SUNFLO
P-2500 PUMPS

Instruction and Operation Manual

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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, or 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.

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INTRODUCTION

Sunflo Centrifugal Pumps

Sunflo pumps provide high-energy performance and competitive efficiencies in an industrial quality, compact unit that is simple to maintain. Sunflo pumps are single stage that utilizes an integral gearbox. Designed to increase the pressure of a continuous flow of fluid by applying centrifugal action, Sunflo pumps are most commonly used in general industry applications. Commonly applied in power generation, reverse osmosis, and washdown services. Sunflo pumps are used in high-head, low-to-medium flow processes.

This manual presents installation, servicing, troubleshooting, maintenance and spare parts information for the latest configuration of Sunflo centrifugal pumps.

***Note**: Parenthetical numbers included in the text correspond to item numbers on the illustrated figures. The correct spare part can be ordered for any generation pump by referencing the item and serial numbers.*

Text Symbols

The following symbols may be found in the text of this manual.

They have the following meanings:

WARNING: Text accompanied by this symbol indicates that failure to follow directions could result in bodily harm or death.

ELECTRICAL HAZARD: Text accompanied by this symbol indicates that failure to follow directions could result in electrical damage to equipment or electrical shock.

RECOMMENDED: Text accompanied by this symbol indicates recommended usage.

REMINDER: Text accompanied by this symbol indicates a reminder to perform an action.

EQUIPMENT USE ALERT: Text accompanied by this symbol indicates that failure to follow directions could result in damage to equipment.

Equipment and Safety Precautions

Sundyne Corporation manufactures centrifugal pumps to exacting International Quality Management System Standards (ISO 9001) as certified and audited by Lloyd's Register Quality Assurance Limited. Genuine parts and accessories are specifically designed and tested for use with these products to ensure continued product quality and performance. Sundyne 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 Sundyne pump parts and accessories is considered misuse and damage or failure caused by misuse is not covered by Sundyne's warranty. Additionally, modification of Sundyne products or removal of original components may impair the safety of these products and their effective operation.

CAUTION

Sundyne pumps may handle hazardous, flammable, and/or toxic fluids. Proper personal protective equipment should be worn. Precautions must be taken to prevent physical injury. Pumpage must be handled and disposed of in accordance with applicable environmental regulations.

***Note**: Safety procedures must be applied prior to any installation, maintenance, or repair of a Sundyne pump. Failure to follow safety precautions may lead to injury!*

Wearing Personal Protective Equipment

To ensure safety, protective equipment must be worn at all times when installing, performing maintenance, or repairing equipment. The following safety recommendations must be adhered to for optimum safety:

- Safety glasses, with the minimum requirement of side shields, must be worn at all times.
- Steel-toed shoes must be worn when lifting equipment greater than 15 pounds (7 kg) or if pallet jacks or forklifts are operated.
- Hearing protection is strongly recommended at all times when noise levels exceed 85 dB during an eight (8.0) hour period.

***Note**: Chemical resistant gloves must be used if chemicals are utilized (refer to Using Chemicals for additional information).*

***Note**: A dust mask respirator must be worn if chemicals have warning labels regarding fumes, dust, or mists.*

When using more than one piece of protective equipment, consider their compatibility. For example, safety glasses will not interfere with hearing protection equipment. Be sure to clean all pieces of personal protective equipment immediately after each use.

Using Forklifts

Any persons operating a forklift must have an active recognized operator license.

***Note**: Before initializing forklift operation, verify that the lift is in a safe operating position.*

Ensuring Electrical Safety

All electrical sources must be powered-off before installation, service, or repair of equipment occurs.

***Note:** Sundyne recommends that a Lock-out/Tag-out program be followed prior to altering the equipment. Locks or tags must be provided to warn employees that equipment is temporarily unavailable.*

Once all work has been completed, the person installing the lock or tag must remove it according to company procedure.

Testing Equipment

Prior to performing a test on newly installed, maintained, or repaired equipment; all personnel in the immediate area must be warned.

***Note**: Follow company procedures prior to equipment testing at all times.*

Using Chemicals

Any chemicals to be used must be accompanied by a relevant material safety data sheet (MSDS), in accordance with government legislation. If applicable, use chemical proof gloves.

***Note**: An eye wash station (or equivalent) should be available in the event of injury. If any hazardous or flammable chemicals pass through the equipment, a complete decontamination of the equipment is required.*

Protection from Falling

Fall protection and associated preventative measures are required when working on equipment located six feet or higher from the ground.

***Note**: Follow company fall prevention procedures prior to working on equipment.*

Preventative Machine Guards

Preventative guards must remain in place on all equipment.

***Note**: Only remove the guards while performing maintenance or repair.*

Replace the guards immediately after working on the equipment and prior to start up.

EXPLOSION/FIRE HAZARD

***Note:** Never use an acetylene torch, open flame, or heat to attempt to remove parts that have seized together in Sundyne equipment. Any residual process gas or liquid that is flammable can result in an explosion or fire with potential for serious injury or death.*

INSTALLATION

Inspection

Immediately inspect your Sunflo product upon receipt of the equipment. Check for any damage, which may have occurred during shipment. Notify the carrier and Sundyne immediately if damage is evident.

Storing Your Pump Short-Term

If your Sunflo pump is not to be installed immediately, protect it from exposure to moisture and dust. Do not remove the factory installed shipping covers for casing flanges and seal ports. Ensure that the shipping covers be kept securely in place.

***Note**: Observe the storage instructions provided by the driver manufacturer.*

Storing Your Pump Long-Term

In addition to the precautions in the short-term section above, additional precautions are required for long-term storage.

If your Sunflo pump will not be operated for a period of time exceeding six months from the date of shipment, long-term storage conditions must be met to ensure minimum corrosion damage to the gearbox and fluid-end components.

***Note**: Sundyne does not accept liability for equipment damaged during the storage period. Sundyne does not guarantee the quality of equipment during and after the storage period.*

To ensure the original quality of the Sunflo pump after storage, all components must be inspected by an authorized Sundyne service engineer. Components that are not manufactured by Sundyne (except mechanical seals) must be inspected by its own manufacturer.

***Note**: Any inspection fees are the sole responsibility of the purchaser.*

Factors which affect the quality of a Sunflo pump, when stored, are:

- Humidity
- Temperature
- Surrounding chemicals

Long-term storage methods must prevent damaging conditions from making contact with the internal components of the equipment. When the equipment is stored in strong chemical environments or near salt water, protection must occur immediately upon receipt of the equipment.

Recommended Long-Term Storage Procedures

Sundyne recommends that you do the following to prevent damage to your pump during long-term storage:

1. Store your pump only in an indoor, climate controlled building. These conditions will maintain constant temperature and humidity.
2. Perform inert gas purging of component internals.
3. Ensure oil flooding of gearbox internals.
4. Use desiccant bags.

***Note:** Because long-term storage of equipment is of a highly critical nature, it is recommended that Sundyne be contacted to provide more details on the above procedure.*

Suction and Discharge Piping

Please adhere to the following best practices for installing and maintaining suction and discharge piping:

1. 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.
2. 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.
3. 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.
4. The pump casing can be rotated in increments of 90° to place the discharge connection in any of the four positions: horizontal right or left or vertical up or down.
5. Do not rotate the seal housing. The seal ports must always be oriented as shown in Figure 1.
6. Gasket surfaces should be parallel and flange bolts should slip into the aligned flange holes without straining the pipe to fit the pump.
7. Piping layouts should be designed to provide sufficient support and flexibility to minimize forces and moments induced by the piping onto the pump.
8. 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.

Note: *Never use force to position piping into place at the flanged suction and discharge connection locations. Failure to have piping properly aligned may impose excessive strains on the unit.*

9. 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.

Note: *Sundyne recommends installation of a differential pressure instrument across strainer to indicate strainer condition.*

10. Always provide a suction pressure gauge on all installations to monitor suction conditions. Install the gauge as close as possible to the suction flange.
11. Always provide a discharge pressure gauge on all installations to monitor discharge conditions. Install the gauge as close as possible to the discharge flange.
12. 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.

Note: *Sundyne recommends installation of a discharge check valve to prevent reverse rotation due to back-flow.*

Seal Environmental Control System

A seal environmental control system may be required depending upon the pump seal arrangement and application.

Always maintain the pump seal environment as detailed on the specification sheet that accompanies each unit.

***Note**: For most applications, a standard control system can be obtained from the factory.*

***Note:** Ensure that the specified seal environmental control system is properly installed and that the seal drain ports are open.*

***Note:** Seal leakage out of the seal drain chamber should be checked periodically. Seals should be replaced if leakage increases to an unacceptable level. With double seals, buffer pressure and usage should be monitored to insure that seals are functioning properly.*

***Note:** The seal ports must always be oriented as shown regardless of discharge configuration, see Figure 1b.*

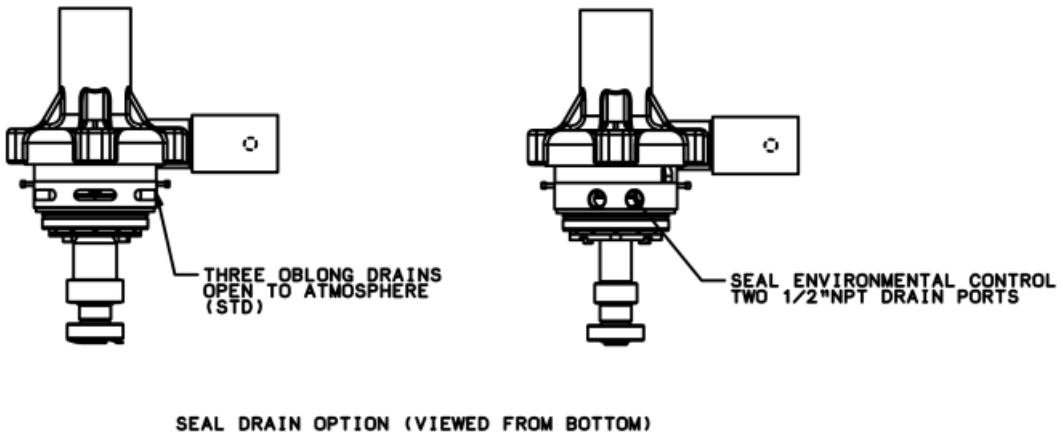

Figure 1a. Seal Drain Option

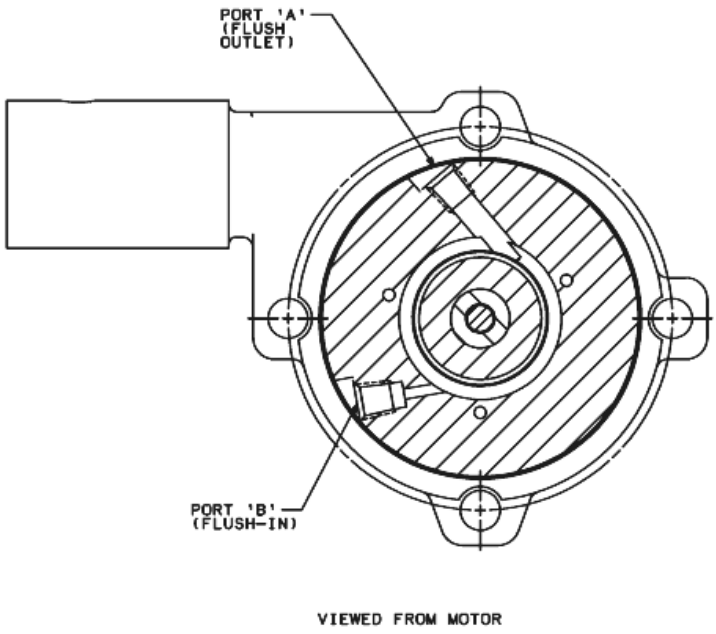

Figure 1b. Seal Housing Ports Orientation

Seal Arrangements

There are two seal arrangements available for the P2500 pump: single seal and double seal.

