



**Pioneer Self Priming Series
ES Series
Operation & Maintenance Manual**

Manual #6001

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INTRODUCTION

Thank you for purchasing a Pioneer Elite Series Self-Priming centrifugal pump, complete with integral suction check valve. The pump is designed for handling non-volatile, non-flammable, mild industrial corrosives, residues and slurries containing large entrained solids. The Pioneer Elite Self-Priming Pump series is designed to be a direct bolt in replacement for the Pioneer Self-Priming Pump series.

WARNING!!!

This manual provides installation, operation and maintenance instructions for your Pioneer Self-Prime Pump and is intended to make your personnel aware of any procedure that requires special attention because of potential hazards to personnel or equipment. Read all instructions carefully and remember, pump installations are seldom identical. Therefore, this manual cannot possibly provide detailed instructions and precautions for each specific application. Thus, it is the owner/installer's responsibility to ensure that neither operator safety nor pump integrity are compromised by installations and applications that are not addressed in this manual.

WARNING!!!

Centrifugal Pumps are designed for specific service and may or may not be suited for any other service without loss of performance or potential damage to equipment/personnel. If there is ever any doubt about suitability for a specific purpose; contact your Pioneer Pump, Inc. representative or the factory for assistance.

Remember: Pump performance may be affected by changes in pumpage such as, specific gravity, viscosity, temperature, operating speed and net positive suction head available (NPSHA).

INSPECTION

The pump assembly was inspected and tested before shipment from the factory. Before installation, inspect the pump for damage that may have occurred during shipment.

PRE-INSTALLATION INSPECTION

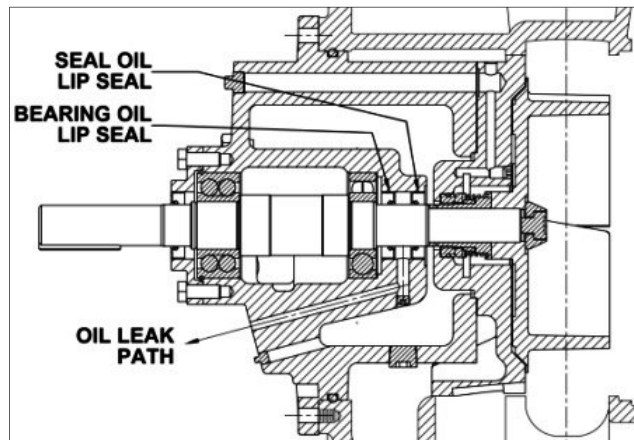
Check as follows: Inspect the pump for cracks, dents, damaged threads, and other obvious damage.

Check for and tighten loose attaching hardware. Since gaskets tend to shrink after drying, check for loose hardware at mating surfaces.

Carefully read all warnings and cautions contained in this manual or affixed to the pump, and perform all duties indicated. Note the direction of rotation indicated on the pump and check that the pump shaft rotates counter-clockwise when standing on the suction side of the pump and facing the impeller.

OIL LEAKAGE CHECK

The bearing oil and mechanical seal oil are each sealed by a shaft lip seal, and a vent to atmosphere exists between these two lip seals to indicate oil leak from either cavity. If either the bearing oil or mechanical seal oil lip seal leaks, oil will leak from the vent. This vent should be checked for leakage prior to pump operation.



CAUTION!!!

If equipment is stored more than twelve (12) months, some of the components or lubricants may have exceeded their maximum shelf life. These must be inspected and replaced as necessary prior to pump operation to ensure proper pump performance.

RECORDING MODEL & SERIAL NUMBERS

Record the model and serial number for your **Pioneer Pump** in the spaces provided below. The factory will need this information when you require parts or service.

PumpModel: _____

PumpSerialNumber: _____

Engine/MotorSerial# _____

Engine/Motor Mgf: _____

WARRANTY INFORMATION

Pioneer Pump's current terms and conditions, including limited warranty policy, can be found on our website <http://www.pioneerpump.com> from the homepage by selecting More > Resources > Terms and Conditions or by following this link:

http://pioneerpump.com/media/232391/M5132_Pioneer_Standard_Terms_and_Conditions-1-.pdf

WARRANTY CLAIMS

Contact the factory to file a warranty claim, before shipping parts back. Parts returned to the factory without an RMA number on file will be scrapped upon arrival.

