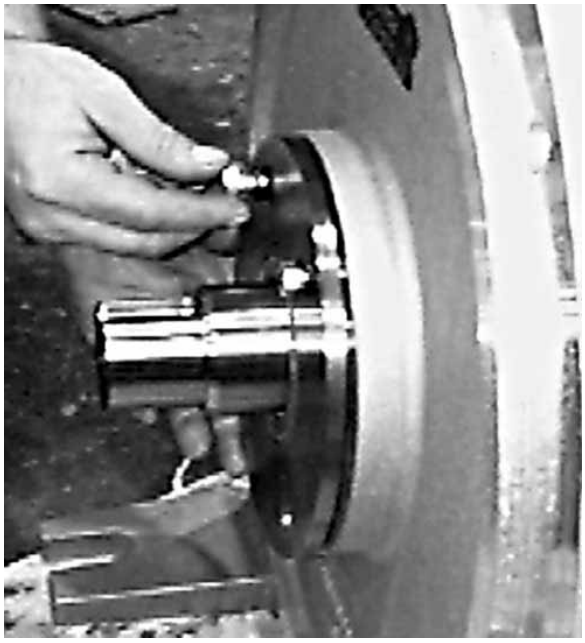


Figure 9. Orientation of Lip Seal into Retainer Cap

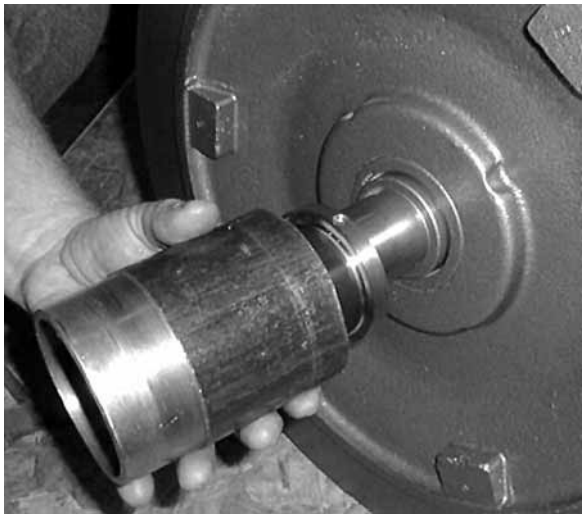


Step 4 (Frame Mounted Units Only)

When installing the retainer cap, leave the 2 bottom socket head cap screws out since these will be needed to fasten the splash guard.

Install the baffle plate with 2 of the 4 socket head cap screws and lock washers.

Steps 5 and 6 of the assembly procedure apply only to close coupled configured units.



Step 5 (Close Coupled Units Only)

Lube the ID of shaft sleeve (Item P3-84) in the area indicated by the asterisk (*) on Figure 10.

Lubricate and slightly stretch the o-ring (Item P3-82) and install into the o-ring groove.

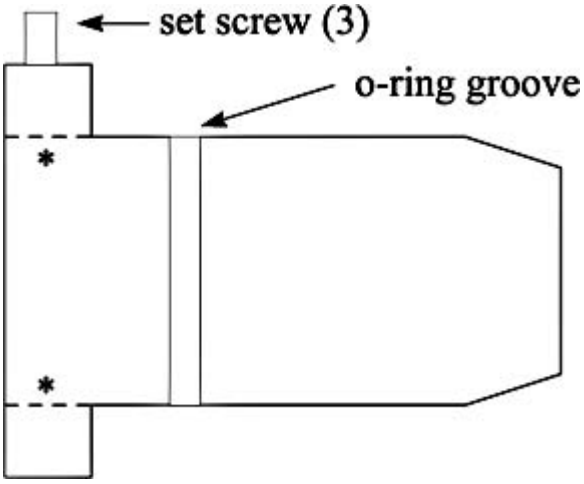


Figure 10. Close Coupled Input Shaft Sleeve

Place an arbor over the sleeve as shown in Figure 11 and use a soft hammer to push the sleeve over the motor shaft. Push the sleeve until it bottoms out.

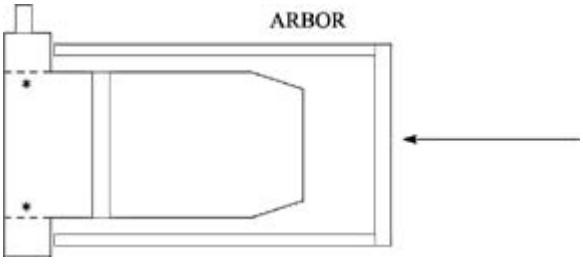
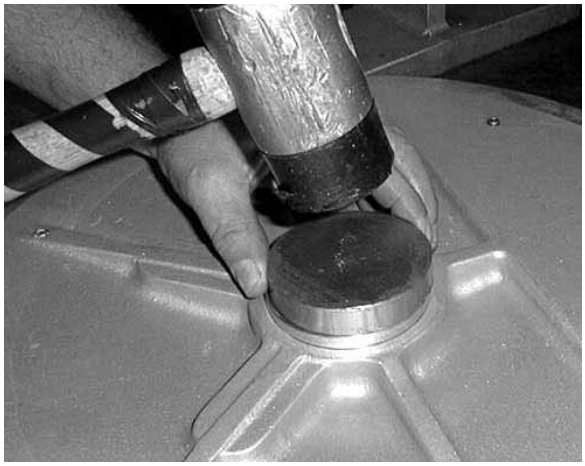


Figure 11. Close Coupled Shaft Sleeve Installation.

Tighten all 3 set screws (Item P3-83).



Step 6 (Close Coupled Units Only)

There is only 1 correct way to in-stall the lip seal into the baffle plate. Refer to Figure 12 for the correct orientation of the seal.

Install a new lip seal (Item P3-85) into the baffle plate (Item P3-44).

Slide baffle plate assembly onto motor shaft until the plate engages the motor.

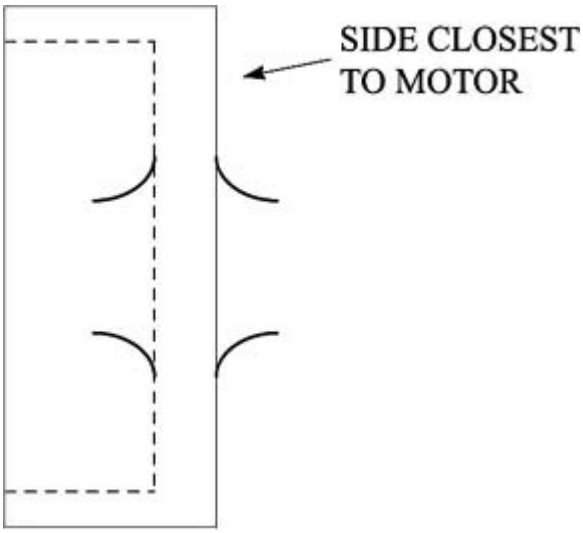
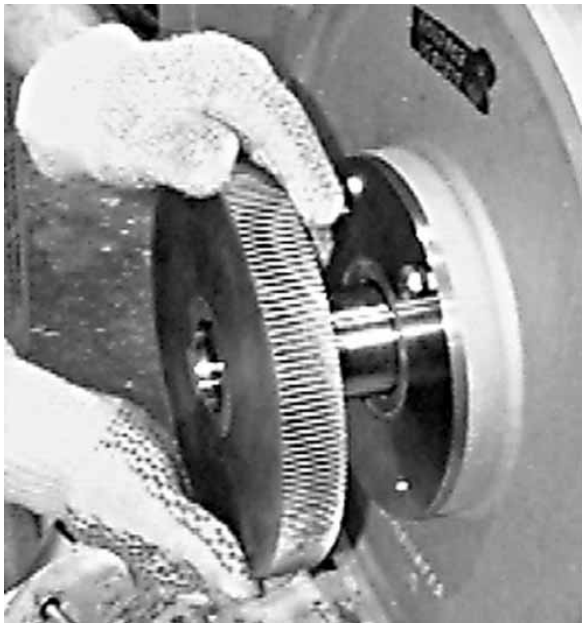


Figure 12. Close Coupled Lip Seal Orientation into Baffle Plate



Step 7

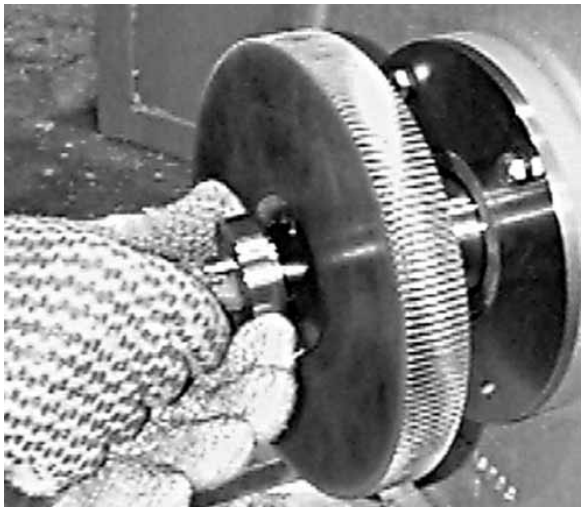
Do not force the drive gear onto the input shaft with a hammer as this may damage the gear.

Heat the drive gear to 350°F – 375°D (175°C – 190°C) for at least 1 hour.

Slide the gear onto input shaft and allow to cool.

If the gear will not fit, then reheat the gear, shrink the motor shaft down with dry ice, and try again.

The lube pump described in this section applies to all units sold after September, 1996. For units purchased prior to this date, refer to the pump assembly appendix at the end of this section for information on assembly of the lube pump. If you are unsure what lube pump design your Sunflo pump uses, refer to the pictures.

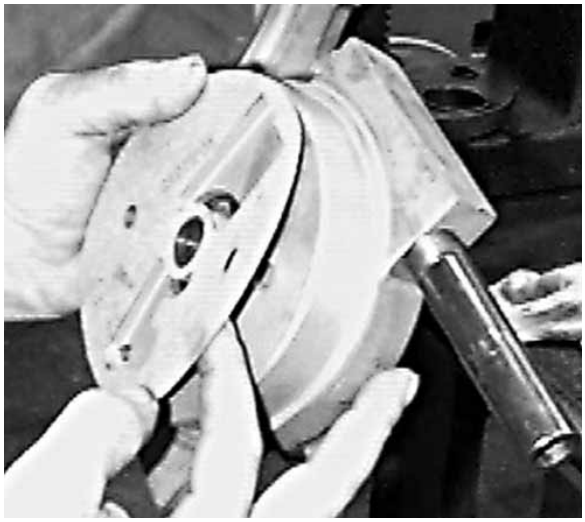


Step 8

Install the lube pump driving lug (Item P3-35) onto the input or motor shaft using the bolt and lock washers.

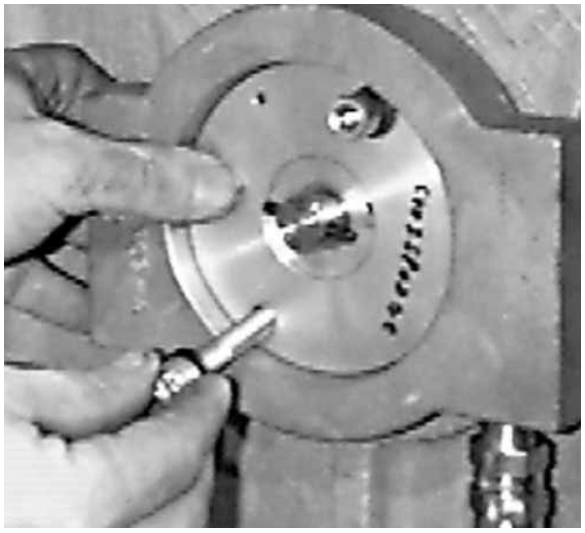
Step 9

Install splash guard (Item P3-141) using the 2 remaining cap screws and lock washers. For a frame mount configuration, these cap screws will also be used to fasten the bearing housing retainer cap.