Single Seal Flush System

When the process fluid is contaminated with solid particles or if the pump fluid temperature dictates the need to flush, a seal flush system with and without throat bushing is available for use with the single seal arrangement. A clean, cool fluid from an external source is introduced into the seal flush port at a pressure of at least 15 psi/103.4 kPa above seal cavity pressure and at a controlled flow of 0.5 to 2.0 gpm / 0.11 to 0.45 m^3/hr. This allows only clean fluid at the seal face minimizing seal deterioration.

Note: *Seal flush port must be plugged if not in use.*

Double Seal Liquid Buffer System

A liquid buffer system is used with double liquid seals to prevent process liquid leakage out of the pump. The buffer must be cool, clean and compatible with the process fluid and pump metallurgy. The buffer is introduced into the "buffer in" port at a pressure of at least 15 psi /103.4 kPa above seal cavity pressure. A buffer flow of 0.5 to 3.0 gpm / 0.11 to 0.68 m^3/hr must be maintained through the buffer cavity. The flow should be regulated by a valve or orifice on the "buffer out" port.

Note: *The buffer system must be in operation prior to flooding the pump casing.*

Gearbox and Process Seal Drain

As a standard, the seal drain chamber has three oblong openings. If seal environmental control system is used, optional configuration with NPT drain ports is required, see Figure 1a.

Seal Cavity Pressure Rise

Whenever a single seal with an external flush, or double seal arrangement is used, the seal cavity pressure rise must be known to determine the seal flush pressure 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/103.4 kPa equals the required double seal buffer pressure or the single seal flush pressure. Please contact the pump manufacturer to obtain information about adequate seal flush/buffer supply pressure and flowrates.

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Mounting

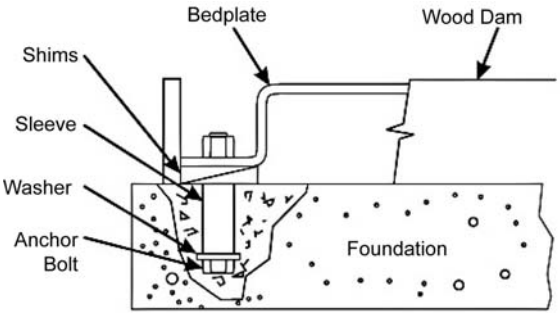
During pump installation, ensure that adequate surrounding space is available for inspection, operation, and maintenance requirements.

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. See Figure 2.
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 spots form. 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 equipment.
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 bedplate.
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.

Note: *Piping must not be connected to the pump until after pump hold-down bolts have been tightened.*

Figure 2. Bedplate Installation



Frame Mount Drive Unit Installation

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.

If the coupling alignment has been disturbed by improper leveling of the baseplate, 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.

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

Note: *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.*

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.

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

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.

Note: *Shielded, grease-lubricated ball bearings in the power frame of all frame-mounted units should be replaced every three years.*

Final Alignment

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. Reconnect coupling and repeat the alignment procedure to verify the alignment.

Note*: Motor shaft height should be equal to pump input shaft height at operating temperature.*

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.

Note: *The final alignment should be re-checked after a week of operation.*

Pre-Commission Checklist

Familiarizing Yourself with the Pump

Before servicing and starting up the Sunflo pump, carefully review all information on the product, including:

- ❑ Specification sheets
- ❑ Outline drawings
- ❑ Performance curves
- ❑ Instruction and related manuals
- ❑ System P&ID/Process Flow Diagram (Client)
- ❑ Control system and operational philosophy/narrative (Client)
- ❑ Familiarize yourself with the pump configuration before starting and operating the pump.

Driver

- ❑ Ensure all installation and starting instructions provided by the driver manufacturer have been followed. (This information is included in the final data package.)
- ❑ If the driver is coupled, un-couple; then verify that the direction of the driver rotates in the same direction as the arrow stamped or cast on the gearbox.

Verifying Auxiliaries

Before start up, verify that the following auxiliaries are met:

- ❑ Check the utility connections
- ❑ Verify that the auxiliary piping conforms to Sundyne standards, as indicated in the detailed specifications
- ❑ Verify all switch and instrument connections
- ❑ Verify that all switch and instrument settings are set to normal operating standards
- ❑ Calibrate all measurement equipment, such as flow meters, ampere meters, and pressure meters, etc.

Seal Environmental Control System

If a seal environment control system is used:

- ❑ Verify proper installation of seal environment control system.

Piping Connections

Verify that the following bolted or threaded connections are tight:

- ❑ Pump flange bolts
- ❑ Seal environment piping and port connections
- ❑ Gearbox oil drain plug

Gearbox

Any oil used in Sunflo gearboxes must meet the lube oil specifications in table 6.

In general, a high-quality turbine oils and synthetic oils with viscosity ISO VG 32 will meet the specifications in table 6. The properties of the oil should be verified with the oil manufacturer prior to use.

The following lubricants (or equivalent lubricants) are recommended for use in Sunflo gearboxes:

- Synthetic oil Mobil SHC 624 (ISO VG 32) for all applications above 50 hp and 10,000 rpm for extended bearing life;
- Mineral oil Mobil DTE Oil Light (ISO VG 32) for low-speed, low-power applications.

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

Remove the fill/vent plug (P25-8) and fill the gearbox until fluid reaches the designated level on the sight glass. Replace gearbox fill plug.

Oil Capacity:
2 quarts / 1.9 liters for aluminum gearbox
2.2 quarts / 2.1 liters for steel gearbox

Note: *Overfilling the gearbox will cause seal leakage, excess foaming and excessive use of horsepower.*

Make up oil can be added through the fill/vent port during operation if required.

Note: *The oil in the gearbox should be changed every six months or 4000 hours.*

START UP

Start Up Checklist

Perform the following steps to start the Sunflo pump:

- ❑ Review pump specification sheet noting design parameters and possible seal system requirements.
- ❑ Check to ensure that the driver has been serviced per instructions provided by the driver manufacturer.
- ❑ Check to ensure temporary suction screen has been installed on inlet side for initial start-up (35-40 mesh recommended).
- ❑ If buffer fluid or external seal flush is required, this system should be pressurized prior to admitting process fluid into the pump casing. If the buffer fluid is not pressurized, process fluid will contaminate the buffer fluid. If the seal flush is not pressurized, contaminants may cause seal face damage.
- ❑ Check oil level in gearbox.
- ❑ Open suction and discharge block valves fully. If there is a check valve in the discharge piping, ensure that the space between the pump and check valve is vented.

***Note**: Never start the pump against a closed discharge valve.*

- ❑ Purge or vent all high points in the suction and discharge lines.
- ❑ 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.
- ❑ Insure that the motor shaft rotation is in the same direction as the arrow on the gearbox marked “MOTOR ROTATION”. To determine shaft rotation, observe the motor shaft or fan while “jogging” the motor in short, one-second intervals. Rotation of the high-speed shaft must be in the same direction as the arrow on the gearbox housing marked “PUMP ROTATION”.

***Note:** Three-phase motor rotation may be reversed by interchanging any two motor leads. Motor and pump rotate in opposite directions due to the single step gear arrangement.*

***Note:** Reverse rotation may cause damage to the pump.*

- ❑ 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.

***Note:** 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.*

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

***Note:** Do not overload the pump or motor (an ammeter is recommended to determine motor load).*

- ❑ 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.

- 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.
- 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.
- 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.

OPERATION & CONTROL

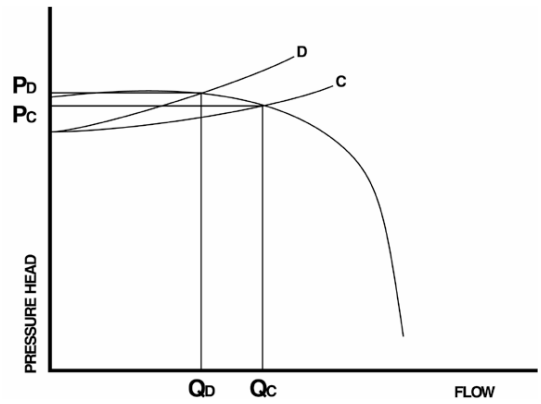
Operation of Sunflo Pumps

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

1. A flow 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.
3. The pump is not operated beyond the recommended maximum flow.

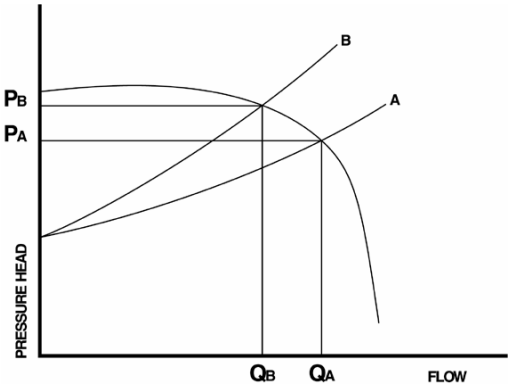
B. The flow at which a centrifugal pump operates depends upon the point of intersection of the system head and pump characteristic curves. In order for control to be steady, the system curve must intersect the pump characteristic curve at a significant angle. Examples of satisfactory and unsatisfactory angles of intersection are shown in Figures 3 and 4.

Figure 3



In Figure 3, 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.

Figure 4



In Figure 4, the angle of intersection between the system curve and the pump performance curve is much larger than that shown in Figure 3. The pump performance curve shown in Figures 3 and 4 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 3, 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 3.

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 is operated on pressure control, contact Sunflo or your local sales representative. It is possible to modify the pump to steepen the pump performance curve with a discharge orifice 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 in Figure 5.

Figure 5

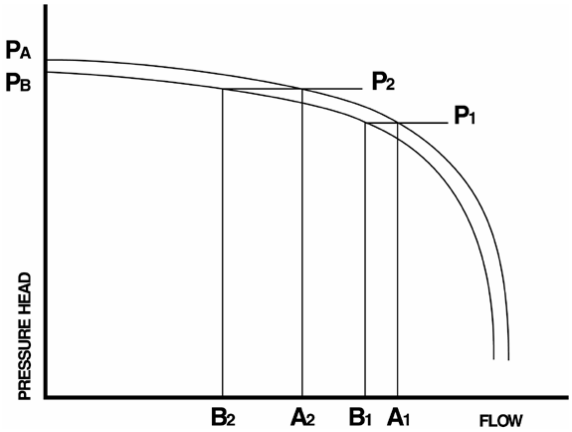
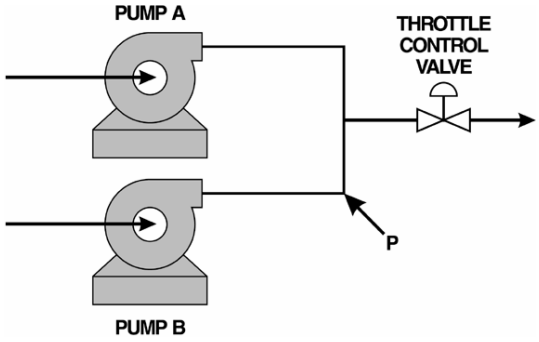


Figure 5 shows the characteristic curves of two duplicated pumps designated as pump A and pump B. Since no two pumps will have exactly the same performance, the curves in Figure 5 show that pump A produces slightly more head than pump B. The pumps arranged with a manifold having a common control valve are as shown in Figure 6.