SAFETY INFORMATION

These warnings apply to **Elite Series** basic pumps. In many cases, **Pioneer Pump, inc.** has no control over or particular knowledge of the power source that will be used. Therefore, refer to the manual accompanying the power source before attempting to begin operation.

WARNING!!!

Before attempting to open or service the pump:

1. Familiarize yourself with this manual.
2. Disconnect or lock out the power source to ensure that the pump will remain inoperative.
3. Check the temperature before opening any covers, plates or plugs.
4. Allow the pump to cool if overheated.
5. Close the suction and discharge valves.
6. Vent the pump slowly and cautiously.
7. Drain the Pump.

WARNING!!!

This pump is designed to handle mild industrial corrosives, residues and slurries containing large entrained solids. Do not attempt to pump volatile, corrosive, or flammable materials that may damage the pump or endanger personnel as a result of pump failure.

WARNING!!!

After the pump has been positioned, make certain that the pump and all piping connections are tight, properly supported and secure before operation. (Refer to Installation section)

DANGER!!!

Do not operate the pump without the guards in place over the rotating parts. Exposed rotating parts can catch clothing, fingers, or tools, causing severe injury to personnel.

WARNING!!!

Do not remove plates, covers, gauges, pipe plugs, or fittings from an overheated pump. Vapor pressure within the pump can cause parts being disengaged to be ejected with great force. Allow the pump to cool before servicing.

WARNING!!!

Do not operate the pump against a closed discharge valve for long periods of time. If operated against a closed discharge valve, pump components will deteriorate, and the liquid could come to a boil, build pressure, and cause the pump casing to rupture or explode.

WARNING!!!

Remove suction and discharge piping from pump prior to moving. Use lifting and moving equipment with adequate capacity and in good repair.

INSTALLATION

Use the following guidelines when installing your new Elite Series Self Priming Pump.

WARNING!!!

Review safety information in safety information section. This section is intended to outline general recommendations and practices required to position and arrange the pump and piping in static lift situations. If installing the unit in flooded suction applications some of the information will need to be tailored to the specific application. Never exceed the maximum permissible operating pressure of the pump as shown on the pump performance curve.

FOUNDATION/BASE PLATE/SKID

If using a concrete foundation it should be rigid enough to inhibit vibration. Pour the foundation well in advance of installation of pump equipment to allow time for drying and curing.

If the pump is to be mounted on a steel frame, or similar structure, it should be set directly over the supporting beams. These beams and the structure must be rigid enough to prevent distortion and potential misalignment due to movement within the structure or base.

The location of this structure should be as close as possible to the pumpage source. Provide adequate space for operation, maintenance and inspection of the pump and equipment.

The concrete foundation should be provided with anchor bolts for attachment to the base plate. If required, provide adequate drainage to keep pump and motor dry and clean. Also, provide either leveling nuts or leveling wedges for mounting the base plate to the foundation.

LEVELING

When mounting the base plate to the foundation use the leveling nuts or wedges to provide a level, flat base plate. Use a machinist's level on the mounting pads and make adjustments as

necessary as the anchor bolts are tightened. This will provide the true alignment between the pump and motor.

GROUT

If this base plate is to be grouted, ensure that you have the mounting surface flat and level for correct alignment of pump and motor. Build a dam around the base plate perimeter that is to be watertight. Use standard grouting practice and be sure to protect (cover) the leveling wedges with caulk or plastic tape if they are to be removed later. After the grout has thoroughly hardened, remove forms. If the wedges are removed, fill holes with grout. Seal grout by covering with a quality paint or sealer.

TRAILER MOUNTED UNITS

See “**OPERATION**” section.

INSTALLING PUMP

Ensure that all foreign material has been removed from the pump before mounting. Be sure to remove all shipping protection prior to operation.