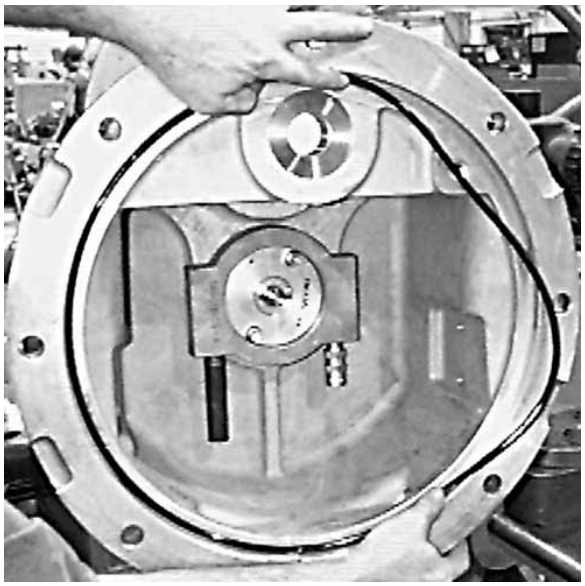
Step10

Install the lube pump manifold assembly into the gearbox housing. Before installing the pump manifold, ensure that a new gasket is being used and that the old gasket has been removed.



Step 11

Install the outboard journal bearing (Item P3-23) into the gearbox housing. Ensure that both o-rings (Item P3-181) have been installed around the OD of the bearing

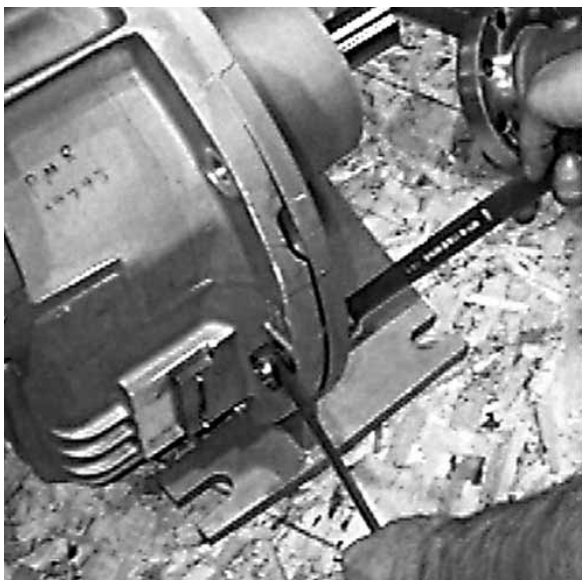


Step 12

Insert a new gearbox sealing o-ring (Item P3-121) into the gearbox.

Install the gearbox onto the mounting frame or motor and tighten the 8 nuts, bolts, and washers (Items P3-1, P3-43, P3-46 and P3-17).

If the gearbox will not seat against its mating flange, then the lube pump driving lug (Item P3-35) is not seating into the lube pump assembly. If this is the case, clock the input or motor shaft 90 degrees and try again.



Step 13

Install the drain plug (Item P3-14) back into the gearbox housing.

Install all lube pump piping including the heat exchanger and filter assembly.

Steps 14 through 26 of the assembly procedure apply to the P-3000 in the single seal configuration. Steps 27 through 41 apply to the P-3000 in the double seal configuration. Steps 42 through 61 apply to the P-3000 in the tandem seal configuration.

During assembly, the gearbox and process mechanical seals should be pressed into position without touching the seal faces. Sunflo recommends that you use an arbor that applies pressure to the seal retainer and not to the seal face. A tool drawing is provided in this manual. (see page 83)

Step 14 (Single Seal Configuration Only)

Place the seal housing on a workbench with the inboard side facing up.

Slightly stretch and lubricate the process seal o-ring (Item P3-28) and install into the o-ring groove in the seal bore.

Install the process mechanical seal (Item P3-77) using the seal installation tool. (see page 83)

Step 15 (Single Seal Configuration Only)

Flip the seal housing over so that the out-board side is facing up.

Slightly stretch and lubricate the gearbox seal o-ring (Item P3-28) and install into the o-ring groove in the seal bore.

Install the gearbox mechanical seal (Item P3-30) using the seal installation tool. (See Figure 14)

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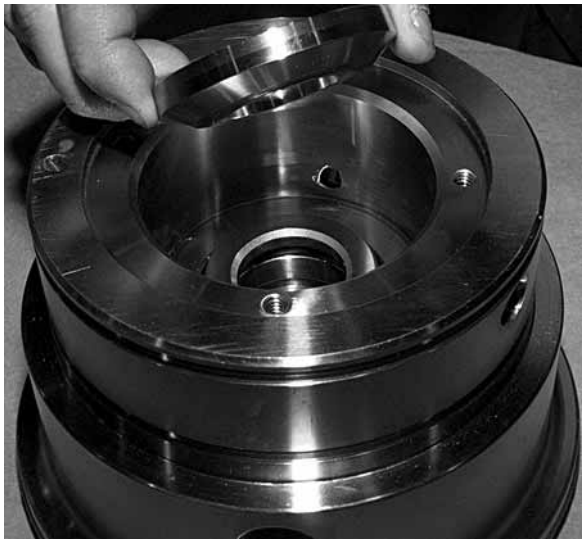
Step 16 (Single Seal Configuration Only)

There is only one correct way to install the gearbox mechanical seal rotating face. One side of the rotating face will have a beveled edge on the ID of the face. This side must not be in contact with the gearbox seal primary ring since this face is not hard coated.

Install the gearbox seal rotating face (Item P3-158) by placing the part onto the gearbox mechanical seal. Ensure that the rotating face is centered on the seal face.



Step 17 (Single Seal Configuration Only)

There is only one correct way to install the thrust runner. One side of the thrust runner will have a wide face and the other side will have a narrow face. The side with the narrow face must be in contact with the gearbox seal rotating face.

Install the thrust runner (Item P3-151) by placing the part onto the gearbox mechanical seal rotating face. Ensure that the thrust runner is centered on the rotating face.

Step 18 (Single Seal Configuration Only)

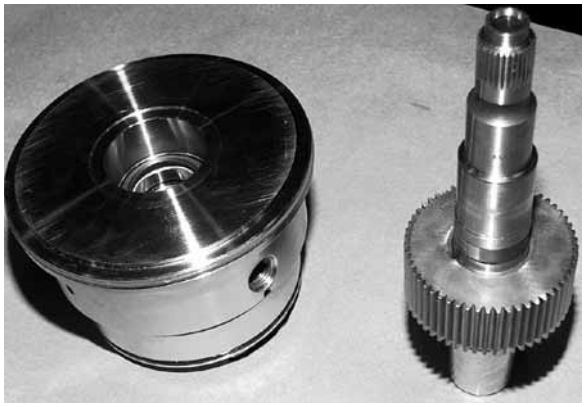
The journal bearing design is different depending on whether the pump discharge orientation is horizontal or vertical. If the pump discharge orientation is being changed, you must consult with your authorized Sunflo sales representative to purchase the correct bearing. Failure to make this change will prevent the bearing from being adequately lubricated and will cause the pump to fail.

Install the inboard journal bearing with o-rings (Item P3-181) using the 4 cap screws and lock washers (Items P3-179 & P3-180). Use the cap screw at the 12 o'clock position to secure the oil fill deflector plate (Item P3-36).

Step 19 (Single Seal Configuration Only)

Place the high-speed shaft on a work surface with the splined end of the shaft pointing up.

Slide the seal housing assembly over the high-speed shaft until the journal bearing engages the shaft thrust runner.



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Step 20 (Single Seal Configuration Only)

Insert the shaft sleeve o-ring (Item P3-183) over the splined end of the high-speed shaft. Using a screw driver or similar tool, push the o-ring down the shaft until it is resting against gearbox mechanical seal rotating face

Step 21 (Single Seal Configuration Only)

Install the shaft sleeve o-ring (Item P3-117) into the groove on the shaft sleeve.

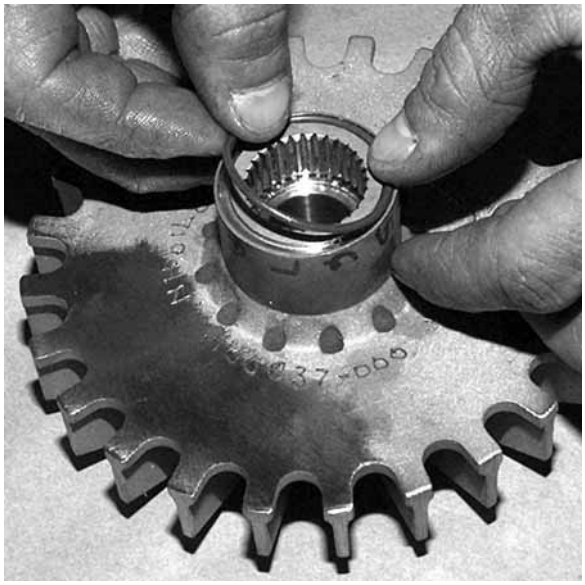
Step 22 (Single Seal Configuration Only)

There is only one correct way to install the shaft sleeve. One side of the sleeve is chamfered to accept the o-ring. The shaft sleeve must be installed such that the chamfered side is pointing towards the gearbox mechanical seal. Failure to properly install the shaft sleeve may bind the high-speed shaft and will cause the assembly to leak.

Slide the shaft sleeve (Item P3-22) onto the high-speed shaft. Push the sleeve into the assembly until it is resting against the gearbox mechanical seal rotating face and o-ring.

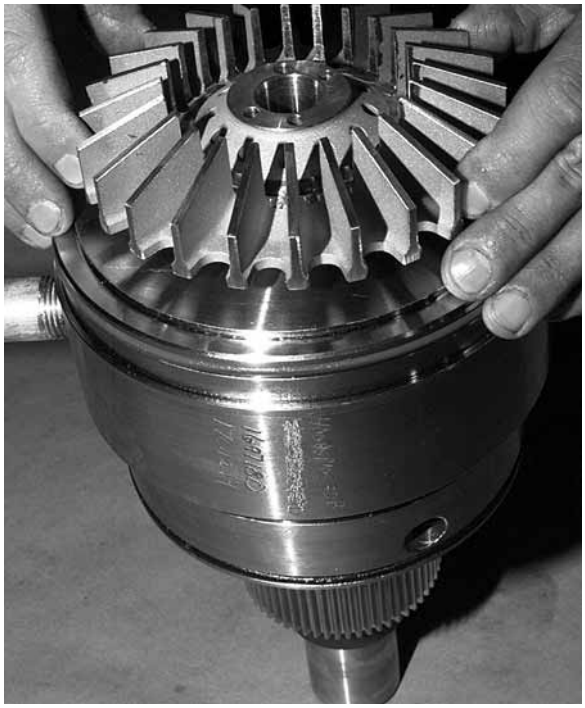
Step 23 (Single Seal Configuration Only)

Slide the process seal rotating face (Item P3-25) onto the high-speed shaft so that it is resting on the seal face.



Step 24 (Single Seal Configuration Only)

Install the impeller o-ring (Item P3-18) into the o-ring groove on the impeller hub, it will be necessary to lubricate the o-ring to keep it in the groove. Then slide the impeller over the splined end of the high-speed shaft.



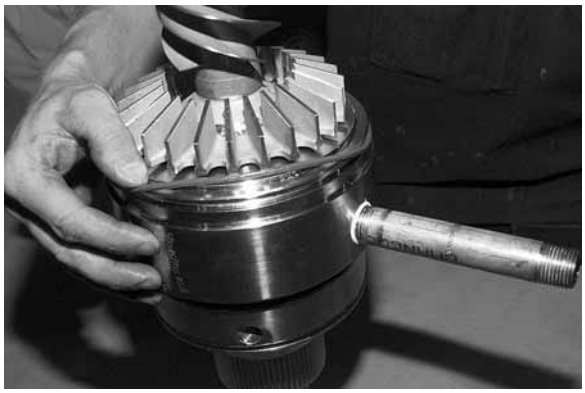
Step 25 (Single Seal Configuration Only)

The inducer stud threads are left-handed.