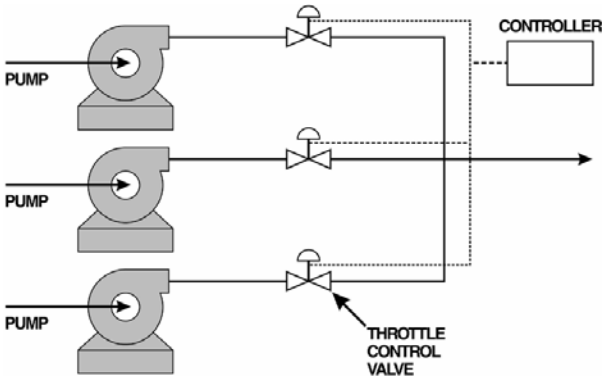
With the manifold pressure set at P1, the flow through pump A is indicated as A1 and the flow through pump B is indicated as B1. If the throttle valve is closed to set the manifold pressure at P2, the flow through pumps A and B are A2 and B2 respectively. If the control valve were closed even further,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

Figure 6



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 7. Sunflo also recommends that individual minimum flow lines be installed for each pump operated in parallel.

Figure 7



Series Operation

I. Series pump operation is not suggested due to possible high suction pressure on the second pump.

Control of Sunflo Pumps

The centrifugal pump is the easiest pump type to control in most applications. This ease of control results from the fact that the centrifugal pump is a “flow thru” device and simple throttling is possible. In most cases, a throttling control valve at the pump discharge is all that is required. In many cases, care in the location of the control valve is required in addition to the discharge throttle valve. Flow extremes involving pumps to be operated in parallel require special considerations. These particular application situations require care because:

A. All centrifugal pumps, when operated at relatively low flows, experience vibration from internal flow separations and recirculation inside the pump. This is further complicated when the liquid in the pipes or vessels on the inlet or discharge of the pump has a tendency to oscillate or resonate at a certain flow rate and pressure.

B. Centrifugal pumps operated at relatively low flows may incur a temperature rise in the pumped fluid sufficient to cause flashing of the fluid across the seal and boiling of the fluid within the pump. These conditions are more likely to occur if the fluid being pumped is already near the boiling point.

C. Single stage centrifugal pumps tend to have a flat head curve. When centrifugal pumps having such a head characteristic (such as Sunflo) are run in parallel (with their outlets simply manifolded together), at low flow it is possible for one pump to overpower another to the point where one pump becomes effectively “deadheaded”. This can damage the pump as described in paragraph B. above.

Guide to Basic Control Methods for Sunflo Pumps

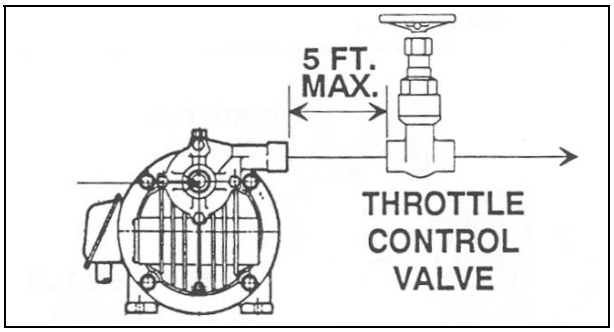
This portion of the manual covers the most common control systems for Sunflo pumps. Consult the factory for advice on unusual systems not covered.

Note: *It is recommended, as a safety margin, that NPSH available be at least two feet (.6 meters) greater than NPSH required.*

System 1. Single Pump with Throttle Valve

Normally a single pump will require only a throttling control valve on the discharge as shown in Figure 8.

Figure 8. System 1



If the flow rate of the pump is to be varied during the course of its operation, then care must be taken to avoid exceeding minimum flow limitations. Excessively high flows can overload the driver and cause cavitation damage. Excessively low flows can cause high vibration, high bearing loads, possible vaporization of the process fluid and seal damage.

As a general rule, the Sunflo P-2500 should normally be limited to operation in the flow range from 25% to 120% of the flow at the best efficiency point. Actual minimum flow depends on both the system and the pump characteristics and must be verified by operation after the pump has been installed. If shutoff operation is a possibility, then a bypass as discussed below is recommended. For more specific recommendations, contact your local Sunflo distributor or the factory.

Note: *Because of the flat performance curve, do not use a pressure relief valve to control the pump flow and pressure.*

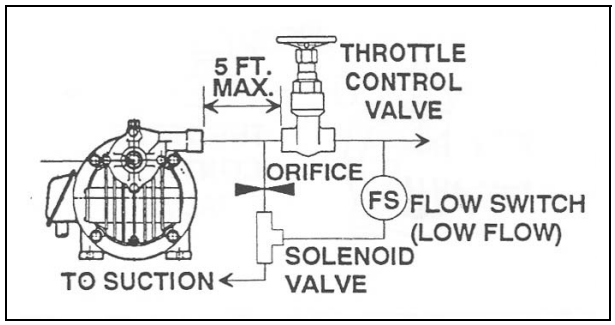
System 2. Single Pump with Throttle Valve and Controlled Bypass

This system should be used if a lower minimum flow than can be reached with System 1 is required, or where the pump must start against a high back pressure. The bypass will maintain minimum flow until the pump can establish flow through the system. Refer to Figure 9.

(1) The throttle control valve must be adjusted to keep the total pump flow above the minimum value as per System 1, thereby realizing less system flow.

(2) A heat exchanger may be required for return to supply tank or suction depending on the pipeline distance, size of the tank, allowable rise, temperature, etc.

Figure 9. System 2



Note: *Optional configuration for system 2 is continuous flow bypass. Size the pump for total flow of process and bypass.*

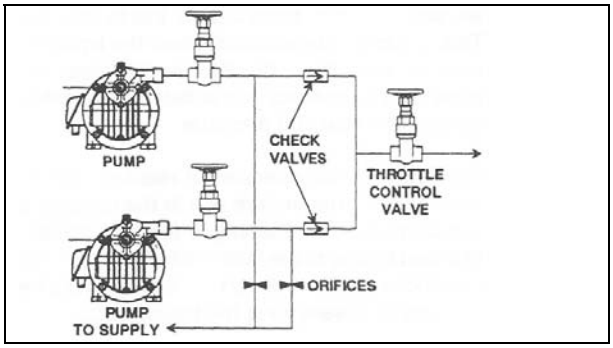
System 3. Two or More Pumps in Parallel. Equipped with Individual Control Valves

This arrangement is a multiple pump version of the Control System 1. A separate throttle valve is installed at each pump discharge to allow each pump to be throttled to approximately the same flow rate. This must be done to prevent one pump from taking the entire load and "deadheading" the other. Refer to Figure 10.

Pump loads can be balanced by monitoring current drag to each motor or by individual pump flow measurements.

Because of the relatively small change in pressure at different flow rates, balancing by pressure readings is not recommended.

Figure 10. System 3

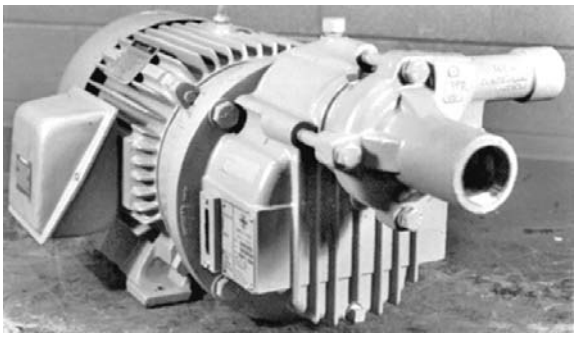


MAINTENANCE

Disassembly of the Sunflo P-2500

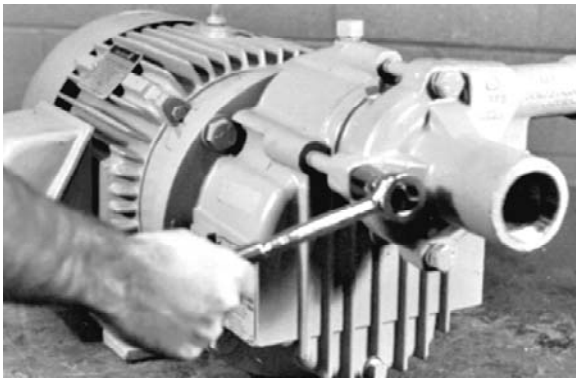
STEP 1

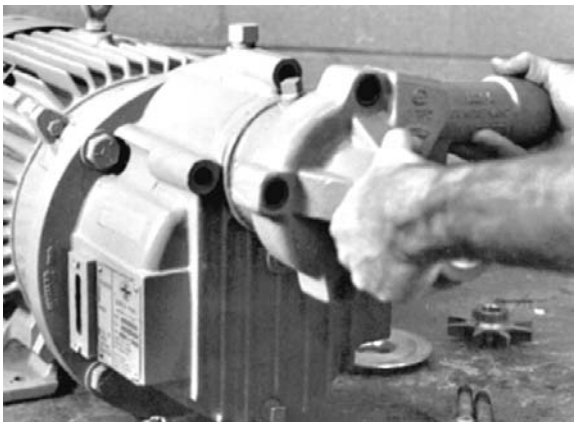
Disconnect all electrical power and insure pump casing and piping have been depressurized. Remove suction and discharge piping.



STEP 2

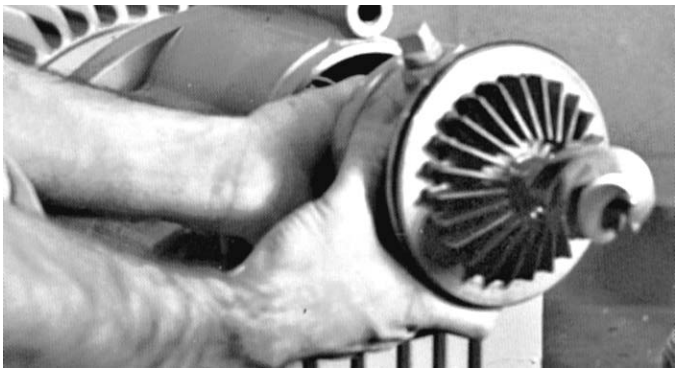
Remove pump casing (P25-32) by unscrewing the four attaching bolts (P25-42).





STEP 3

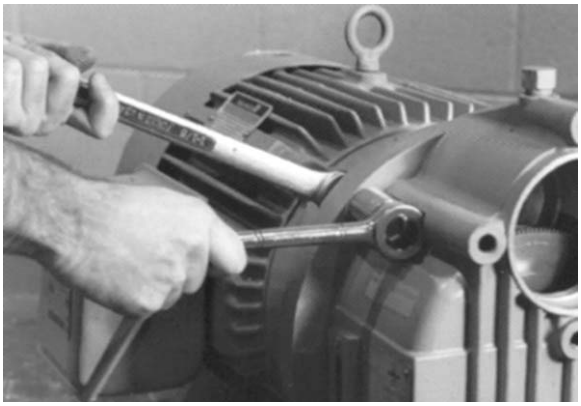
Pull out the high-speed shaft assembly (P25-9).