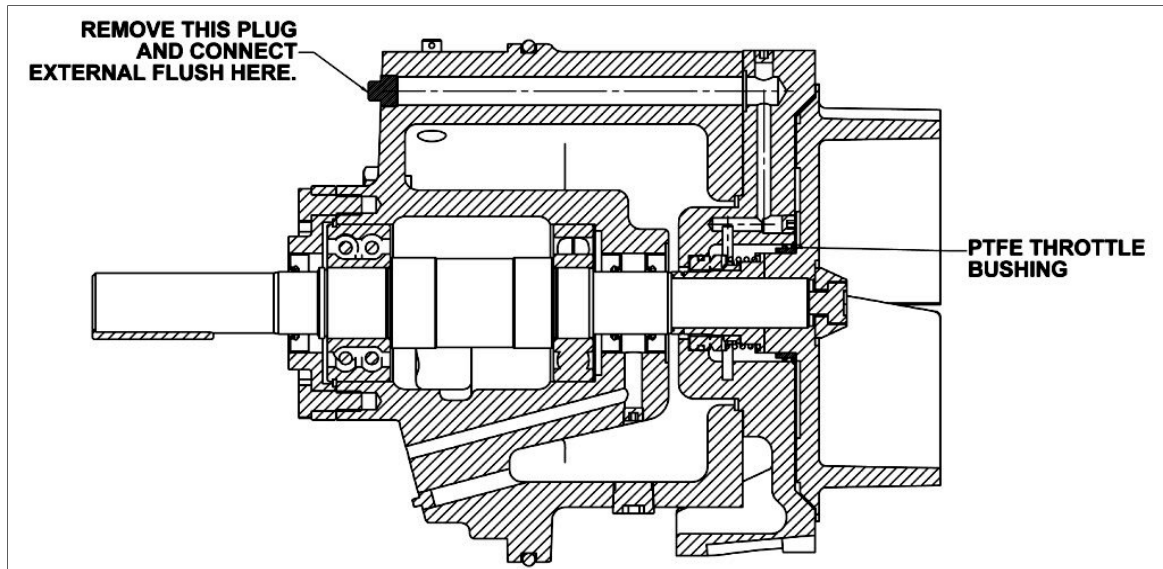
NOTE: Many of the bare pumps are shipped with protective guards and coatings.

SUCTION PIPING

For best performance the suction piping should be at least as large as the pump flange, never smaller. Use an eccentric reducer at the suction flange with the straight side up. The use of flow-retarding fittings is to be avoided and if necessary should never be placed closer to the pump suction than four (4) times the pipe diameter. The pump should be at the highest point of the piping. Slope the piping up to the pump to prevent air pockets and avoid changing pipe size with the exception of the eccentric reducer mentioned above. All suction piping and fittings are to be checked for any foreign material (rocks, bolts, wire, etc.) and also any sharp burrs that could disrupt the flow.

PRODUCT FLUSH

With the throttle bushing installed, remove the ½ NPT pipe plug above the shaft at the drive end of the bearing housing. Connect a water source to the ½” NPT port that maintains no less than 50% of the discharge pressure. Water will flow through the seal housing into the pumpage to keep it from entering the seal housing.



CAUTION!!!

The suction and discharge pipe/hose material should be compatible with the liquid being pumped.

CAUTION!!!

If hose is used on the suction line it should be of the reinforced type to prevent collapse under suction lift.

DANGER!!!

If a manual shut-off valve is installed in the discharge line, it must not be left closed during operation, a closed manual shut off valve will cause overheating and possible explosive rupture of the pump casing. Personnel could be severely injured!

DISCHARGE PIPING

Use a concentric taper on the discharge side to increase discharge pipe diameters. All valving and additional fittings should be the same size as the discharge main-line. The discharge size should be adequate to maintain reasonable velocities and reduce friction losses. It is strongly recommended that a pressure relief valve is installed on the discharge piping.

SUCTION & DISCHARGE PIPE FLANGES

All piping is to be supported, braced and lined up square before connection to the pump flanges. A flexible fitting is recommended on both suction and discharge, to eliminate misalignment loads or stresses being transmitted to the pump.

NOTE: Flexible pipe couplings must be restrained so as not to transmit any strain to the pump flanges when expanding or contracting under pressure. Unrestrained expansion fittings can transmit enormous forces to the pump flanges.

SCREENING

Make provisions for the installation of a suction screen or strainer to prevent any debris from clogging the impeller. The open area of the strainer should be equal to at least four (4) times the area of the pipe. The screen should be rigid enough to prevent collapse when flow is reduced due to clogging.

SUMP DESIGN

The submergence of the suction pipe into the liquid should be at least four (4) to five (5) times the pipe diameter. If this is not possible then provide a baffle or a floating board. This is to prevent any vortex action allowing air into the pipe. For best performance a bell mouth fitting is recommended. Recommended pipe submergences for various flows as well as recommended bell diameters are shown in the table below whose data was taken from ANSI/HI 9.8-1998.