The inducer stud must be completely threaded into the inducer before installation into the pump shaft. Failure to completely thread the stud may allow the inducer to come loose during operation and damage the pump.

Install the inducer o-ring (Item P3-58).

Thread the inducer stud (Item P3-102) completely into the inducer. Install the inducer and tighten.



Step 26 (Single Seal Configuration Only)

Install the seal housing o-rings (Item P3-148).

Install the casing o-ring (Item P3-20).

Step 27 (Double Seal Configuration Only)

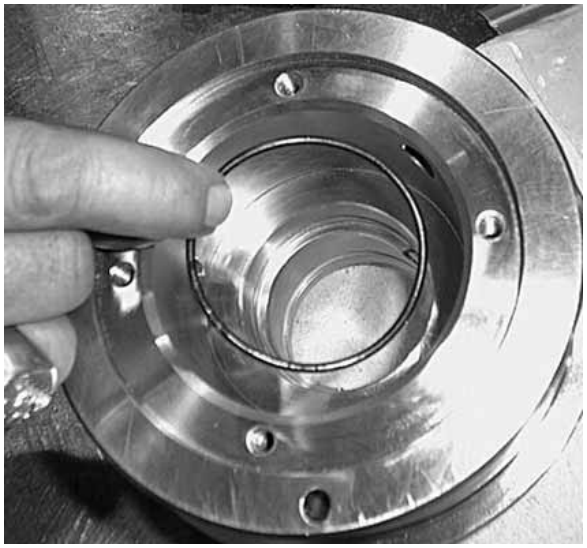
During assembly, the gearbox and process mechanical seals should be pressed into position without touching the seal faces. Sunflo recommends that you use an arbor that applies pressure to the seal retainer and not to the seal face. A tool drawing is provided in this manual. (see page 83)

Place the seal housing on a workbench with the inboard side facing up.

Slightly stretch and lubricate the process seal o-ring for the outboard seal (Item P3-28) and install into the o-ring groove in the seal bore.

Install the outboard process mechanical seal (Item P3-77) using the seal installation tool.

After the seal is installed, slightly stretch and lubricate the process seal o-ring for the inboard seal (Item P3-28) and install into the o-ring groove in the seal bore.



Step 28 (Double Seal Configuration Only)

Turn the seal housing over so that the outboard side is facing up.

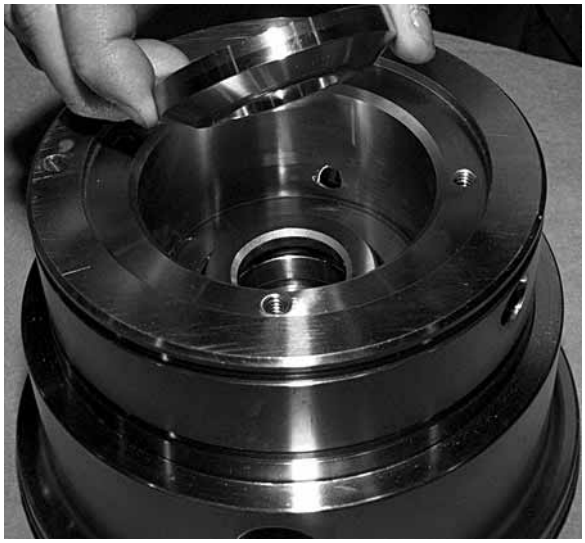
Slightly stretch and lubricate the gearbox seal o-ring (Item P3-28) and install into the o-ring groove in the seal bore.

Install the gearbox mechanical seal (Item P3-30) using the seal installation tool. (see page 83)

Step 29 (Double Seal Configuration Only)

There is only one correct way to install the gearbox mechanical seal rotating face. One side of the rotating face will have a beveled edge on the ID of the face. This side must not be in contact with the gearbox seal primary ring.

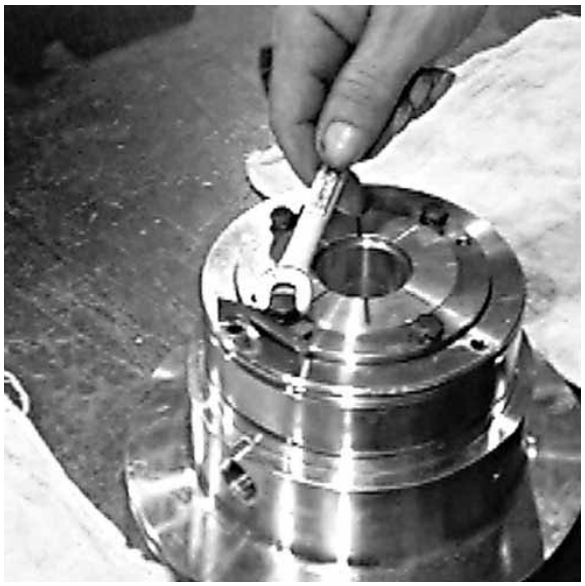
Install the gearbox seal rotating face (Item P3-158) by placing the part onto the gearbox mechanical seal. Ensure that the rotating face is centered on the seal face.

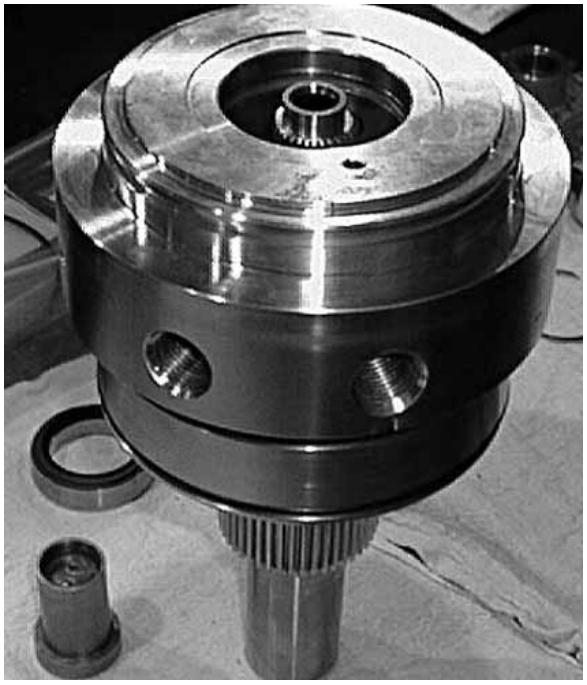


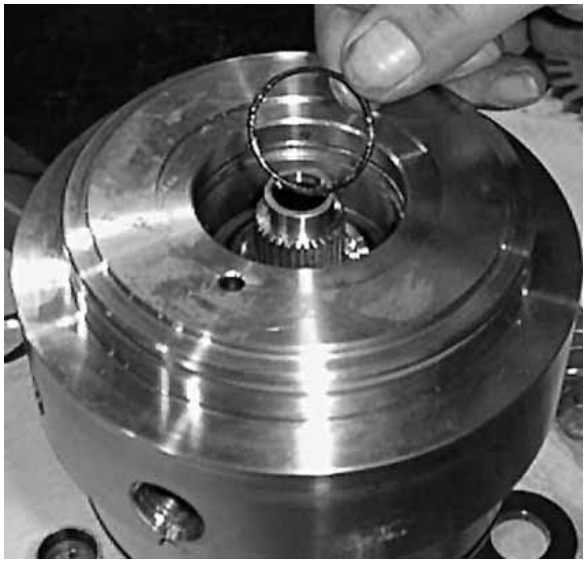
Step 30 (Double Seal Configuration Only)

There is only one correct way to install the thrust runner. One side of the thrust runner will have a wide face and the other side will have a narrow face. The side with the narrow face must be in contact with the gearbox seal rotating face.

Install the thrust runner (Item P3-151) by placing the part onto the gearbox mechanical seal rotating face. Ensure that the thrust runner is centered on the rotating face.



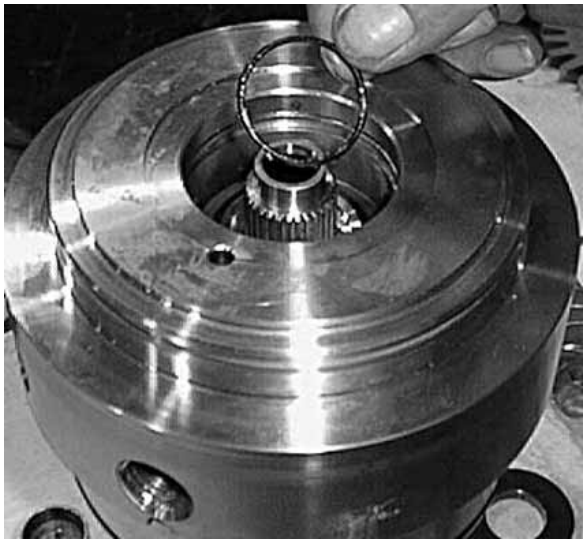




Step 31 (Double Seal Configuration Only)

The journal bearing design is different depending on whether the pump discharge orientation is horizontal or vertical. If the pump discharge orientation is being changed, you must consult with your authorized Sunflo sales representative to purchase the correct bearing. Failure to make this change will prevent the bearing from being adequately lubricated and will cause the pump to fail.

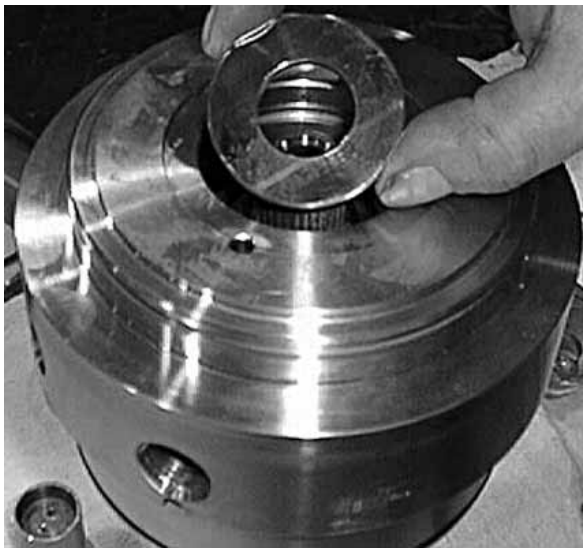
Install the inboard journal bearing with o-rings (Item P3-181) using the 4 cap screws and lock washers (Items P3-179 & P3-180). Use the cap screw at the 12 o'clock position to secure the oil fill deflector plate (Item P3-36).



Step 32 (Double Seal Configuration Only)

Place the high-speed shaft on a work surface with the splined end of the shaft pointing up.

Slide the seal housing assembly over the high-speed shaft until the journal bearing engages the shaft thrust runner.

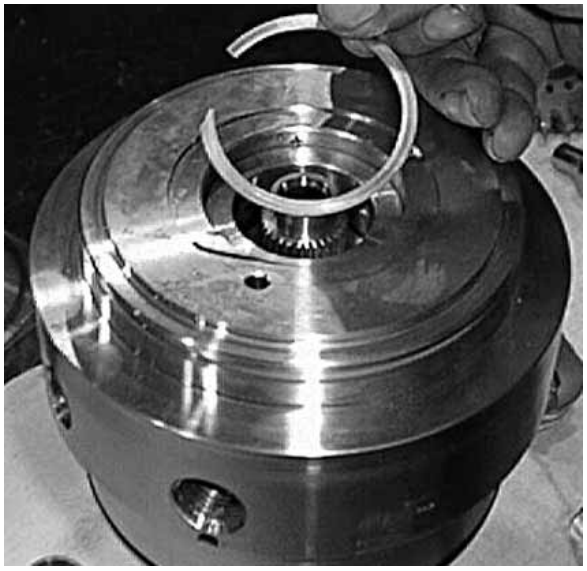


Step 33 (Double Seal Configuration Only)

Insert the shaft sleeve o-ring (Item P3-183) over the splined end of the high speed shaft. Using a screw driver or similar tool, push the o-ring down the shaft until it is resting against gearbox mechanical seal rotating face.