Note: *Support the shaft firmly while removing. Be careful not to bump the outboard bearing against the drive gear.*

STEP 4

Drain gearbox oil by removing drain plug (P25-13).



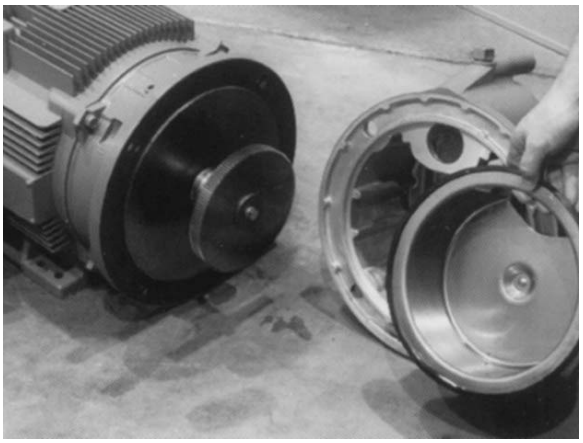
Note: *Gearbox oil will not drain completely. A small amount of oil will remain inside the gearbox oil shroud (P25-16).*

Remove the gearbox by unscrewing the housing bolts (P25-17) if adapter flange (P25-71) is used.

Note: *Adapter flange (P25-17) is used if driver size is 40 hp or above. Adapter flange removal is required for driver replacement only.*

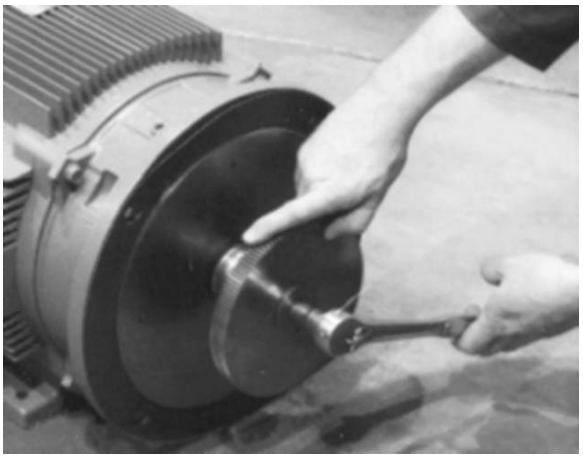
STEP 5

Lift out gearbox shroud. (P25-16).



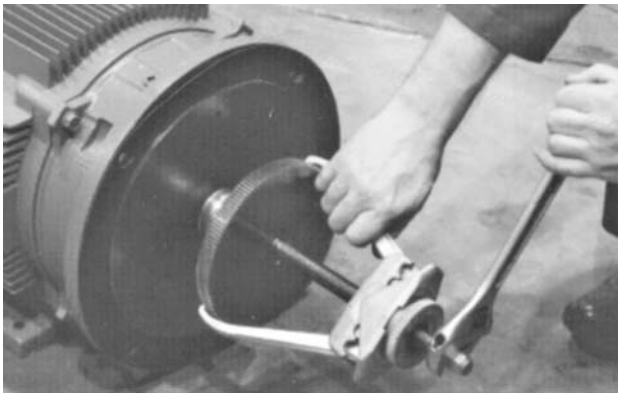
STEP 6

Remove driver gearbox bolt (P25-62) and washer (P25-63).



STEP 7

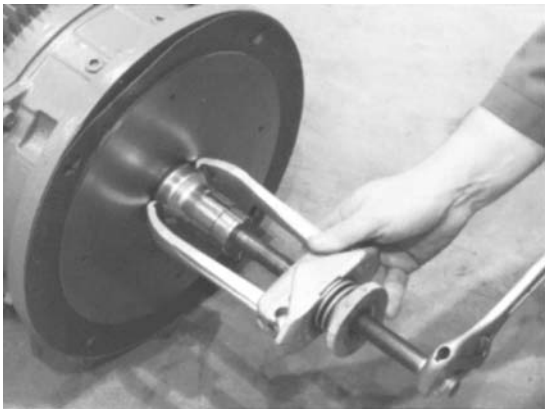
Using a gear puller, remove drive gear (P25-3).



Note: *Do not allow puller to bear directly on the gear teeth. Teeth are case hardened and may be damaged.*

STEP 8

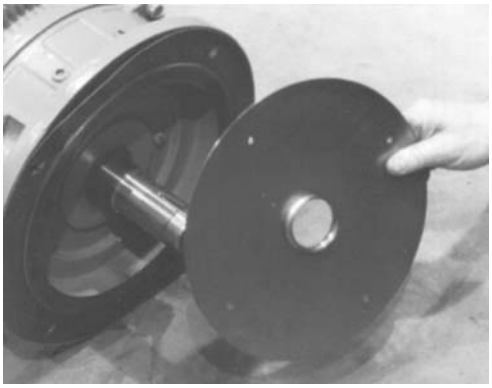
Remove the drive key (P25-5). Use a puller to remove the baffle sleeve (P25-45).



Note: *In most cases, the baffle sleeve must be replaced on reassembly.*

STEP 9

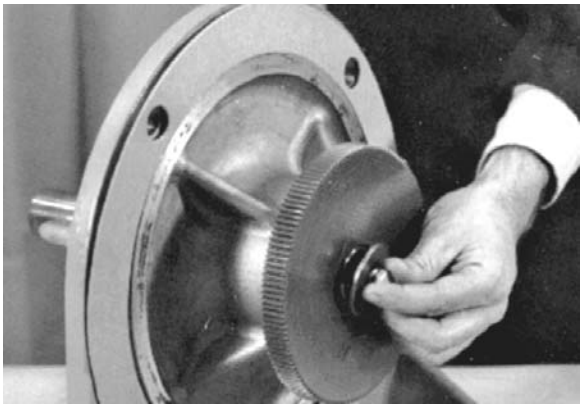
Remove gearbox baffle (P25-44).



Step 10 to 14 – For Frame Mounts Only

STEP 10

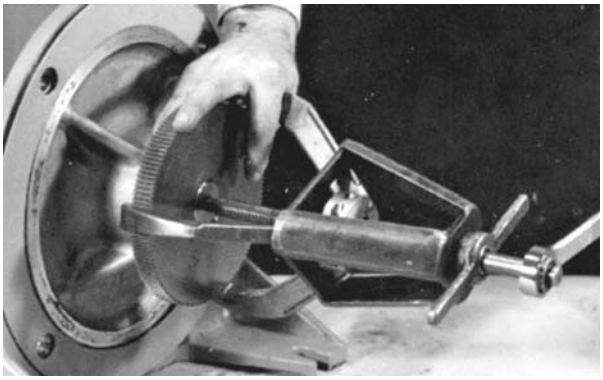
Remove the drive gear bolt (P25-62) and washers (P25-63) and (P25-64).



For Gearbox Cooling Option Only: **Remove the shoulder bolt (p25-531) and slinger (p25-530), then, lift out gearbox shroud with center hole (P25-16).**

STEP 11

Using a gear puller, remove the drive gear (P25-3).

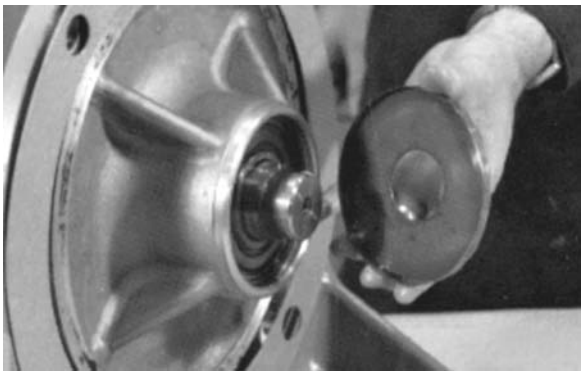


Note: *Do not allow puller to bear directly on gear teeth.*

Note: *To install the drive gear, heat to 250°F (121°C), not over 300°F (149°C) in an enclosed oven for approximately 1 hour.*

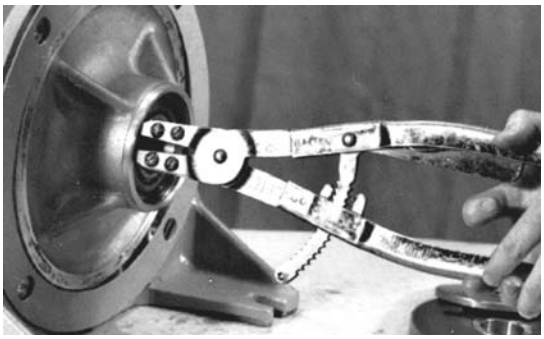
STEP 12

Remove the drive gear key (P25-127) and slinger (P25-116).



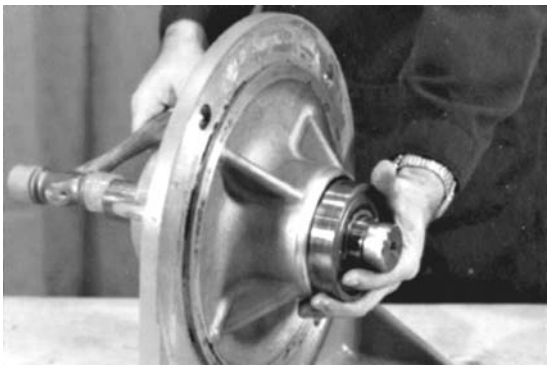
STEP 13

Using snap ring pliers, remove the shaft retaining ring (P25-114).



STEP 14

Using a soft mallet, gently tap on the driver end of the shaft and remove the shaft and bearing assembly from the frame mount (P25-100).



Note: *Do not use heat to remove or install the input shaft bearings (P25-95). These bearings are grease packed for life and contain two non-removable seals. Do not immerse bearings in solvent.*

Assembly of the Sunflo P-2500

To reassemble the pump, simply perform the steps described 1 through 14 in reverse order. Refer to Table 5 for bolt torque values.

Note: *All o-rings must be replaced during the reassembly of the pump.*

Disassembly of the High-Speed Shaft

STEP 1

Bend back two tabs of the locking washer (p25-515) that secure the inducer from loosening due to accidental reverse rotation of the high-speed shaft.

Note: *Inducer, stud and shaft are left-hand threaded. DO NOT FORCE them in the wrong direction.*

To loosen inducer (p25-57), hold the impeller (p25-33) with a wrench on one of the impeller vanes.

Once the inducer is loose, remove it along with impeller stud (p25-102), locking tab washer and impeller. Discard the inducer o-ring (p25-58) and impeller o-ring (p25-18).

STEP 2

Loosen (but do not remove) the two locking socket head cap screws (p25-501) located on bearing housing (p25-500).

Once they are loose, remove seal housing (p25-19) with stationary seal (p25-77) and rotating face.

Remove seal rotating face (p25-25).

Loosen and remove three hex head cap screws (p25-512) that secure the mechanical process seal to the seal housing. Discard o-ring (p25-514) between the seal and the seal housing.

Note: *Be careful not to damage stationary and rotating faces of the mechanical seal during disassembly.*

Double seal configuration: **once the atmospheric side mechanical seal (p25-77) is removed, take out seal rotating face (p25-25) and spacer (p25-520). Remove retaining ring (p25-89) and inboard process seal (p25-90) by pulling it out of the seal housing.**
Discard o-ring (p25-28) between the inboard process seal and the seal housing and spacer o-ring (p25-521).