FLOW (GPM)	500	1000	1500	2000	2500	3000	3500	4000	4500
SUBMERGENCE WITH BELL (FT)									
Bell Diameter (in)	6.1	8.6	10.6	12.2	13.6	14.9	16.1	17.2	18.3
Submergence (FT)	2.1	2.6	3.0	3.3	3.5	3.7	3.9	4.1	4.3
SUBMERGENCE WITHOUT BELL (FT)									
PIPE ID (in)- No Bell	SUBMERGENCE WITHOUT BELL (FT)								
3	4.7								
4	3.3	6.3							
6	2.1	3.7	5.3						
8	1.7	2.8	3.8	4.9	6.0				
10	1.6	2.3	3.1	3.8	4.6	5.4	6.1	6.9	7.6

LIFTING

Any lifting equipment is to be rated for at least five (5) times the weight of the item being lifted. Use only established methods when lifting or moving any heavy components.

ALIGNMENT OF PUMP AND MOTOR

Precise alignment is mandatory to achieve correct performance of the system. Every time a component is moved this alignment will have to be checked. The alignment can be checked with a straight edge and an outside caliper, taper thickness gauge, dial indicators, or for best results, use a laser alignment tool. Use the straight edge across the outside diameters of the coupling to ensure that the two halves are concentric and parallel. The outside calipers or the taper thickness gauge is to correct for any angular misalignment and to verify the correct gap between the coupling flanges. Use a laser alignment tool or dial indicators to adjust for concentric and angular displacement. With dial indicators, rotate shafts together and take readings every ninety (90) degrees. Make adjustments by placing shims under the driver, and be sure that the mounting bolts are properly tightened while taking readings and after final adjustment then install coupling guard.

ROTATION

Before the pump is started correct rotation must be confirmed. If the rotation is not correct then follow the direction given by the driver manufacturer.

OPERATION

Review all safety information in the safety information section, before operating the pump.

PRE-START CHECK LIST

- 1) Verify that rotation is correct and that the shaft rotates freely.
- 2) Check all piping connections for tightness.
- 3) Inspect all accessories and make sure they are appropriate for your installation.
- 4) Verify that the driver and coupling are aligned correctly and that all guards are in place.
- 5) Ensure that all bearings and grease seals are lubricated.
- 6) Oil levels should be checked and also, maintained during pump operation.
- 7) Follow the instruction on all tags, labels and decals attached to the equipment.
- 8) Review the operations manual furnished with the power source. (Equipment driver)

WARNING!!!

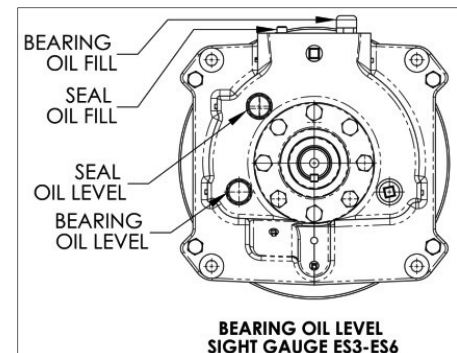
This pump is designed to handle most non-volatile, non-flammable liquids containing specified entrained solids and corrosives. Do not attempt to pump volatile, corrosive, or flammable liquids that may damage the pump or endanger personnel as a result of pump failure.

CAUTION!!!

Pump speed and operating condition points must be within the continuous performance range shown on the Performance Curve in the separate Part List Manual for your specific pump model.

LUBRICATION

This pump is oil lubricated. The bearing housing contains an oil cavity for lubricating the bearings and an oil cavity for lubricating the mechanical seal in case the pump runs dry. The sight gauge on the side of the bearing housing should read half full to indicate the bearings have the correct amount of oil. The mechanical seal oil should read at least half full.



PRIMING

This pump is self-priming, but the pump should never be operated without liquid in the pump casing. The pump casing needs to be half filled with liquid in order to prime.

CAUTION!!!

The pump will not prime when dry. Extended operation of a dry pump will destroy the seal assembly. Make sure pump casing is half filled with liquid when priming.

Add liquid to the pump casing when:

1. The liquid in the pump casing is low.
2. The pump has not been used to an extended period of time.
3. The pump is being put into service for the first time.

Once the pump casing has been filled, the pump will prime and re-prime as necessary.

WARNING!!!

Do not attempt to operate the pump unless all connecting piping, fill plug and other fittings are securely installed, failure to do so, could cause liquid pumped to be forced out under pressure causing injury to personnel.

WARNING!!!