Step 34 (Double Seal Configuration Only)

Slide the shaft sleeve (Item P3-22) onto the high-speed shaft. Push the sleeve into the assembly until it is resting against the gearbox mechanical seal rotating face.



Step 35 (Double Seal Configuration Only)

Install the shaft sleeve o-ring (Item P3-117) into the groove on the shaft sleeve.

Step 36 (Double Seal Configuration Only)

Install the process seal rotating face (Item P3-25) by placing the part onto the outboard mechanical seal primary ring. Ensure that the rotating face is centered on the seal face.

Step 37 (Double Seal Configuration Only)

Install the inboard process mechanical seal (Item P3-77) using the seal installation tool shown on page 83. Ensure that the seal primary ring is facing away from the inboard side of the seal housing.

Step 38 (Double Seal Configuration Only)

Install the seal retaining ring (Item P3-54).

Step 39 (Double Seal Configuration Only)

Install the impeller o-ring (Item P3-18). It will be necessary to lubricate the o-ring to keep it in the groove. Then install the impeller over the splined end of the high-speed shaft

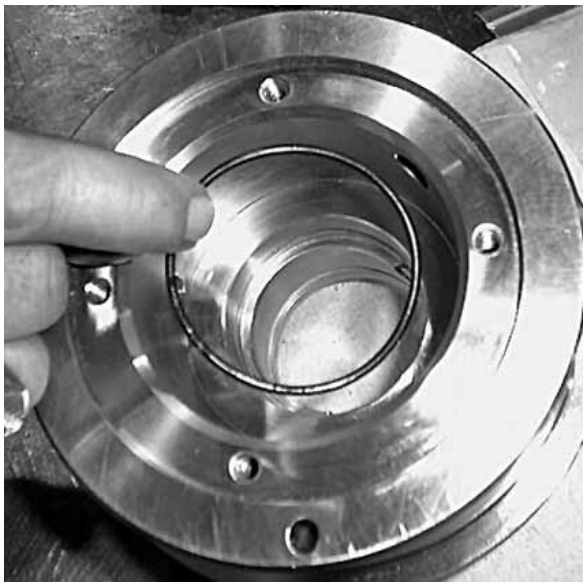
Step 40 (Double Seal Configuration Only)

The inducer stud threads are left-handed.

The inducer stud must be completely threaded into the inducer before installation into the pump shaft. Failure to completely thread the stud may allow the inducer to come loose during operation and damage the pump.

Install the inducer o-ring (Item P3-58).

Thread the inducer stud (Item P3-102) completely into the inducer. Install the inducer and tighten.



Step 41 (Double Seal Configuration Only)

Install the seal housing o-rings (Item P3-148).

Install the casing o-ring (Item P3-20).

Step 42 (Tandem Seal Configuration Only)

During assembly, the gearbox and process mechanical seals should be pressed into position without touching the seal faces. Sunflo recommends that you use an arbor that applies pressure to the seal retainer and not to the seal face. A tool drawing is provided in this manual. (see page 83)

Place the seal housing on a workbench with the inboard side facing down.

Slightly stretch and lubricate the gearbox seal o-ring (Item P3-28) and install into the o-ring groove in the seal bore.

Install the gearbox mechanical seal (Item P3-30) using the seal installation tool. (see page 83)

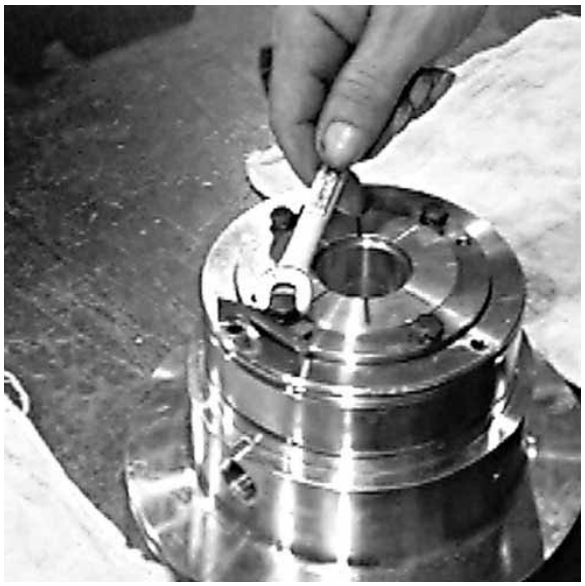
Install the first seal snap ring (Item P3-108).

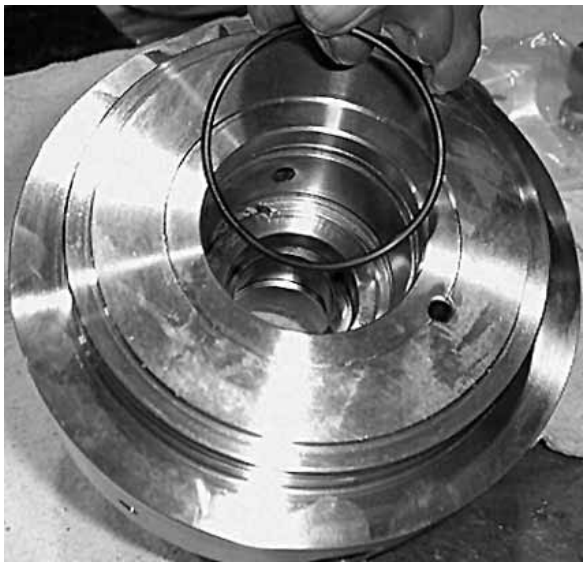
Step 43 (Tandem Seal Configuration Only)

Unlike the P-3000 single and double seal configurations, the P-3000 model with tandem seals does not use a separate gearbox mechanical seal rotating face and thrust runner. There is only one part that functions as both the rotating face and thrust runner.

There is only one correct way to install the rotating face/thrust runner. One side of the part will have a wide face and the other side will have a narrow face. The side with the narrow face must be in contact with the gearbox mechanical seal.

Install the rotating face/thrust runner (Item P3-151) with the large face pointing outwards.





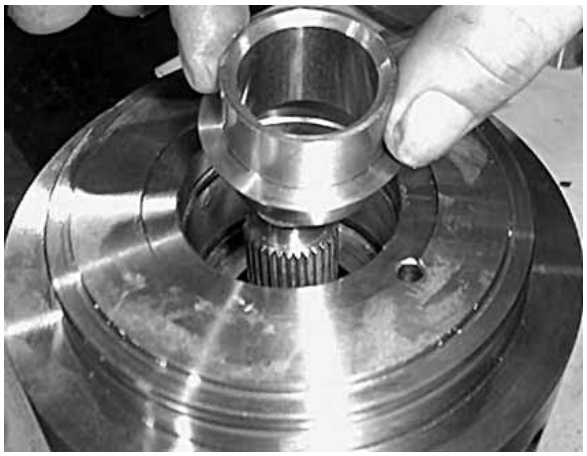
Step 44 (Tandem Seal Configuration Only)

The journal bearing design is different depending on whether the pump discharge orientation is horizontal or vertical. If the pump discharge orientation is being changed, you must consult with your authorized Sunflo sales representative to purchase the correct bearing. Failure to make this change will prevent the bearing from being adequately lubricated and will cause the pump to fail.

Install the inboard journal bearing with o-rings (P3-181) using the 4 cap screws and lock washers (Item P3-179 & P3-180). Use the cap screw at the 12 o'clock position to secure the oil fill deflector plate (Item P3-36)

Step 45 (Tandem Seal Configuration Only)

Slightly stretch and lubricate the outboard (secondary) process seal o-ring (Item P3-28) and install into the o-ring groove in the seal housing bore.



Step 46 (Tandem Seal Configuration Only)

Slightly stretch and lubricate the inboard (primary) process seal o-ring (Item P3-28) and install into the o-ring groove in the seal housing bore

Step 47 (Tandem Seal Configuration Only)

Place the high-speed shaft on a work surface with the splined end of the shaft pointing up.

Slide the seal housing assembly over the high-speed shaft until the journal bearing engages the shaft thrust runner.

Step 48 (Tandem Seal Configuration Only)

Slightly stretch the first outboard shaft sleeve o-ring (Item P3-183) and slide the o-ring down the shaft. Using a screw driver or similar tool, push the o-ring down the shaft until it is resting against gearbox seal rotating face/thrust runner.

Step 49 (Tandem Seal Configuration Only)

There is only one correct way to install the outboard shaft sleeve. If you inspect the sleeve, you will see that there are two different outer diameters. The side of the sleeve with the larger of the two diameters must be towards the gearbox seal rotating face/thrust runner.

Slide the outboard shaft sleeve (Item P3-64) down the high-speed shaft until the sleeve slides over the o-ring and engages the gearbox seal rotating face/thrust runner.

Step 50 (Tandem Seal Configuration Only)

Install the outboard (secondary) process mechanical seal (Item P3-77) using the seal installation tool (see page 83). Ensure that the seal primary ring is facing towards the suction side.

Install the second seal snap ring (Item P3-108).

Step 51 (Tandem Seal Configuration Only)

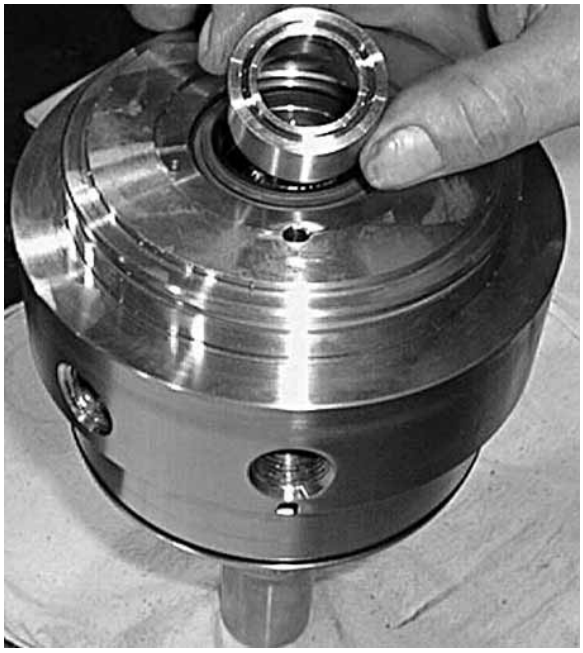
Slightly stretch the second outboard shaft sleeve o-ring (Item P3-183) and slide the o-ring down the shaft. Using a screw driver or similar tool, push the o-ring down the shaft until it is flush with the top of the lower shaft sleeve. There will be a chamfer for the o-ring to slide into.

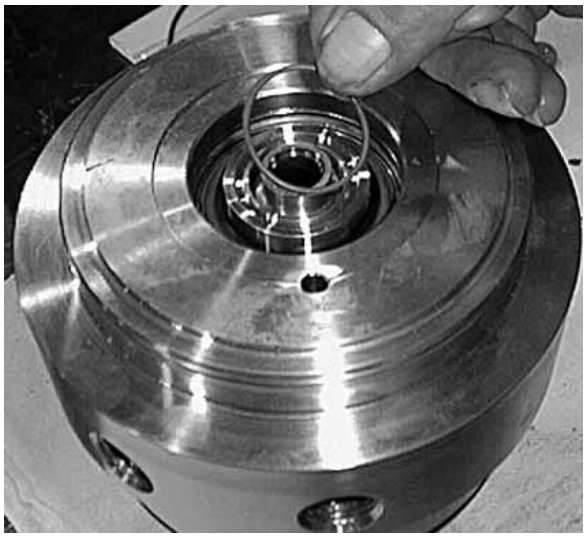
Step 52 (Tandem Seal Configuration Only)

Slide the outboard (secondary) process seal rotating face (Item P3-70) down the high-speed shaft until the rotating face is engaged against the seal face.