Note: *An alternate method - If it is too tight to pull it out by hand, to avoid seal damage, first, remove carbon part and, then, tap out seal retainer using drift punch and light hammer.*

STEP 3

Remove and discard seal rotating face o-ring (p25-117). Remove sleeve with slinger (p25-22). Remove and discard sleeve o-ring (p25-510).

Remove gearbox seal rotor (p25-509) by turning over the remaining part of the shaft assembly.

Be prepared to capture the seal rotor as it falls free of the shaft.

STEP 4

Position bearing housing (p25-500) on top of assembly tool by inserting shaft into tool bore as shown. Loosen and remove four socket head cap screws (p25-504). Lift the remaining assembly and lightly tap out shaft with both bearings and bearing retaining ring (p25-505) from the bearing housing.

***High-power, high-speed configuration*:**
Using two ¼-20 socket head cap screws as jack screws, separate the shaft with bearings from the bearing housing with gearbox labyrinth seal stator (p25-508) and grooved spacer (p25-506).

***Note**: The outer ring and cage with rollers of outboard bearing are separable from the inner ring*

Remove bowed snap ring (p25-502). Discard bowed snap ring if worn. Remove collar and outer ring of outboard bearing (p25-23) as shown.

To remove bearing clamp (p25-505) from inboard bearing (p25-37), lightly tap out high-speed shaft (p25-38) while holding the bearing clamp flange.

***Note:** Inspect bearings. If bearings require replacement, they can be dismounted by using a puller or other suitable withdrawal tools*

***Note**: Inspect gearbox labyrinth seal stator. Replace stator if worn or damaged. Discard o-ring (p25-507) between the seal stator and the bearing housing.*

Prepare Parts for Assembly

CLEAN, DRY AND INSPECT PARTS

WARNING: Solvent cleaners can be flammable, poisonous and cause burns. To avoid serious injury when using solvent cleaners, you must carefully follow the manufacturer's product instruction and these procedures:

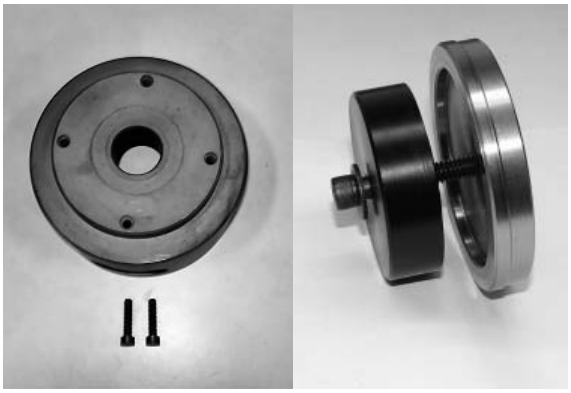
- **Wear safe eye protection.**
- **Wear clothing that protects your skin.**

Carefully inspect all parts for wear or damage before you assemble them. Replace worn or damaged parts.

There are two repair kits available (see Spare Parts section) consisting of O-Ring Replacement Kit and Seal Repair Kit.

High-Speed Shaft Reassembly

Assembly Tools Required



STEP 1

Note: *Prepare all the equipment, parts and the necessary tools before mounting. Ensure that they are clean. Bearings are supplied in protective packages and should not be taken out earlier than immediately before mounting so that they do not become contaminated with dirt.*

Note: *Inboard bearing clamping ring (p25-505) should be placed onto shaft before bearing installation.*

Press inboard and outboard deep groove ball bearings on shaft until inner races contact corresponding shaft shoulders: use suitable sleeve to apply force to outboard bearing inner race.

Note: *Never apply force to the outer ring when mounting bearing on shaft*

High-power configuration

Note: *Inboard bearing retainer (p25-505) should be placed onto shaft before bearing installation.*

Place spherical roller bearing (SRB) in assembly fixture as shown and press shaft with integral pinion gear (p25-38) down until bearing (p25-37) inner ring sits against shaft shoulder.

STEP 2

Lubricate o-ring (p25-507) with silicone lubricant and install onto the labyrinth gearbox seal stator (p25-508).

Place seal stator into the bearing housing (p25-500), aligning drains of both components.

For optional bearing housing with NPT drain ports: align drains in both parts as shown.

Install seal mounting tool and insert tool clamping nut into the bore of the bearing housing.

Note: *The labyrinth seal stator is designed to have slight interference fit with the bearing housing bore. Carefully push stator in position in the bearing housing by tightening socket head cap screw of the mounting tool.*

STEP 3

Place bearing housing on top of assembly tool as shown and install grooved spacer (p25-506).

Note: *Make sure that the side with grooves is facing up.*

High-power configuration:

Position shaft in bearing housing as shown.

Position SRB retainer and push or lightly tap it over the bearing into bearing housing.

Note: *An alternate method - use two socket head cap screws supplied with the assembly tool to push the SRB retainer into housing.*

Apply low-strength Loctite Threadlocker 222 to four socket head cap screws (p25-504), install and tighten. The correct torque value is specified in Table 5.

STEP 4

Note: *Be sure to wear proper heat-insulated gloves for hand protection.*

<u>High-power configuration:</u> **Place inner ring of outboard cylindrical roller bearing (CRB) in heater for one hour. Normally a bearing temperature of 80 to 90 °C (144 to 162 °F) above that of the shaft is sufficient for mounting. Never heat a bearing to a temperature greater than 125 °C (257 °F).**

Note: *Assemble bearing ring onto shaft with the rib side facing down and position ring against shaft shoulder.*

Then, allow to cool to room temperature.

Continue assembly of bearing by sliding outer ring with rollers onto inner ring and then place bearing collar onto shaft. (NUP type bearing has a collar ring located on ribless side of the inner ring).

Note: *Position outer bearing ring with markings facing up. Install bearing collar ring with markings the same way so that both are facing up.*

Install bowed snap ring (p25-502) in shaft groove (applies to both low and high-power shaft configurations). Retaining ring can be installed with snap ring pliers as shown.

Note: *Curved shape of bowed retaining ring acts as a spring, compensating for the slightly undersized pieces and holding the assembly firmly in place.*

STEP 5

Turn the assembly over and carefully remove the assembly tool. Maintain the squareness of the bearing housing with the pinion shaft.

Install labyrinth gearbox seal rotor onto shaft.

Note: *Apply only light hand pressure to push seal rotor down into the seal stator. Properly installed rotor sits against the inboard bearing face.*

Apply a bead of high-temperature grease (supplied in seal repair kit) along the inner rim of the seal stator as shown.

STEP 6

Lubricate a new sleeve o-ring (p25-510) with silicone lubricant and place it on top of seal rotor.

Install sleeve with slinger (p25-22). Lubricate a new seal rotating face o-ring (p25-117) with silicone lubricant and place it into the face groove of the sleeve.

STEP 7

Perform the reverse order of Disassembly STEP 2. Install and tighten three hex head cap screws (p25-512) according to the specified torque in Table 5. Align two notches on the pilot diameter of the seal housing with two locking socket head cap screws (p25-501) located on the bearing housing (p25-500).

Double seal configuration: **Lubricate a new inboard process seal o-ring (p25-28) and install in groove of the seal housing. Reinstall inboard mechanical seal (p25-90): carefully push it by hand against the step in the seal housing bore. Install retaining ring (p25-89).**

Tighten two locking screws to secure the seal housing.

Note: *Securing seal housing to the bearing housing with locking screws is necessary to prevent damage to the seal carbon face during handling of the high-speed shaft assembly.*

STEP 8

Install the impeller o-ring (p25-18) in the impeller groove. Use a small amount of silicone grease to retain the ring in place.

Hand tighten the inducer (p25-57) with impeller stud (p25-102) till threaded stud reaches the bottom end of a threaded hole in the inducer. Install the impeller over the pinion shaft. Apply a thin coat of *Never Seize* to both faces of the locking tab washer (p25-515) and install it onto inducer hub. Lubricate a new inducer o-ring (p25-58) with silicone lubricant and install it into the groove.

Apply a thin coat of *Never Seize* to the impeller stud open end (p25-102) and screw it counterclockwise into the pinion shaft hand tight. Hold the impeller with a wrench on one of the impeller vanes and tighten inducer to the correct torque value specified in Table 5.

Note: *Inducer, stud and pinion shaft are left-hand threaded. DO NOT FORCE them in the wrong direction*

STEP 9

Bend tabs of locking tab washer (p25-515) to prevent inducer loosening: two tabs outward 90° with pliers or a flat-blade screwdriver over the inducer grooves and two tabs into holes located in impeller face.

Lubricate a new pump case o-ring (p25-20) with silicone lubricant and install into groove on seal housing.

Lubricate a new gearbox o-ring (p25-148) with silicone lubricant and install into groove on bearing housing.

The high-speed shaft assembly is now ready to be placed back into gearbox housing.

Gearbox Bearing Liner Installation

Parts and Tools

Installation of bearing liner (p25-536) in gearbox bore requires use of the following tools:

Liner Installation Tool (TO01SJ04), Supporting Block

STEP 1

Install tolerance ring (p25-538) by lightly squeezing ring to fit into bore.

Note: *Ensure that tolerance ring is installed on top of step in gearbox bore (applies to P-2500 gearbox with integral spacer).*

Note: *Tolerance ring ends should be oriented toward gearbox top as shown.*

STEP 2

Installation of bearing liner using arbor press (recommended). Support gearbox rear bearing hanger with block to prevent hanger distortion.

Place bearing liner in gearbox bore on top of tolerance ring.

Align bearing liner with tolerance ring and apply light force to drive liner into position while compressing tolerance ring.

Properly installed bearing liner sits against shoulder in gearbox bore.

Verify liner installation by carefully tapping liner on the flange using wooden stick.

STEP 3

To inspect liner installation, measure depth from gearbox face to liner face in four positions 90º apart using depth micrometer.

The maximum dimensional deviation of all four measurements should not vary more than .002".

TROUBLESHOOTING

Gearbox and Pump Diagnostics

Several system factors may affect the performance of the pump. These factors are:

- Temperature
- Specific gravity
- Suction pressure
- Driver speed
- Flow rate and control characteristic

These factors as well as internal problems must be considered when analyzing pump system performance. The following table gives diagnostic information that can be useful when analyzing gearbox and pump performance problems.

Table 3. Gearbox and Pump Diagnostics

Situation/Symptom	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 air or gas in pumped liquid.
		NPSH reduced by a more volatile process liquid.
	Failure of drive component such as missing drive gear key, 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 opposite directions. Rotation can be checked by viewing driver fan or input shaft on frame-mounted units. Reverse any 2 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.