Never run the pump with the discharge valve closed for extended periods of time. Never use the suction valve to throttle the flow. Check all suction and discharge piping for leaks.

If a suction strainer is installed, check the pressure drop across the strainer. If the differential in pressure exceeds five (5) PSI have the strainer cleaned.

OPERATION OF ENGINE DRIVEN UNITS

Review pre-start instructions in the beginning of the Operation section.

Before Starting,

Check the fuel level and oil levels in the engine.

CAUTION!!!

Make sure the pump is level. Lower jack stands and chock the wheels. Use caution when positioning the skid-mounted unit to prevent damage to the fuel tank. Consult the engine operations manual before attempting to start the unit.

WARNING!!!

Do not operate the pump without guards in place over the rotating parts. Exposed rotating parts can catch clothing, fingers or tools, causing severe injury to personnel.

STARTING

Consult the operations manual furnished with the power source.

Rotation

The correct direction of pump rotation is counter-clockwise when standing on the suction side of the pump and facing the impeller. The pump could be damaged and performance adversely affected by incorrect rotation. If pump performance is not within the specified limits, verify rotation. If necessary, check the connection to the power source, and interchange two leads (three phase power) in order to change rotation.

If an electric motor is used to drive the pump, remove V-belts, couplings, or otherwise disconnect the pump from the motor before checking motor rotation. Operate the motor independently while observing the direction of the motor shaft, or cooling fan.

If rotation is incorrect consult the power source operation manual.

Operation

Open all valves in the discharge line and start the power source. Priming is indicated by a positive reading on the discharge pressure gauge or by a quieter operation. The pump may not prime immediately because the suction line must first fill with liquid. If the pump fails to prime within five minutes, stop it and check the suction line for leaks.

Liquid Temperature and Overheating

The maximum liquid temperature for this pump is 160° F (71° C). Do not apply it at a higher operating temperature.

Overheating can occur if operated with the valves in the suction and/or discharge lines closed. Operating against closed valves could bring the liquid to a boil, build pressure, and cause the pump to rupture or explode. If overheating occurs, stop the pump and allow it to cool before servicing it. Refill the pump casing with cool liquid.

As a safeguard against rupture or explosion due to heat, this pump is equipped with a pressure relief valve that will open if vapor pressure within the pump casing reaches a critical point. If overheating does occur, stop the pump immediately and allow it to cool before servicing it.

Approach any overheated pump cautiously. It is recommended that the pressure relief valve assembly be replaced at each overhaul, or any time the pump casing overheats and activates the valve.

Pump Vacuum Check

With the pump inoperative, install a vacuum gauge in the system. Make sure the pump is at least half filled with liquid. Block the suction line and start the pump. At operating speed, the pump should pull a vacuum of 20 inches of mercury (508.0 mm) or more. If it does not, check for air leaks at the suction piping gaskets.

STOPPING

Never halt the flow of liquid suddenly. If the liquid being pumped is stopped abruptly, damaging shock waves can be transmitted to the pump and piping system. Close all connecting valves slowly.

On engine driven pumps, reduce the throttle speed slowly and allow the engine to idle briefly before stopping.

Cold Weather Protection

If the pump is to remain idle during below freezing conditions, drain the pump to prevent damage from freezing. Also, clean out any solids by flushing with a hose.

Bearing Temperature Check

Bearings normally run at higher than ambient temperatures because of heat generated by friction. Temperatures up to 160° F (71° C) are considered normal for bearings, and they can operate safely to at least 180° F (82° C). Measure bearing temperature with a contact-type thermometer.

MAINTENANCE

Under normal conditions this pump is designed to run maintenance free, because of its rugged construction, for extended periods of time. However, all centrifugal pumps contain wear parts that will gradually deteriorate, affecting pump performance. This pump does contain wear parts and these parts should be replaced as required to maintain optimum performance.

General maintenance can be performed without removing the pump from the driver. The following instructions assume a complete disassembly of the pump is required.

The equipment covered in this section is limited to the pump components only. Refer to the applicable vendor's manual for motors, engines and other accessory equipment. This manual also provides a troubleshooting section to diagnose many operational or performance problems. Use the troubleshooting section to help determine the cause of any problems, and only disassemble the pump components required to remedy the problem condition.

Drain volute case of pumpage when pumping unit is idle to avoid freezing and possible thermal cracking of pump case.

SPARE PARTS

Spare parts should be kept on hand to reduce downtime. At a minimum the following parts should be stocked.