Step 53 (Tandem Configuration Only)

Slightly stretch the inboard shaft sleeve o-ring (Item P3-183) and slide the o-ring down the shaft. Using a screw driver or similar tool, push the o-ring down the shaft until it is flush with secondary rotating face.





Step 54 (Tandem Seal Configuration Only)

Install the third seal snap ring (Item P3-108).

Install the inboard (primary) process mechanical seal (Item P3-77) using the seal installation tool (see page 83). Ensure that the seal primary ring is facing towards the suction side.

Install the fourth seal snap ring (Item P3-108).

Step 55 (Tandem Seal Configuration Only)

There is only one correct way to install the inboard shaft sleeve. If you inspect the sleeve, you will see that one side has a 45° chamfer and the other side does not. The side with the chamfer must be facing towards the secondary process seal rotating face.

Install the inboard shaft sleeve (Item P3-22) until the sleeve slides over the o-ring and engages the secondary seal rotating face.

Step 56 (Tandem Seal Configuration Only)

Install the inboard shaft sleeve face o-ring (Item P3-117) into the groove on the shaft sleeve face.

Step 57 (Tandem Seal Configuration Only)

Install the inboard (primary) process seal rotating face (Item P3-25) so that the rotating face engages the face of the outboard shaft sleeve.

Step 58 (Tandem Seal Configuration Only)

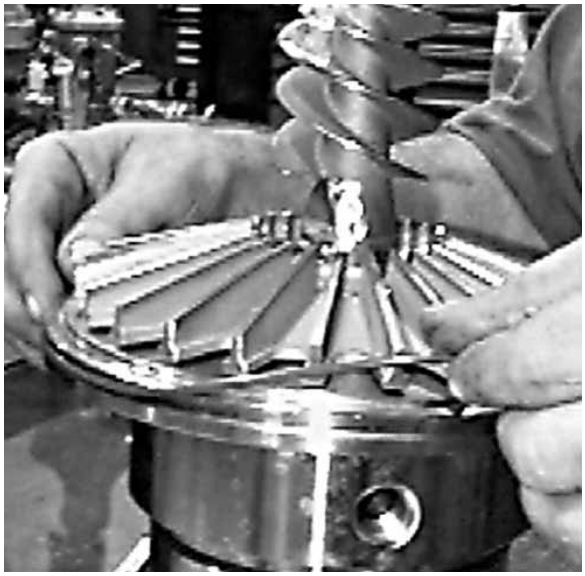
Install the throat bushing (Item P3-72).

Step 59 (Tandem Seal Configuration Only)

Install the throat bushing retaining ring (Item P3-74).

Step 60 (Tandem Seal Configuration Only)

Install the impeller o-ring (Item P3-18). It will be necessary to lubricate the o-ring to keep it in the groove. Then install the impeller over the splined end of the high-speed shaft.



Step 61 (Tandem Seal Configuration Only)

The inducer stud threads are left-handed.

The inducer stud must be completely threaded into the inducer before installation into the pump shaft. Failure to completely thread the stud may allow the inducer to come loose during operation and damage the pump.

Install the inducer o-ring (Item P3-58).

Thread the inducer stud (Item P3-102) completely into the inducer. Install the inducer and tighten.

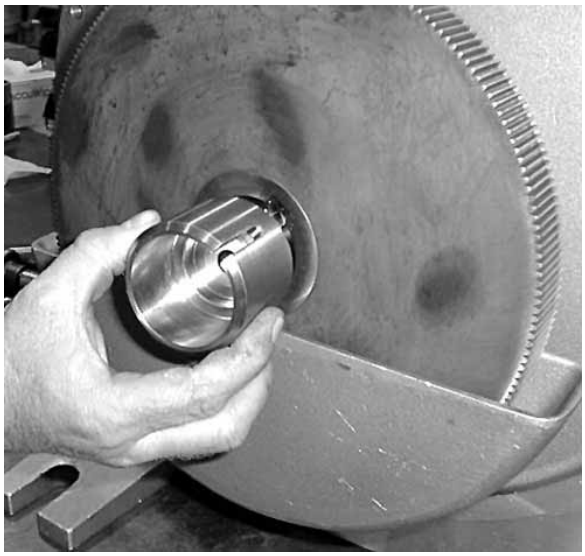
Step 62 (Tandem Seal Configuration Only)

Install the seal housing o-rings (Item P3-148).

Install the casing o-ring (Item P3-20)

Pump Assembly Appendix

The following steps are for the installation of the internal lube pump assembly on Sunflo P-3000 models manufactured prior to September, 1996. If you are unsure which lube pump design your Sunflo pump uses, compare your model to the pictures.

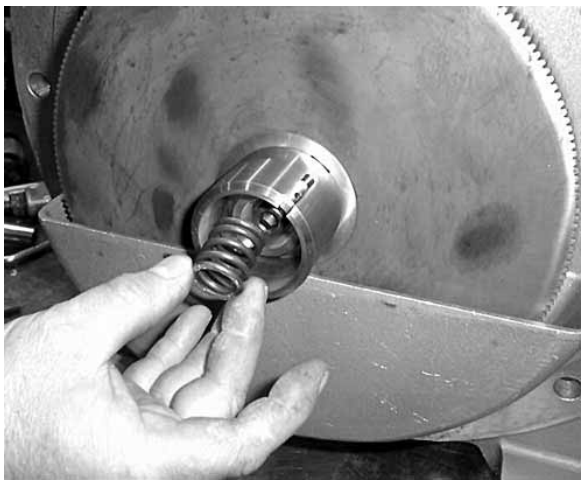


Step 1

Install the gear retainer. The gear retainer has an alignment pin that indexes to the slot in the end of the shaft.

Fasten the gear retainer into the end of the input shaft using the socket head screw and lock washer.

.



Step 2

Install the lube pump relief spring into the retainer.

Step 3

Completely immerse the lube pump in the same oil that will be used for the gearbox. This is required to ensure that the gears are properly lubricated when the pump is started for the first time.

Install the lube pump into the retainer. Ensure that the pin on the lube pump indexes to the slot on the gear retainer.

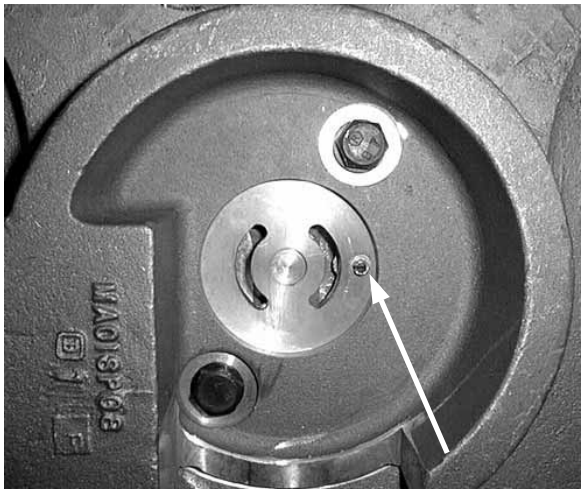
Step 4

The lube pump manifold may be installed into the gearbox housing using the 2 socket head cap screws and lock washers. Ensure that the old gasket has been removed and a new gasket between the manifold and gearbox is used

Step 5

The relief area on the lube pump must be positioned to line up with the anti-rotation pin in the lube pump manifold. Position the lube pump so that the anti-rotation pin in the lube pump manifold will be at the midpoint of the relief area on the lube pump when assembled.

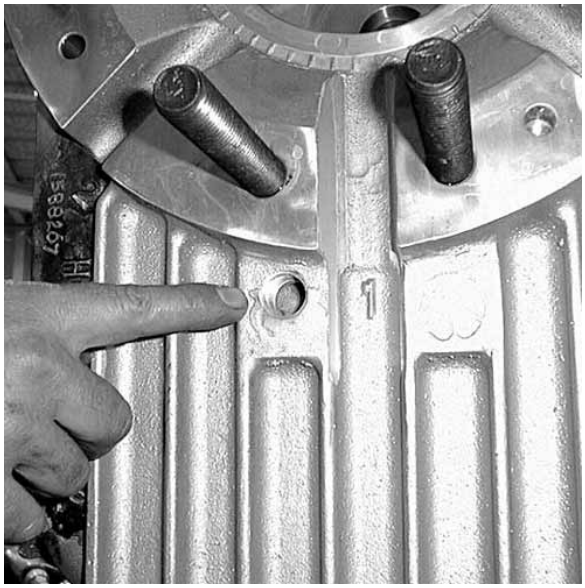
Proceed with the assembly of the gearbox housing onto either the motor or the mounting frame. During assembly, only fasten the housing with 2 of the bolts.



Steps 6 and 7 are needed to ensure that the lube pump was been properly assembled. Improper assembly of the lube pump system will cause a failure of the journal bearings.

Step 6 only applies when you have the lube oil system piping removed.

Step 7 only applies when you have the lube oil system piping installed.

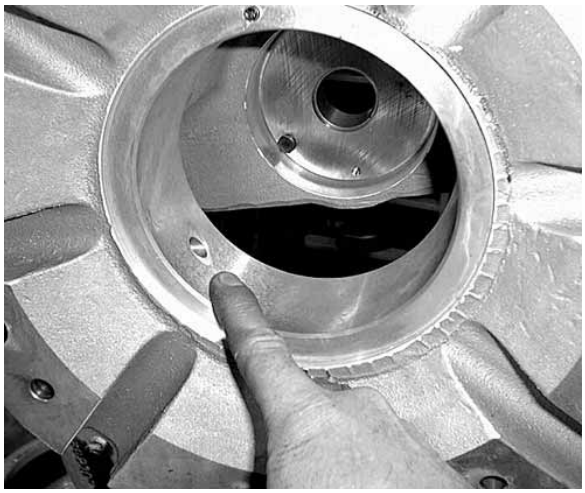


Step 6 (Lube Oil System Piping Removed)

Pour enough oil into the gearbox housing so that the oil level reaches the stand pipe of the lube oil manifold assembly.

Place your finger over the lube oil discharge hole on the front face of the gearbox housing.

With your finger over the hole, turn either the input shaft for frame mounted units or the motor fan for close coupled units. While turning the shaft, you should feel pressure being developed on your finger.



Step 7 (Lube Oil System Piping Installed)

Pour enough oil into the gearbox housing so that the oil level reaches the stand pipe of the lube oil manifold assembly.

Place your finger over the lube oil discharge hole inside the seal housing bore.

With your finger over the hole, turn either the input shaft for frame mounted units or the motor fan for close coupled units. While turning the shaft, you should feel pressure being developed on your finger.

Step 8

If oil pressure is not being developed, then something went wrong with the assembly. Drain the oil out of the gearbox sump and remove the gearbox housing.

Repeat this procedure beginning at Step 1.

If you continue to have problems with developing oil pressure, contact your Authorized Sunflo Sales Representative for technical assistance.