Table 3. Gearbox and Pump Diagnostics

Situation/Symptom	Possible Cause	Investigative / Corrective Action
Insufficient flow or head rise	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 must be as shown by arrow on gearbox housing. Note: Impeller and driver rotate in opposite directions. Rotation can be checked by viewing driver fan or input shaft on frame-mounted units. Reverse any 2 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 flow and increased power consumption. A specific gravity higher than what was specified will cause increased power consumption.
	Driver speed too low.	Check driver speed against specification sheet. Check phase current for maximum of 3% variance between phases. Consult authorized motor repair shop.
	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 3. Pump and Gearbox Diagnostics

Situation/Symptom	Possible Cause	Investigative / Corrective Action
Insufficient flow or pressure. (cont)	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 overloaded.	Fluid specific gravity or viscosity is higher than what the pump was initially designed for.	Decrease specific gravity and/or viscosity, or pump flow must be reduced to level that will compensate for the higher specific gravity and/or viscosity.
		Reduce pump flow to the level that will reduce driver power consumption to an acceptable level.
	Electrical failure in driver.	Check circuit breaker heater size and setting.
		Check motor voltage.
		Check motor current in each phase. The current should be balanced within 3 percent.
	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 all 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.	Minor pitting may be polished with emery cloth. Major pitting indicates a failed part and must be replaced. 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.
Excessive discharge pressure pulsation (may be associated with a “hammering” sound or may sound like “gravel” being pumped).	Flow rate too low	Increase flow rate through pump. Add bypass if required.

Table 3. Pump and Gearbox Diagnostics

Situation/Symptom	Possible Cause	Investigative / Corrective Action
Excessive discharge pressure pulsation (may be associated with a "hammering" sound or may sound like "gravel" being pumped). (cont)	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 replaced damaged hardware with Genuine Sundyne Parts.
Excessive gearbox oil consumption.	Damaged gearbox seal.	Check for fluid leakage from drain port. Disassemble and replace worn or damaged hardware.
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 2 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.
	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 & 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 Seal Diagnostics

The following table contains diagnostic information that is applicable to single seal and double seal equipped units.

Table 4. Pump Mechanical Seal Diagnostics

Situation/Symptom	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.
	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.
	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.
	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.

Table 4. Pump Mechanical Seal Diagnostics

Situation/Symptom	Possible Cause	Investigative/Corrective Action
Sudden increase in seal leakage (cont)	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.
	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, non aqueous, non volatile external seal flush.
		Install a double seal system.
	Chemical attack of seal faces, seal parts, or o-rings (P25-18 and P25-28).	Investigate process fluid properties and change seal and o-ring materials if needed.

SPECIFICATIONS

Torque Values

Table 5. Torque Values

Item No.	Part Description	Torque Value	
		ft – lbs	N-m
P25-512	Seal Hex Head Screw 1/4”-20	7-8	10-11
P25-504	Bearing Retainer Socket Head Screw 1/4”-20	7-8	10-11
P25-62	Drive Gear Hex Head Screw 3/8”-16	23-25	32-34
P25-57	Inducer 1/2”-20	36-40	49-54
P25-42	Pump Casing Hex Head Screw 5/8”-11	52-54	71-73
P25-17	Gearbox Flange Hex Head Screw 3/4”-10	102-107	138-145

***Note**: When using PTFE o-rings, allow 15 minutes between repeated torquing for the PTFE to cold flow. Repeat until there is no change in torque value.*

Gearbox Lube Oil Specifications

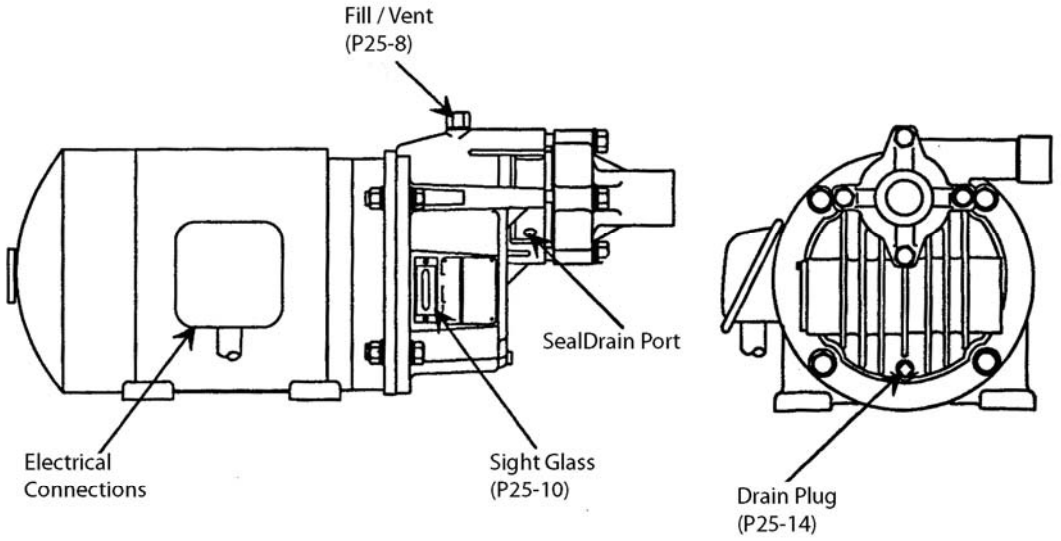
Table 6. Gearbox Lube Oil Specifications

Recommended Gearbox Lube Oil Specifications	
API Gravity	29.5 nominal
Viscosity, Saybolt Universal Seconds	
100°F (38°C)	200 maximum
210°F (100°C)	38 minimum
Viscosity Index, ASTM D2270	90 minimum
ISO Viscosity Grade	32
Flash Point, °F, ASTM D92	360 minimum
Pour Point, °F, ASTM D97	-20 maximum
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
Maximum, Sequence 2	50/0
Maximum, Sequence 3	25/0

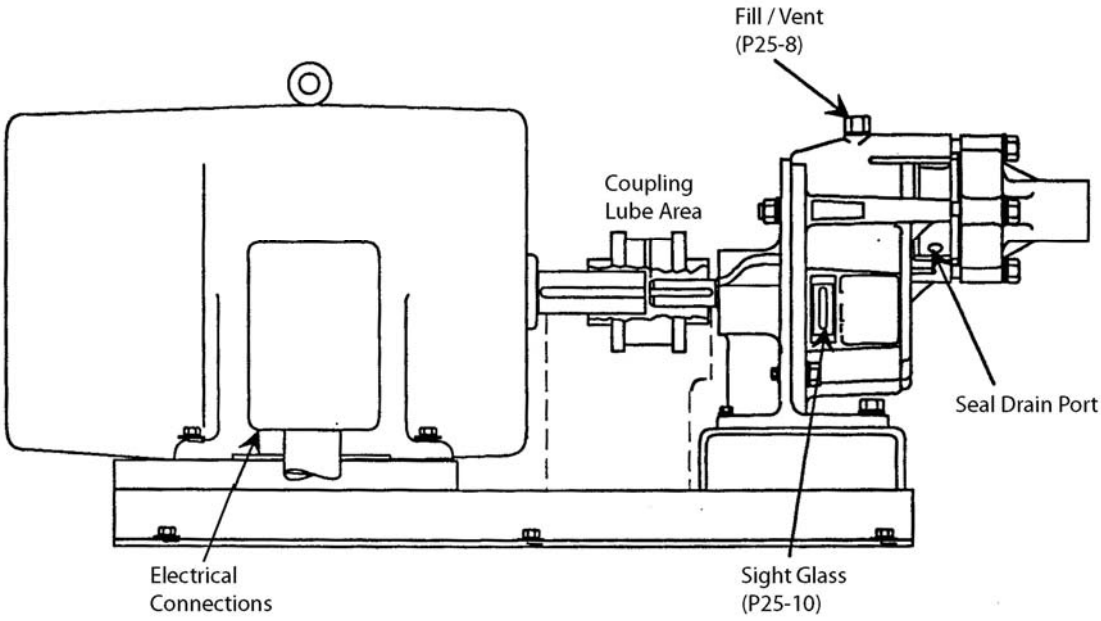
Note: *No additives are recommended.*

DRAWINGS

Figure 12. Servicing Checkpoints

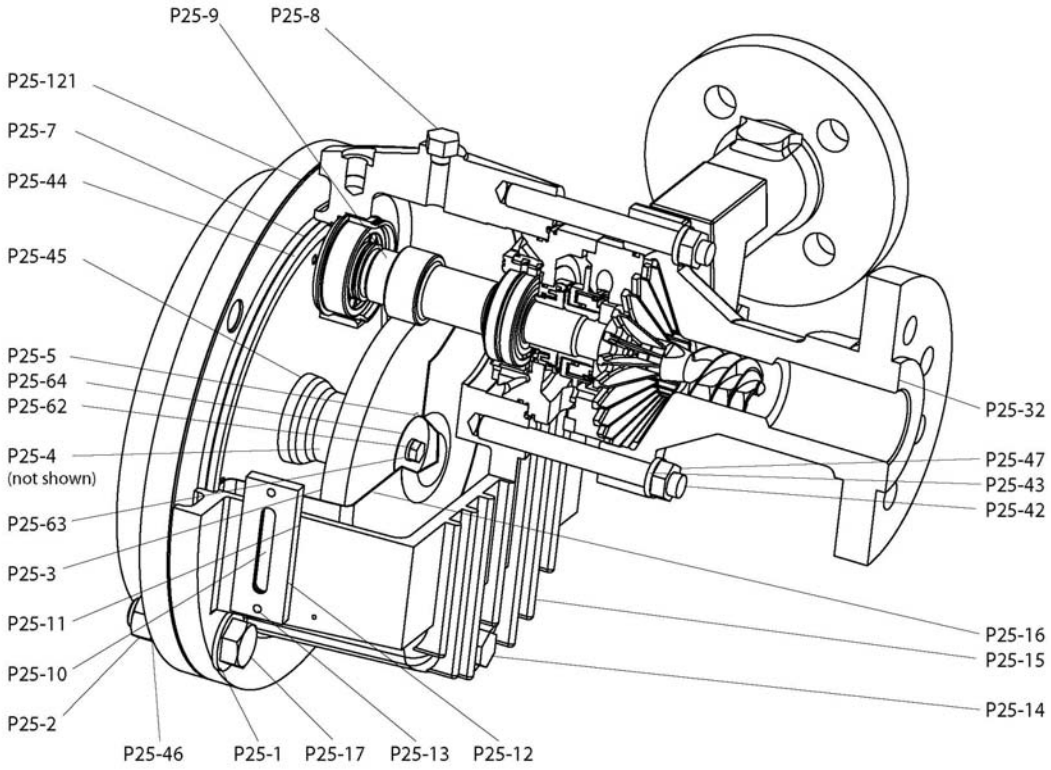


CLOSE COUPLED



FRAME MOUNTED

Figure 13. Pump and Gearbox



Note: *Recommendation - Entire high-speed shaft assembly P25-9 is available. To avoid costly downtime, keep a spare assembly in your stock.*

Table 7. Pump and Gearbox

Item	Part Name	Qty.	Item	Part Name	Qty.
P25-1	Flat Washer	4	P25-45	Baffle Sleeve	1
P25-2	Hex Nut	4	P25-46	Lock Washer	4
P25-3	Drive Gear	1	P25-50	Gearbox Housing Assembly	1
P25-4	Motor Shaft	1	P25-8	• Fill and Vent Fitting	1
P25-5	Drive Gear Key	1	P25-10	• Sight Glass	1
P25-7	Oil Shroud Gasket	1	P25-11	• Sight Glass Gasket	2
P25-9	High Speed Shaft Assembly	1*	P25-12	• Sight Glass Retainer	1
	(Refer to Figures 14and 16)		P25-13	• Self Tapping Screw	2
P25-16	Gearbox Oil Shroud	1	P25-14	• Square Head Pipe Plug	1
P25-17	Hex Head Cap Screw	4	P25-15	• Gearbox Housing	1
P25-32	Pump Casing	1	P25-62	Hex Head Screw	1
P25-42	Stud	4	P25-63	Lock Washer	1
P25-43	Lock Washer	4	P25-64	Flat Washer	1
P25-44	Gearbox Baffle	1	P25-121	Gearbox Gasket	1*
P25-47	Hex Nut	4			
*Recommended spare parts per unit					