Wear Plate
All O-rings
Set of bearings
Mechanical seal
Set of grease seals

If you have unusual pumping conditions, consult **Pioneer Pump, Inc.** for additional recommended spare parts.

When ordering parts from **Pioneer Pump, Inc.** please provide the following information:

- 1) Pump serial number
- 2) Pump model

- 3) Cross section drawing number
- 4) Part number from cross section drawing
- 5) Description of part
- 6) Quantity required
- 7) Package Vehicle Identification Number (VIN)

WARNING!!!

Before attempting to service this pump, read this manual carefully. Operators and maintenance personnel should have a good understanding of all aspects of this pump and the pumping conditions. Failure of operating personnel to be familiar with all aspects of pump operation outlined in this manual could contribute to equipment damage, bodily injury or possible death.

WARNING!!!

Before any servicing:

- 1) Read this manual carefully.
- 2) Shut down driver and lock out incoming power to ensure that the pump will remain inoperative.
- 3) If the pump or components are hot, allow adequate cooling prior to servicing the unit.
- 4) Close the suction and discharge valves.
- 5) Vent the pump slowly and drain completely.

WARNING!!!

If this pump is used to handle any hazardous materials that can cause illness, either directly or indirectly, take precautions by wearing approved protective clothing and use appropriate safety equipment.

WARNING!!!

Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. When lifting the pump with chains or cable wrapped around the pump, make certain that they are positioned so as not to damage the pump, and so that the load will be balanced. The bail on trailer or skid mounted units is intended for use in lifting the pump assembly only. Suction and discharge hoses and piping must be removed from the pump before lifting.

CAUTION!!!

When servicing this pump, use only components provided by **Pioneer Pump, Inc.** Any use of non-authorized parts could result in sub-standard performance, damage to equipment and possible injury to personnel. **Non-authorized parts will also void the warranty.**

When using this manual any reference to part numbers or names will be directed to the applicable cross section drawing. These parts will also be called out in the bill of materials for full description.

WARNING!!!

Select a clean suitable location for any required maintenance, and note that all work must be performed by qualified personnel.

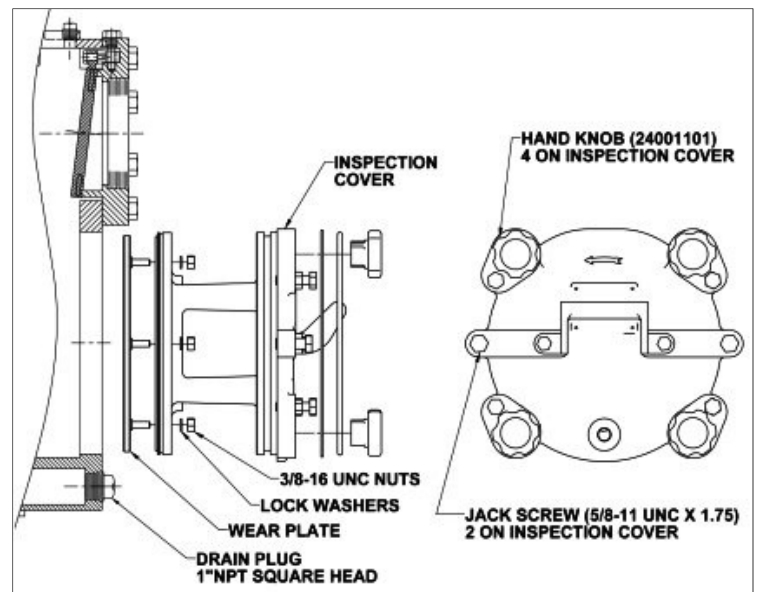
DISASSEMBLY

Before performing maintenance on your pump, verify the following:

1. Driver is shut down and power is **locked out**.
2. If pump components are hot, **allow to adequately cool**.
3. Suction and discharge valves are shut.
4. Drain pump after it has adequately cooled.
5. For power source maintenance refer to power source O & M manual.
6. Review all safety information and follow the instructions in this manual, as well as, all tags, labels and decals attached to the pump or related equipment.