SEAL INSTALLATION TOOL DRAWING (PART NUMBER _____)
(ALL DIMENSION IN INCHES)

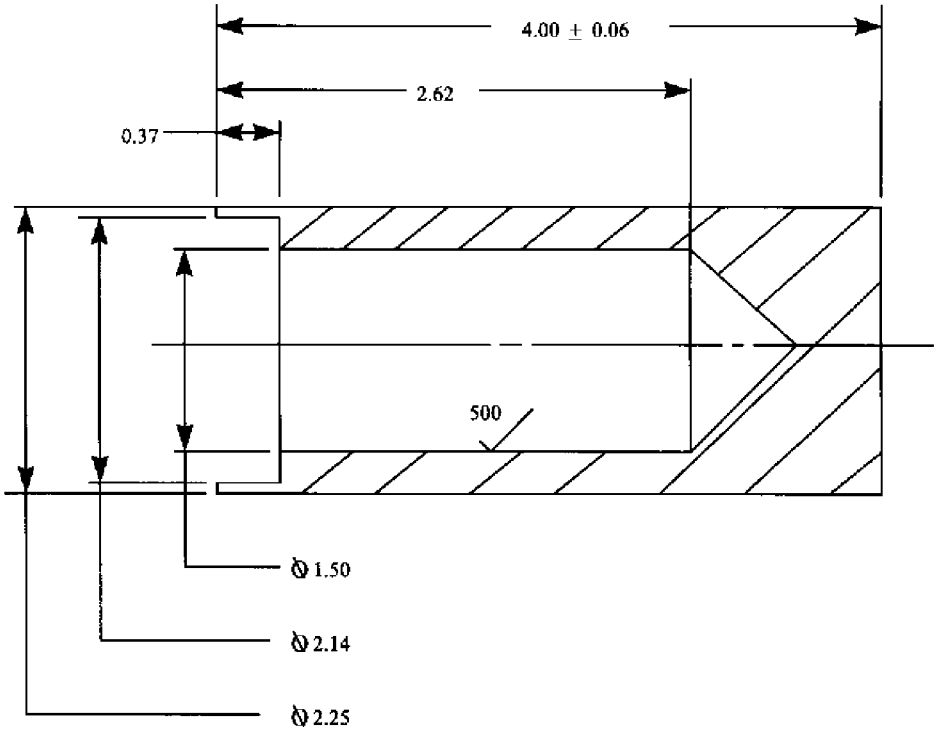


Figure 13

P-3000 CLOSE COUPLED MOTOR SHAFT SLEEVE ARBOR (PART NUMBER _____)
(ALL DIMENSIONS IN INCHES)

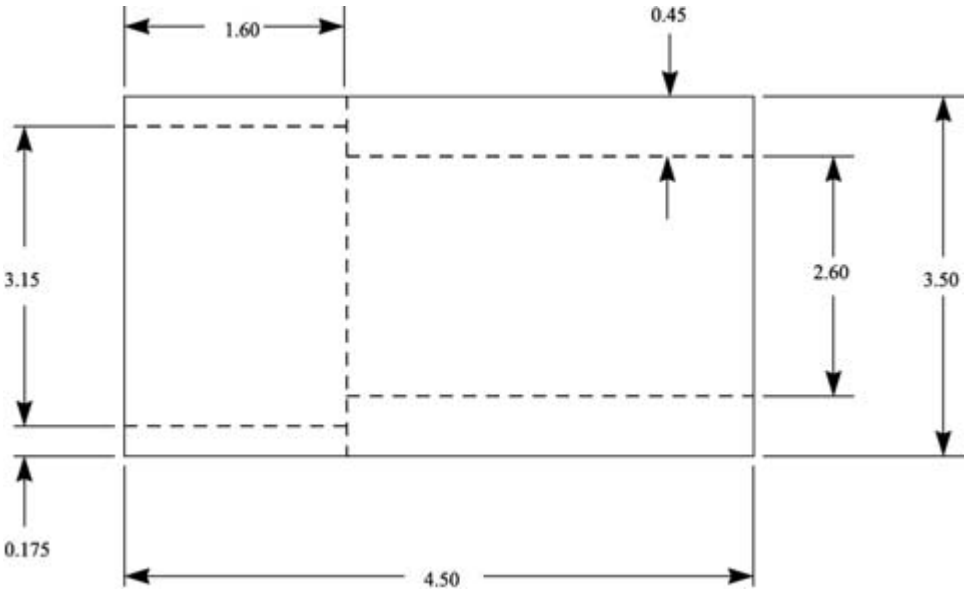


Figure 14

Parts List

General

A. Assemblies, subassemblies, and components of the P-3000 pump are illustrated on the following exploded and cross sectional views. The corresponding parts lists, keyed to each part by item number, identify detailed parts by part name, quantity, and location.

Recommended Spares

B. Recommended spare parts are indicated in the quantity column by an asterisk (*) to the specific quantity. The quantity column and the indicated spares recommended are based on the support of one unit.

C. The type and quantity of spare parts may vary with each application, depending upon equipment location, operating conditions, and the type of liquid being pumped. An available supply of recommended spares provides immediate replacement parts without costly downtime and keeps inventory requirements to a minimum. You can obtain assistance for planning an adequate supply of recommended spare parts by contacting your local Sunflo sales representative.

Ordering Replacement Parts

D. When ordering spare parts, they should be ordered through your local Sunflo sales representative. Please provide the unit serial number and list each part by item number as shown in this instruction manual. If part numbers are available, list both part numbers and item numbers. Please specify the quantities desired.

E. If you do not know who your distributor is, contact the following:

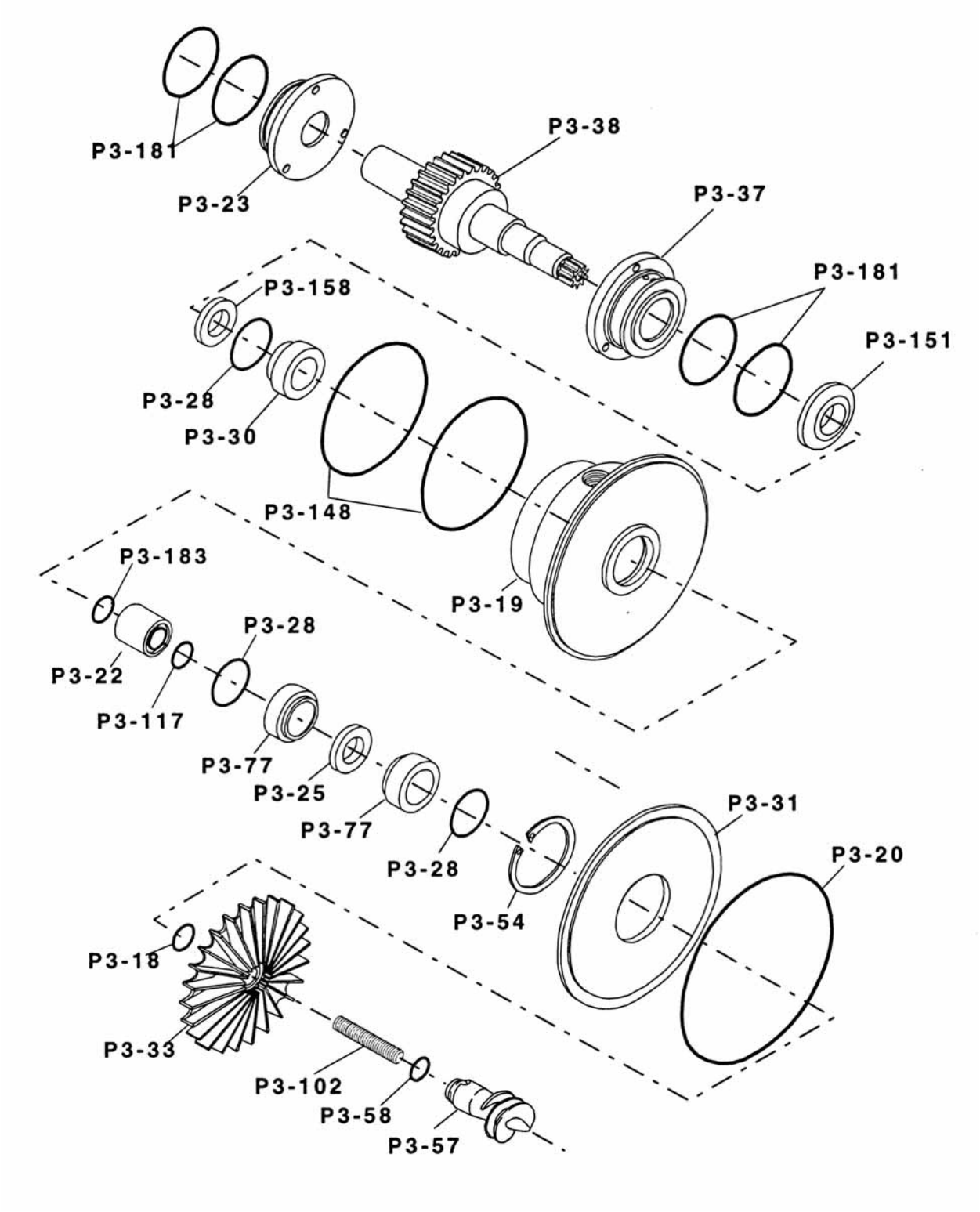
Sundyne Corporation, Attention: Parts Order coordinator, 14845 W. 64th Avenue, Arvada, CO 80007, USA
Phone: +1-303-425-0800
FAX: +1-303-425-0896

or

Sundyne Corporation, S.A.,Fluid Handling Division, DeKleetlaan 5, Box 1, B-1831Diegem, Belgium
Phone: +322-719-78-70
Fax: +322-719-78-80

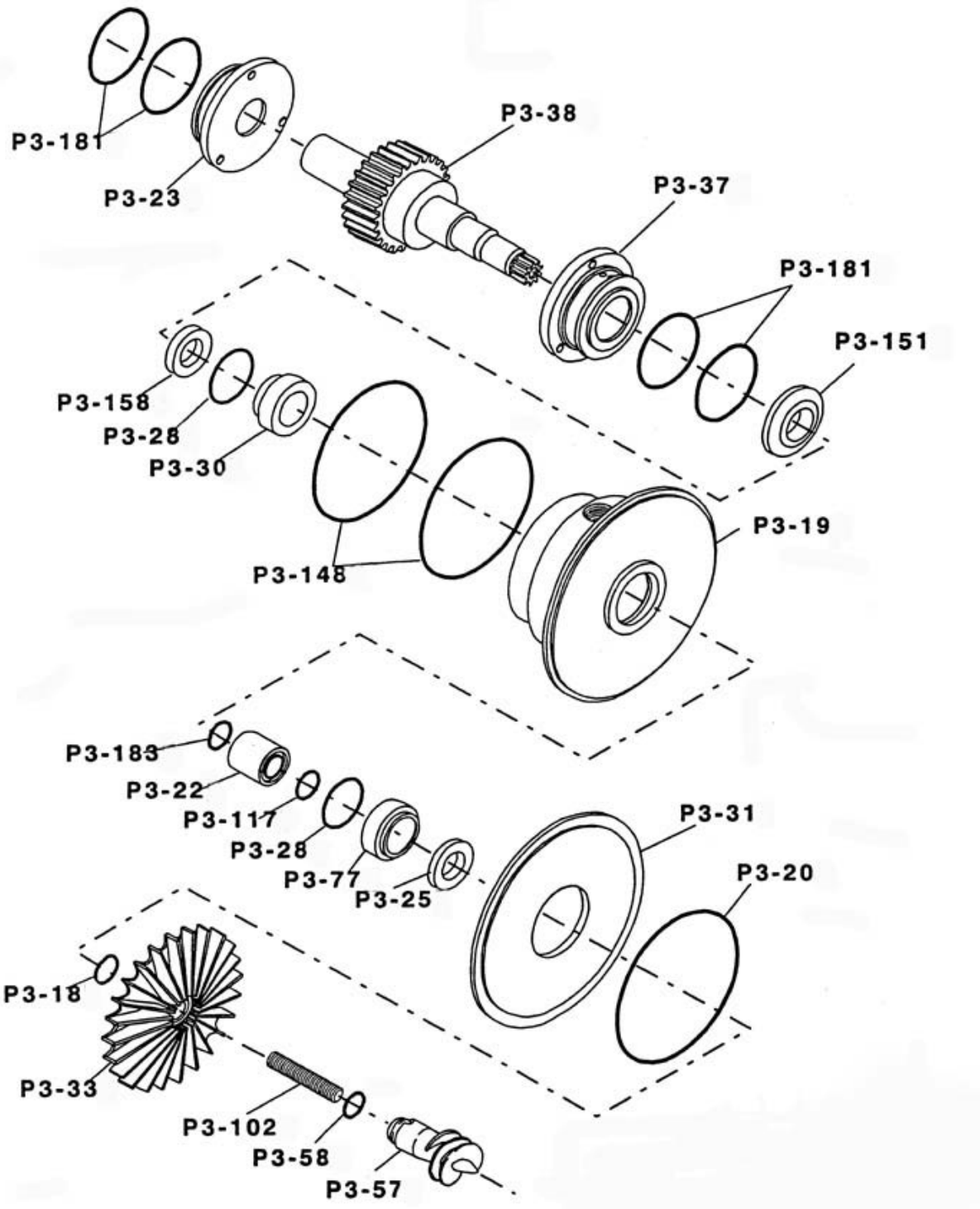
or

Nikkiso-Sundyne Company, Ltd., 17-10, Ebisu 2 Chome, Shibuya-Ku, Tokyo, Japan
Phone: +81-3-3444-6475
FAX: +81-3-3444-6806