Figure 14. High-Speed Shaft Assembly, Single Seal

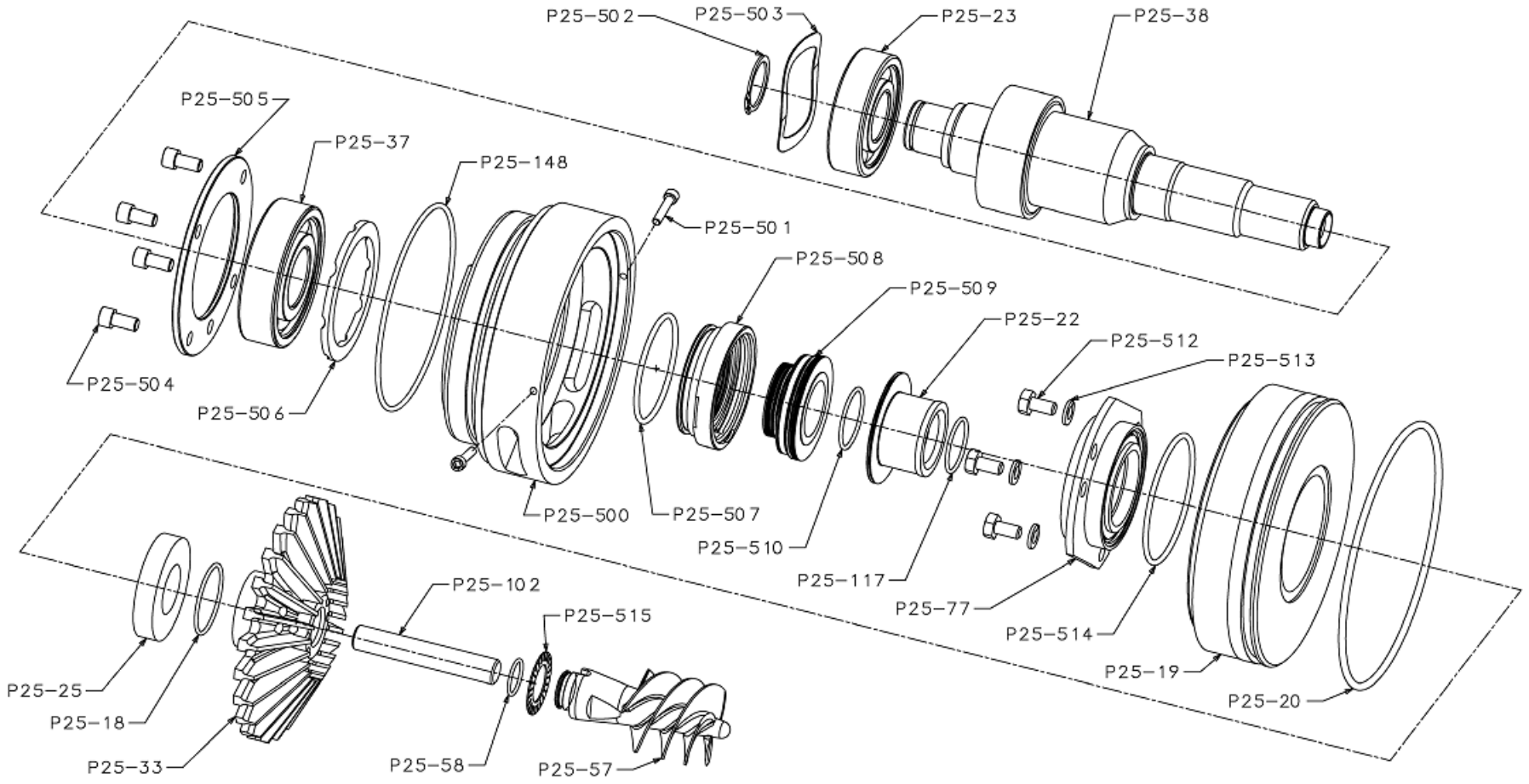


Figure 15. Single Seal Cross Section

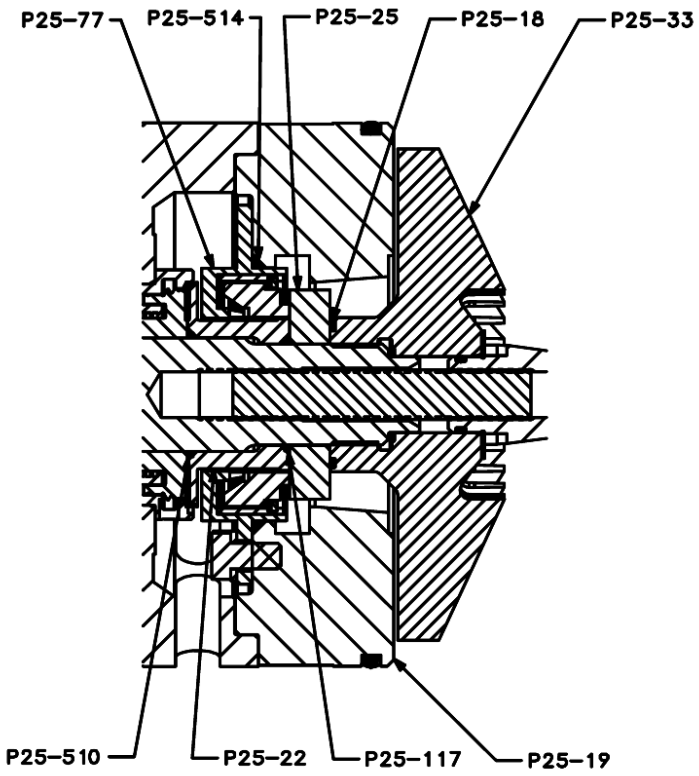


Table 8. High-Speed Shaft Assembly, Single Seal

ITEM	DESCRIPTION	QTY	ITEM	DESCRIPTION	QTY
P25-512	SCREW,HHC	3	P25-19	SEAL HOUSING	1
P25-504	SCREW,SHC	4	P25-500	BEARING HOUSING	1
P25-501	SCREW,SHC	2	P25-33	IMPELLER	1
P25-513	WASHER,LOCK	3	P25-57	INDUCER	1
P25-502	SNAP RING	1	P25-505	RETAINER RING	1
P25-117	ORING	1	P25-25	SEAL ROTATING FACE	1
P25-510	ORING	1	P25-508	GEARBOX LABY SEAL STATOR	1
P25-58	ORING	1	P25-77	PROCESS SEAL	1
P25-18	ORING	1	P25-38	HIGH SPEED SHAFT	1
P25-514	ORING	1	P25-509	GEARBOX LABY SEAL ROTOR	1
P25-20	ORING	1	P25-22	SLINGER SLEEVE	1
P25-148	ORING	1	P25-506	SPACER RING	1
P25-507	ORING	1	P25-102	INDUCER STUD	1
P25-37	BALL BEARING, INBOARD	1	P25-515	TAB WASHER	1
P25-23	BALL BEARING, OUTBOARD	1	P25-19	SEAL HOUSING	1
P25-503	SPRING, WAVY	1			