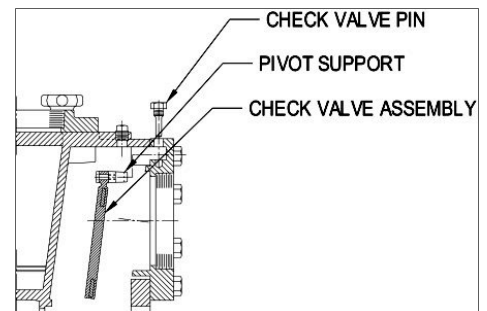
INSPECTION COVER AND WEAR

Once the pump has been drained, clean the drain plug and reinstall into inspection cover. Remove the four (4) hand lugs and use the two (2) jackscrews provided to remove the inspection cover and assembled wear plate. Replace the wear plate if it is badly worn or scored. To remove the wear plate, remove the 2 nuts (ES3, ES4) or 4 nuts (ES6). Inspect the inspection cover o-rings and replace if necessary.



SUCTION CHECK VALVE

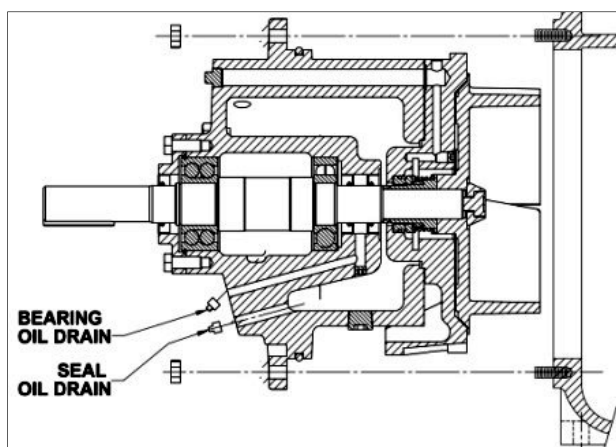
With the inspection cover removed, the check valve can be accessed without removing the suction piping. To service the check valve assembly, remove the check valve bolt, reach through the inspection cover opening and pull the complete assembly from the suction flange. Service the check valve as required.



ROTATING ASSEMBLY

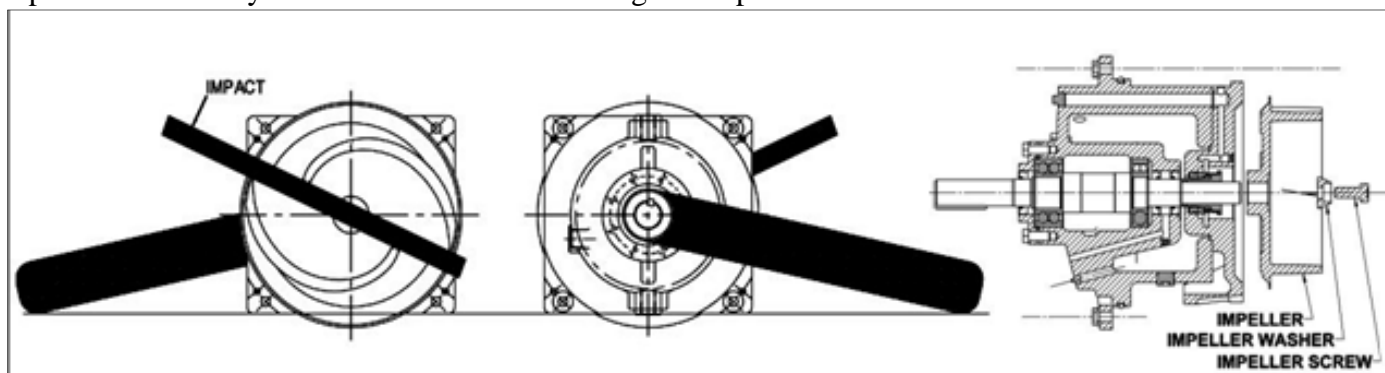
The power source must be removed prior to removing the rotating assembly. Drain the oil in the seal cavity by removing the seal cavity drain plug. Clean and replace the drain plug after draining seal cavity of oil. Remove the four (4) nuts on the studs of the volute, and use the two

(2) jackscrews to remove the rotating assembly from the volute. Separate the rotating assembly by pulling straight away from the pump casing.