P-3000 High Speed Shaft Assembly – Double Seals
Figure 15

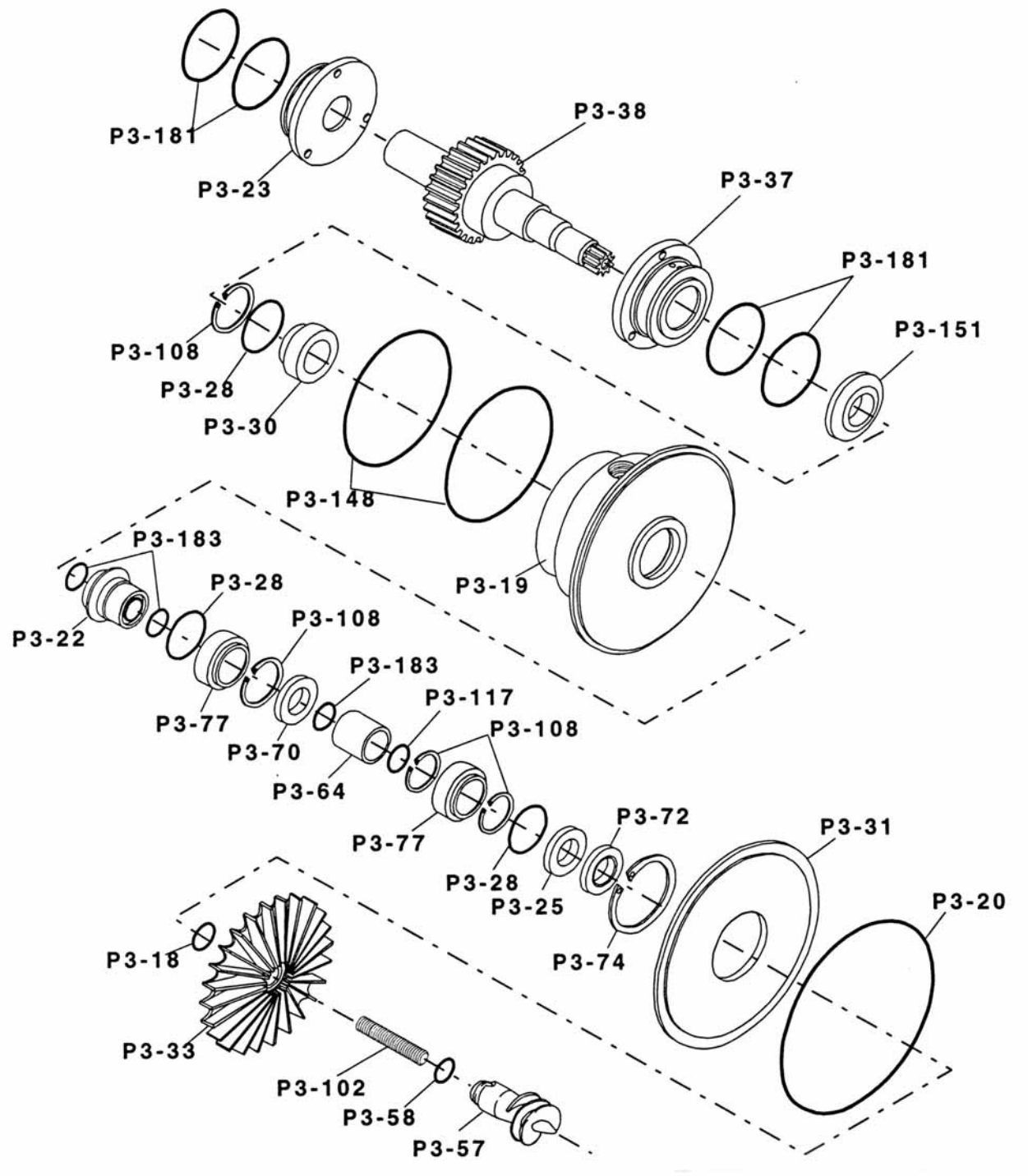
NOTE: P3-31 (Cover Plate) is integral to P3-19 (Seal Housing).



P-3000 High Speed Shaft Assembly – Single Seal

Figure 16

Note: P3-31 (Cover Plate) is now integral to P3-19 seal housing



P-3000 High Speed Shaft Assembly – Tandem Seal

Figure 17

NOTE: P3-31 (Cover Plate) is integral to P3-19 (Seal Housing).

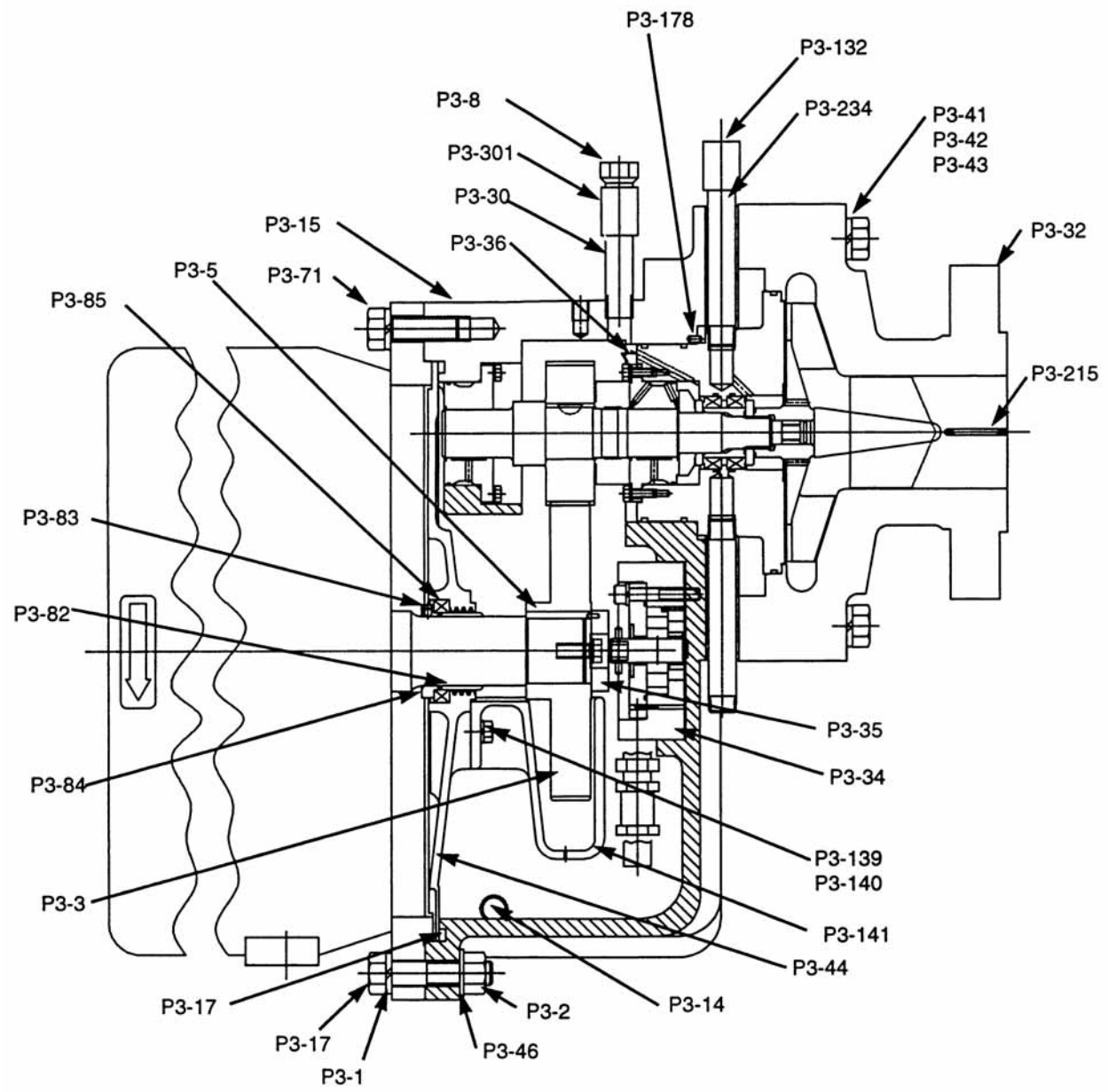

P3-178
P3-132
P3-8
P3-234
P3-41
P3-42
P3-43
P3-301
P3-30
P3-15
P3-36
P3-32
P3-5
P3-71
P3-85
P3-215
P3-83
P3-82
P3-35
P3-34
P3-84
P3-139
P3-140
P3-3
P3-141
P3-44
P3-17
P3-14
P3-2
P3-17
P3-46
P3-1