Figure 16. High-Speed Shaft Assembly, Double Seal, Environmental Control

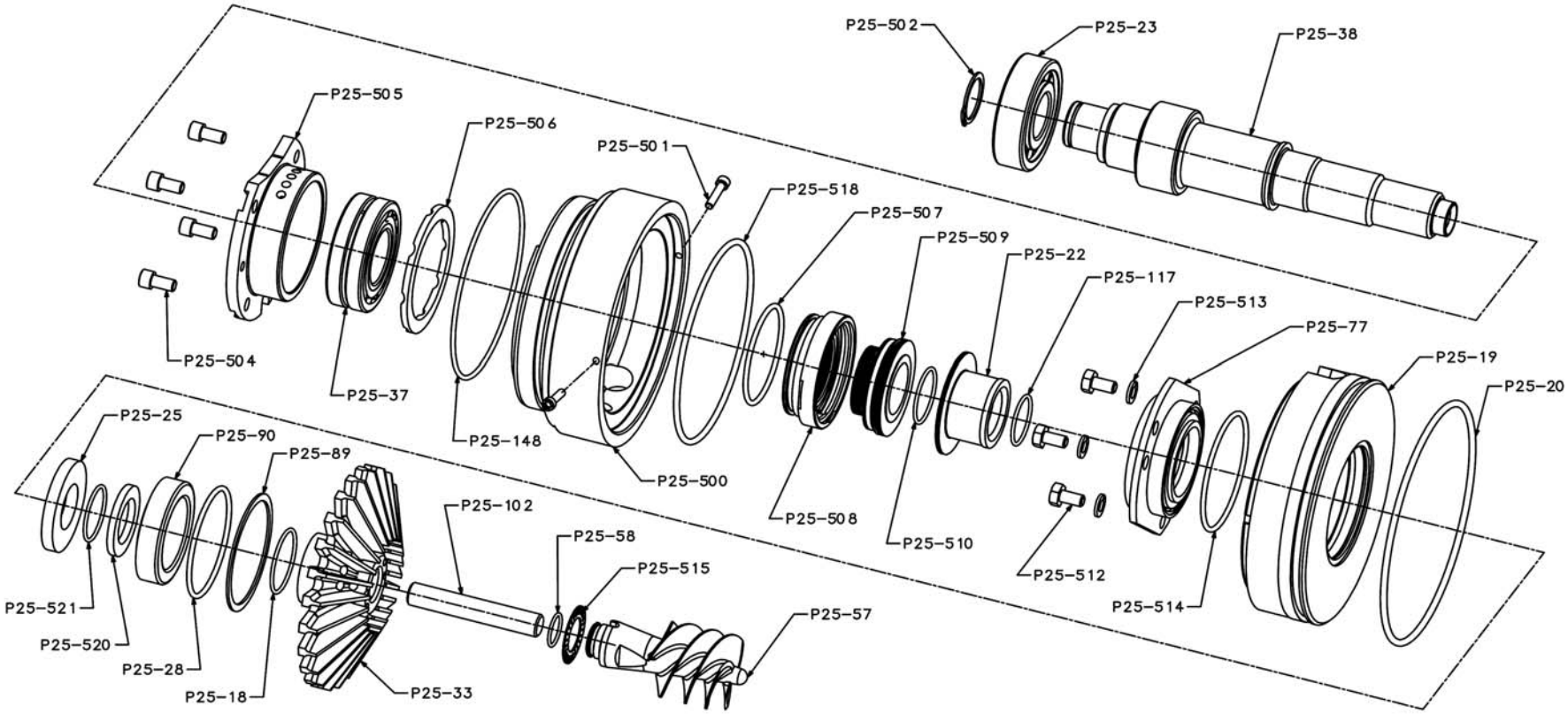


Figure 17. Double Seal Cross Section

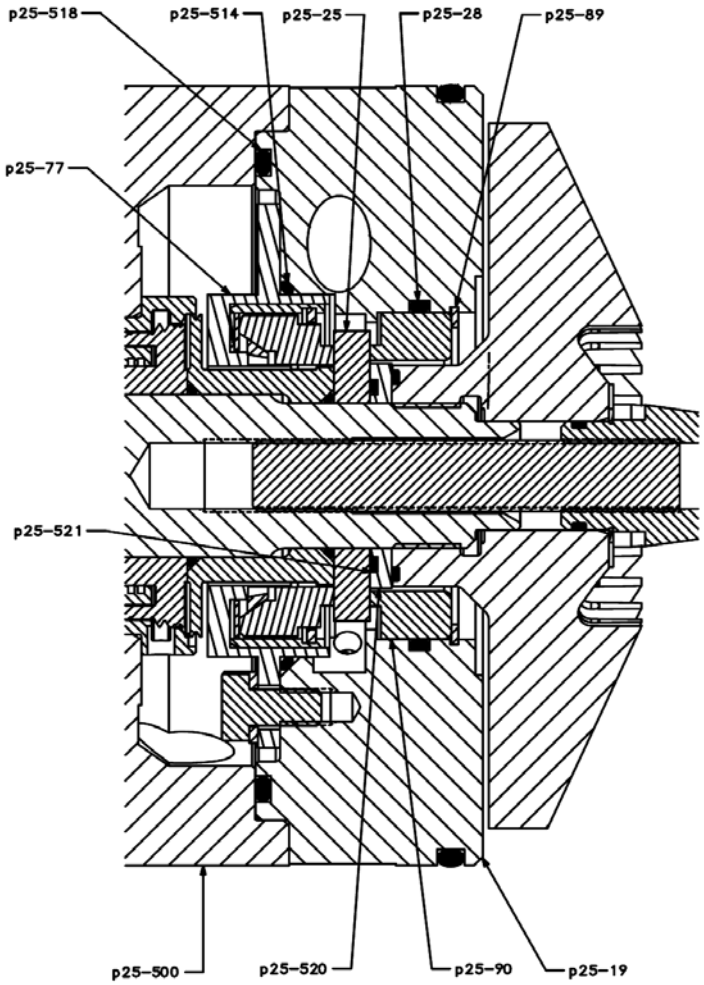
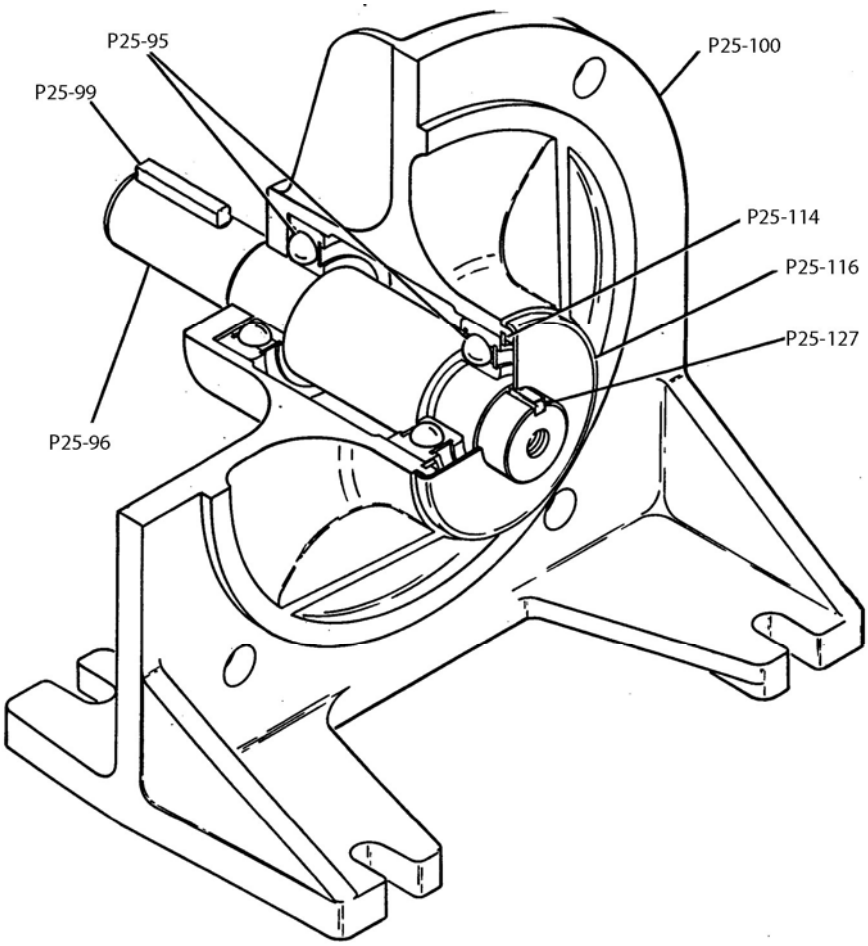


Table 9. High-Speed Shaft Assembly, Double Seal

ITEM	DESCRIPTION	QTY
P25-512	SCREW,HHC	3
P25-504	SCREW,SHC	4
P25-501	SCREW,SHC	2
P25-513	WASHER,LOCK	3
P25-502	SNAP RING	1
P25-89	RING, RETAINING	1
P25-117	ORING	1
P25-510	ORING	1
P25-521	ORING	1
P25-28	ORING	1
P25-58	ORING	1
P25-18	ORING	1
P25-514	ORING	1
P25-20	ORING	1
P25-518	ORING	1
P25-148	ORING	1
P25-507	ORING	1
P25-37	BEARING, INBOARD	1

ITEM	DESCRIPTION	QTY
P25-23	BEARING, OUTBOARD	1
P25-19	SEAL HOUSING	1
P25-500	BEARING HOUSING	1
P25-33	IMPELLER	1
P25-57	INDUCER	1
P25-505	RETAINER, BEARING	1
P25-25	SEAL ROTATING FACE	1
P25-508	GEARBOX LABY SEAL STATOR	1
P25-77	PROCESS SEAL	1
P25-90	PROCESS SEAL	1
P25-38	HIGH SPEED SHAFT	1
P25-509	GEARBOX LABY SEAL ROTOR	1
P25-22	SLEEVE, SLINGER	1
P25-506	SPACER RING	1
P25-520	SPACER RING, SHAFT	1
P25-102	INDUCER STUD	1
P25-515	TAB WASHER	1

Figure 18. Frame Mount Assembly



Note: *Recommendation: The shaft and bearings are available as an assembly (P25-97). To minimize downtime, keep a spare assembly in your stock.*

Table 10. Frame Mount Assembly

Item No.	Part Name	Qty.
P25-95	Ball Bearings	2*
P25-96	Input Shaft	1
P25-97	Shaft and Bearing Assembly	1*
P25-99	Key	1*
P25-100	Mounting Frame	1
P25-114	Retaining Ring	1
P25-116	Slinger	1
P25-127	Drive Gear Key	1
*Recommended spare parts per unit.		

Figure 19. Adapter Flange and Hardware

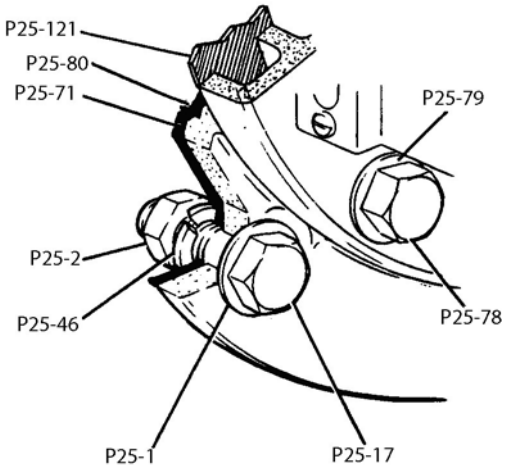
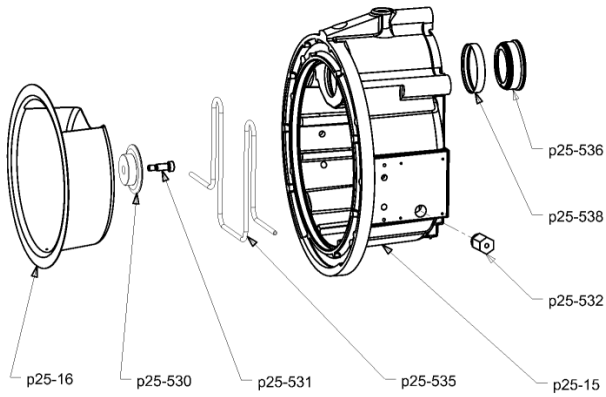


Figure 20. Aluminum Gearbox with Liner and Cooler



ALUMINUM GEARBOX WITH COOLER

Table 11. Adapter Flange and Hardware

Item No.	Part Name	Qty.
P25-1	Flat Washer	4
P25-2	Hex Nut	4
P25-17	Hex Head Screw	4
P25-46	Lock Washer	4
P25-71	Adapter Flange	1
P25-78	Hex Head Screw	4
P25-79	Stat-O-Seal Washer	4
P25-80	Adapter Flange Gasket	1
P25-121	Gearbox Gasket	1*
*Recommended spare parts per unit.		

Table 12. Aluminum Gearbox with Liner and Cooler

Item No.	Part Name	Qty.
P25-15	Gearbox Housing	1
P25-16	Oil Shroud	1
P25-530	Oil Slinger	1
P25-531	Shoulder Bolt	1
P25-532	Conn,M,(Bored Thru)	2
P25-535	Hex Head Screw	4
P25-536	Stat-O-Seal Washer	4
P25-538	Adapter Flange Gasket	1

SPARE PARTS

When ordering replacement parts, provide the pump serial number, and list each part required by item number and part name along with quantities desired. When requesting information concerning your Sunflo Pump, always refer to the pump model number and pump serial number as they appear on the nameplate.

All Sunflo products are available on an expedited basis. The factory should be contacted prior to order placement to ensure part availability. Stock spare parts requiring no machining will be shipped 24 hours after receipt of order at the factory and parts requiring additional machining will be shipped within 96 hours after receipt of order at the factory.

The kits shown below simplify maintenance and inventory control. They are available through your Sunflo distributor.

O-Ring Repair Kits

- Packages all o-rings in one kit
- Color coded o-ring material
- Easy-to-read instructions describe exact location of each o-ring

Seal Repair Kits

- Custom tailored for the specific pump and seal type
- Single and double seal options
- Easy-to-read instructions prevent installation mistakes
- Eliminates misplacement of parts and simplifies inventory control

Exchange High Speed Shaft Assemblies

- Easier to perform routine seal and bearing maintenance
- Normal delivery is two weeks
- Same quality construction, testing and warranty as new shaft assemblies
- Can ship on an expedited three-day basis when needed. Old shaft assembly can be returned for credit within 60 days.

Note: *A highly recommended option to normal pump maintenance is the purchase of a spare high-speed shaft assembly which can be replaced quickly and easily as a complete unit.*

Ordering Replacement Parts

Order parts through your Sunflo distributor. For information or assistance contact:

Sundyne Corporation
14845 W. 64th Avenue
Arvada, Colorado 80007
Telephone: 303-425-0800
Fax: 303-425-0896
Attention: Parts Order Coordinator

or

Sundyne Europe
13-15 Blvd. Eiffel
Zone Industrielle de Dijon SUD (21600)
BP30
21600 Longvic Cedex, France
Telephone: 011-33-3-80-383300
Fax: 011-33-3-80-383371

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