Figure 18

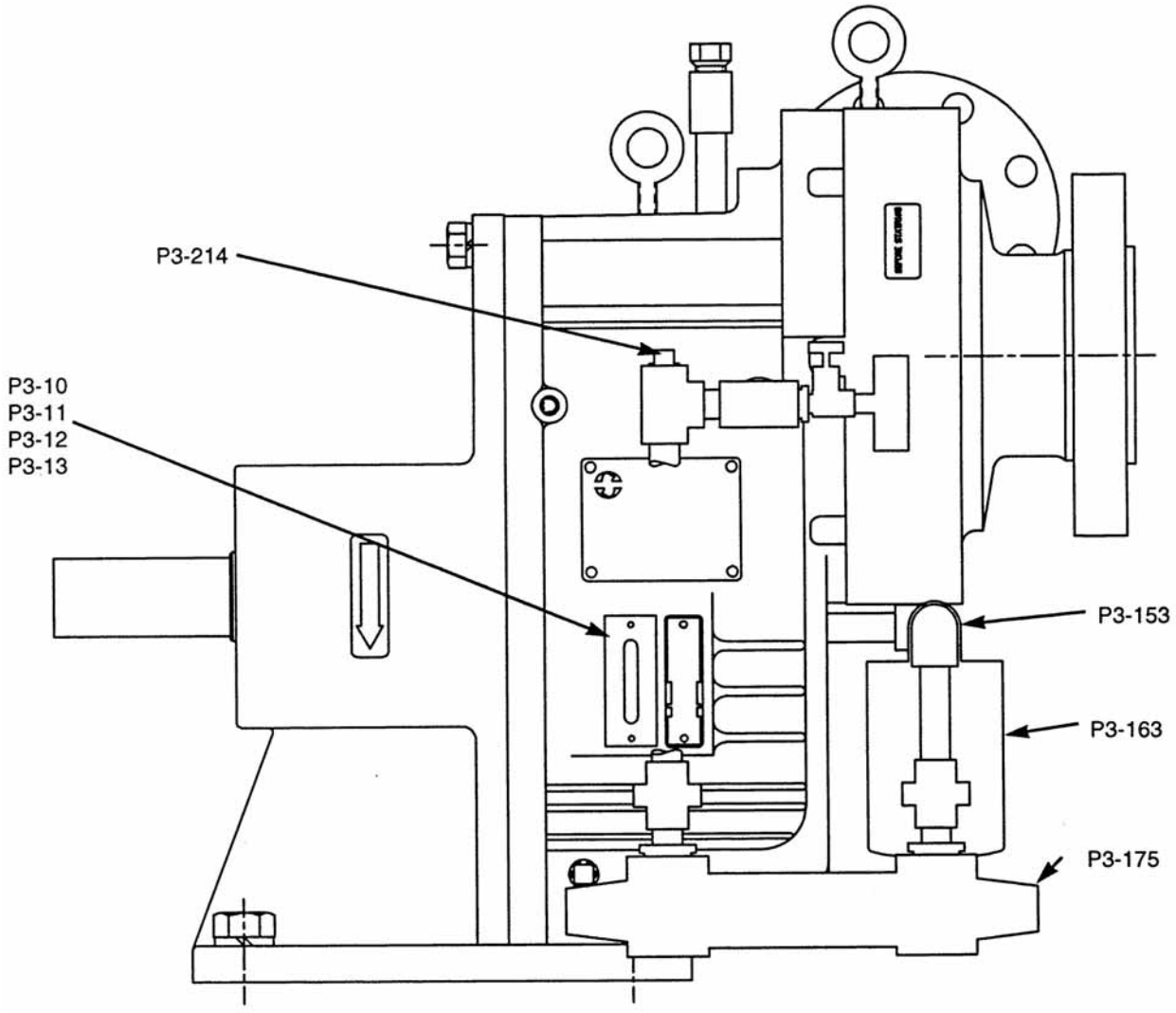


Figure 19

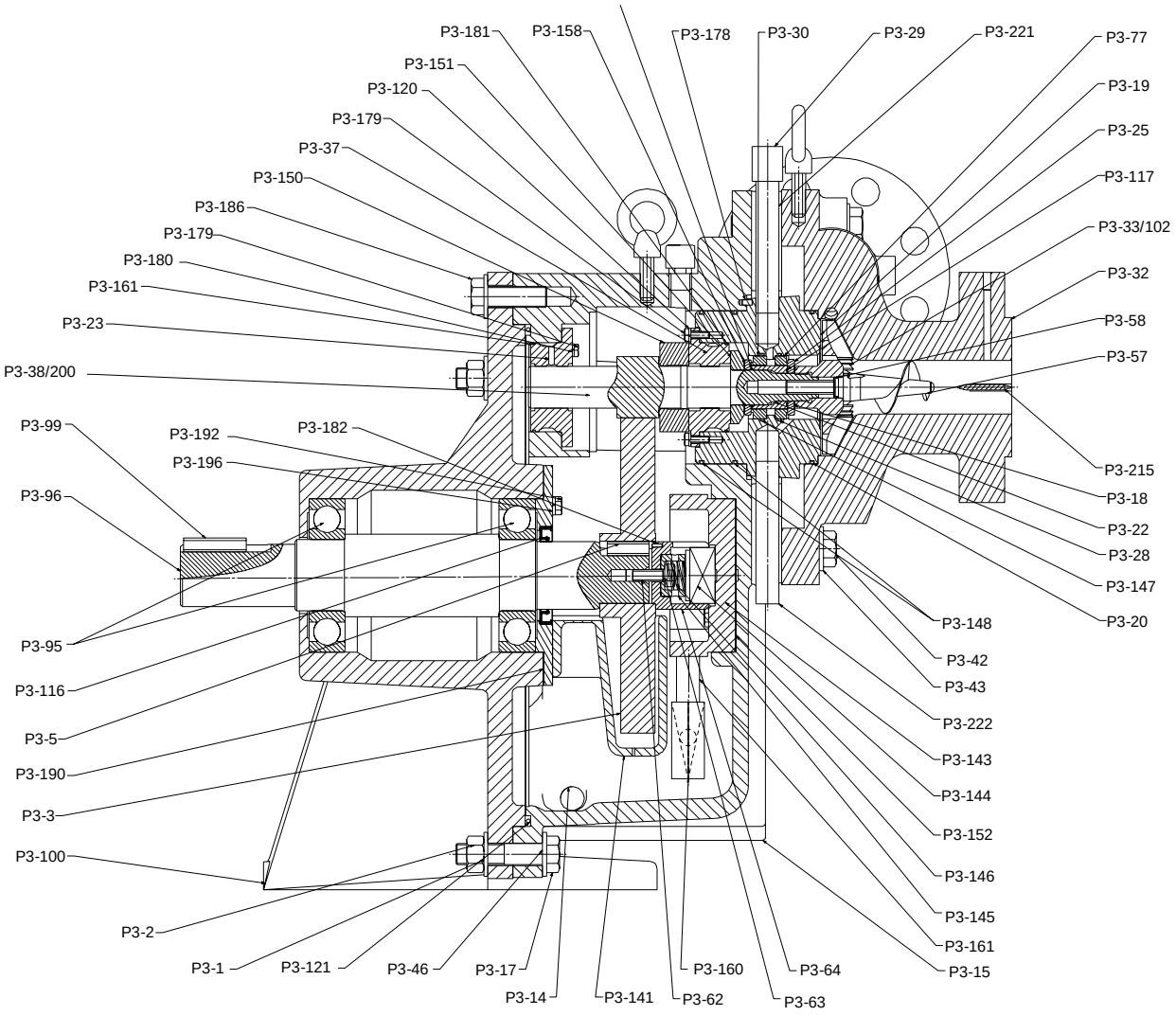

P3-181
P3-158
P3-178
P3-30
P3-29
P3-221
P3-77
P3-151
P3-120
P3-19
P3-179
P3-25
P3-37
P3-150
P3-117
P3-186
P3-33/102
P3-179
P3-180
P3-32
P3-161
P3-58
P3-23
P3-57
P3-38/200
P3-99
P3-192
P3-182
P3-215
P3-196
P3-18
P3-96
P3-22
P3-28
P3-147
P3-20
P3-148
P3-42
P3-95
P3-43
P3-116
P3-222
P3-5
P3-143
P3-190
P3-144
P3-3
P3-152
P3-100
P3-146
P3-145
P3-2
P3-161
P3-15
P3-1
P3-121
P3-46
P3-17
P3-160
P3-64
P3-14
P3-141
P3-62
P3-63

Figure 20

Table 7. Common Parts (All Seal Configurations) * Recommended Spare Parts		
Item No.	Part Name	Qty.
P3-1	Gearbox Housing Flat Washer	7
P3-10	Sight Glass	2
P3-11	Sight Glass Gasket	2
P3-12	Sight Glass Retainer	2
P3-13	Sight glass Self-Tapping Screw	2
P3-14	Oil Drain Plug (Note 1)	1
P3-15	Gearbox Housing	1
P3-17	Gearbox Housing Bolt	7
P3-2	Gearbox Nut	7
P3-3	Drive Gear	1
P3-32	Pump Casing	1
P3-34	Lube Pump Assembly (Note 2)	1
P3-35	Lube Pump Driving Lug Assembly (Note 2)	1
P3-36	Oil Fill Deflector Plate (Note 2)	1
P3-41	Pump Casing Studs	8
P3-42	Pump Casing Nuts	8
P3-43	Flat Washers	16
P3-44	Baffle Plate (Close Coupled Configuration Only)	1
P3-46	Gearbox Housing Lock Washer	7
P3-5	Drive Gear Key	1
P3-71	Gearbox Housing Bolt (Note 3)	1
P3-8	Gearbox Fill/Vent Plug	1
P3-82	Shaft Sleeve O-Ring (Close Coupled configuration)	*1
P3-83	Set Screws (Close Coupled Configuration)	3
P3-84	Shaft Sleeve (Close Coupled Configuration)	1
P3-85	Baffle Plate Lip Seal (Close Coupled Configuration	1
P3-95	Ball Bearing (Frame Mount)	2
P3-96	Input Shaft (Frame Mount Configuration)	1
P3-99	Coupling Key (Frame Mount)	1
P3-100	Mounting Frame (Frame Mount Configuration)	1
P3-121	Gearbox Housing O-Ring	1
P3-132	Seal Flush Cap	1
P3-139	Splash Guard Washer	2
P3-140	Splash Guard Bolt	2
P3-141	Splash Guard	1
P3-153	Oil Filter Manifold	1
P3-163	Oil Filter	*1
P3-175	Heat Exchanger	1

Table 7. Common Parts (All Seal Configurations) * Recommended Spare Parts		
Item No.	Part Name	Qty.
P3-178	Seal Housing Locating Pin	1
P3-190	Baffle Plate (Frame Mount)	1
P3-192	Baffle Plate Bolt (Frame Mount)	4
P3-214	Lube Oil Fill Plug	1
P3-215	Flow Straightener	1
P3-234	Seal Housing Pipe Nipple (Note 4)	3
P3-239	Baffle Plate Lip Seal (Frame Mount)	1
P3-30	Gearbox Vent Nipple	1

Notes:

1. Units sold before September, 1996 require 2 plugs.
2. Only supplied on units sold after September, 1996.
3. Used only at the 12 o'clock position.
4. Three applies required on tandem seal models. Two applies required on all other models.

Table 8. Old Style Lube Pump Assembly (Picture Not Shown)		
Item No.	Part Name	Qty.
P3-62	Lube Pump Socket Head Screw	4
P3-146	Lube Pump Relief Spring	1
P3-145	Lube Pump Retainer	1
P3-144	Lube Pump	3
P3-143	Lube Pump Manifold Assembly	1
P3-142	Lube Pump Gear Retainer	1
P3-113	Lube Pump Manifold Anti-rotation Pin	1
P3-152	Lube Oil Manifold Gasket	1

Table 9. High Speed Shaft Assembly (Single and Double Seals) *Recommended Spare Parts		
Item No.	Part Name	Qty.
P3-18	Impeller O-ring	*1
P3-19	Seal Housing	1
P3-20	Pump Casing O-ring	*1
P3-22	Shaft Sleeve	1
P3-23	Outboard Journal Bearing	1
P3-25	Process Mechanical Seal Mating Ring	*1
P3-28	Seal/Seal Housing O-ring	*3
P3-30	Gearbox Mechanical Seal	*1
P3-31	Cover Plate	1
P3-33	Impeller	1
P3-37	Inboard Journal Bearing	1
P3-38	High Speed Shaft	1
P3-54	Snap Ring	1
P3-57	Inducer	1
P3-58	Inducer O-ring	*1
P3-77	Process Mechanical Seal	*2
P3-102	Inducer Stud	1
P3-117	Shaft Sleeve Inboard O-ring	*1
P3-148	Seal Housing/Gearbox Housing O-ring	*2
P3-151	Thrust Runner	1
P3-158	Gearbox Mechanical Seal Mating Ring	*1
P3-179	Journal Bearing Screw	6
P3-180	Journal Bearing Lock Washer	6
P3-181	Journal Bearing O-ring	*4
P3-183	Shaft Sleeve Outboard O-ring	*1

Table 10. High Speed Shaft Assembly (Tandem Seals) *Recommended Spare Parts		
Item No.	Part Name	Qty.
P3-18	Impeller O-ring	*1
P3-19	Seal Housing	1
P3-20	Pump Casing O-ring	*1
P3-22	Inboard Shaft Sleeve	1
P3-23	Outboard Journal Bearing	1
P3-25	Primary Process Mechanical Seal Mating Ring	*1
P3-28	Seal/Seal Housing O-ring	*3
P3-30	Gearbox Mechanical Seal	*1
P3-31	Cover Plate	1
P3-33	Impeller	1
P3-37	Inboard Journal Bearing	1
P3-38	High Speed Shaft	1
P3-57	Inducer	1
P3-58	Inducer O-ring	*1
P3-64	Outboard Shaft Sleeve	1
P3-70	Secondary Process Mechanical Seal Mating Ring	*1
P3-72	Throat Bushing	1
P3-74	Throat Bushing Retaining Ring	1
P3-77	Process Mechanical Seal (Primary & Secondary)	*2
P3-102	Inducer Stud	1
Pe-108	Seal Snap Ring	4
P3-117	Inboard Shaft Inboard O-ring	*1
P3-148	Seal Housing/Gearbox Housing O-ring	*2
P3-151	Thrust Runner/Gearbox Mating Ring	*1
P3-179	Journal Bearing Screw	6
P3-180	Journal Bearing Lock Washer	6
P3-181	Journal Bearing O-ring	*4

SUNFLO

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