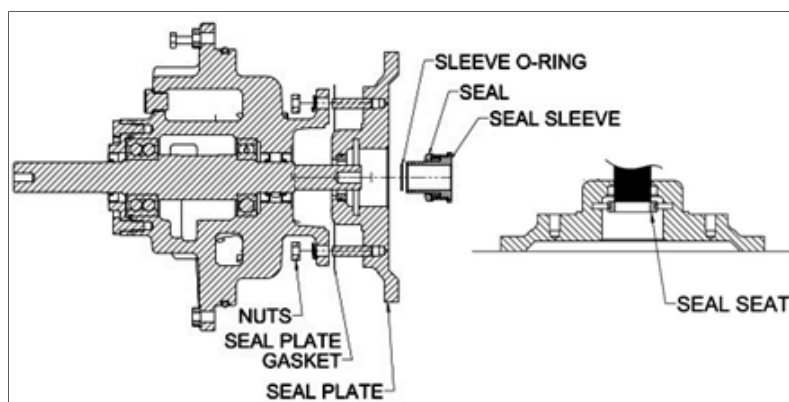
IMPELLER

With the rotating assembly removed from the pump casing, remove the impeller lock screw and unscrew the impeller from the shaft. The impeller was installed at the factory using Loctite® and so may be fairly difficult to unscrew. A propane torch can be used to ease loosening the screw if necessary. Use the impeller removal tool to fix the shaft from rotating, and use a metal bar or piece of wood to rotate the impeller counter-clockwise until it is free of the shaft. It may be necessary to pound the bar with a hammer to loosen the impeller. Inspect the impeller and replace as necessary. Use caution when removing the impeller.



MECHANICAL SEAL

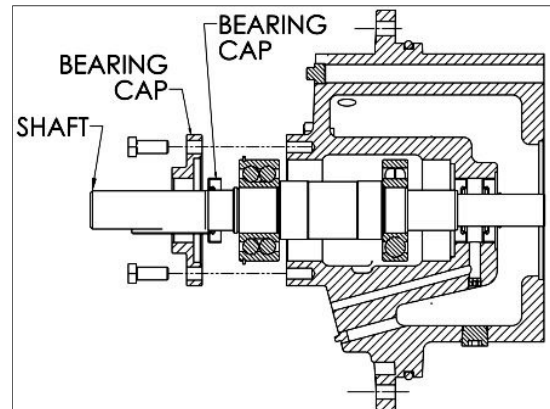
With the rotating assembly out of the volute and the impeller removed, slide the shaft sleeve and rotating portion of the seal off of the shaft as one unit (3" to 8" pumps). On the P10 there is no sleeve or sleeve o-ring. Drain the oil in the seal cavity by removing the seal cavity drain plug, located on the bearing housing's bottom front boss (figure 4). Clean and replace the drain plug after draining seal cavity of oil. Remove the seal housing from the bearing frame, and place it, face down, on a flat surface. With a suitable tool press on the backside of the stationary seat until it



is removed from the seal housing. On the P10, the stationary seat is held in a retainer, and the two are pressed out together.

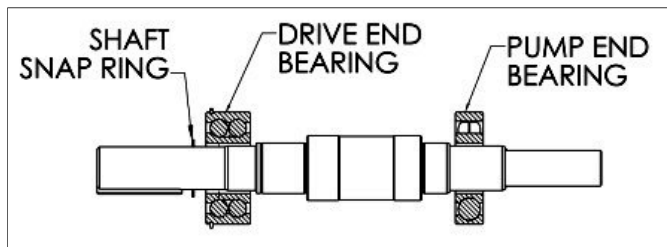
SHAFT AND BEARING

With the mechanical seal removed, remove the bearing housing drain plug located on the front bottom left of the bearing frame (figure 4), and drain oil. Clean plug and reinstall in housing. Remove fasteners, and slide the bearing cap/SAE bracket and grease seal off the shaft. Press the grease seal from the bearing cap/SAE bracket. Place a block of wood against the impeller end of the shaft and gently tap the shaft and bearings out of the housing.



BEARING REMOVAL

Remove the shaft snap ring. This will require the use of snap ring pliers. It will be necessary to use a puller or hydraulic press to remove the drive-end bearings and pump-end bearing from the shaft. If the bearings are to be reused, be certain that puller jaws bear only against the inside races (shaft-side) of the bearings.



REASSEMBLY OF COMPONENTS

SHAFT AND BEARINGS

Clean the housing and components with appropriate cleaning solvent and use compressed air to dry components. If bearings need replacement, remove the outboard (drive-end) bearing retaining ring and use appropriate bearing puller to remove bearings from shaft. Inspect shaft and replace if distorted, nicked or scratched beyond repair.

If bearings are to be replaced, then the bearings may be heated to 250° F for ease of installation. An induction heater, electric oven or hot plate may be used to heat the bearings. Never use direct flame to heat bearings.

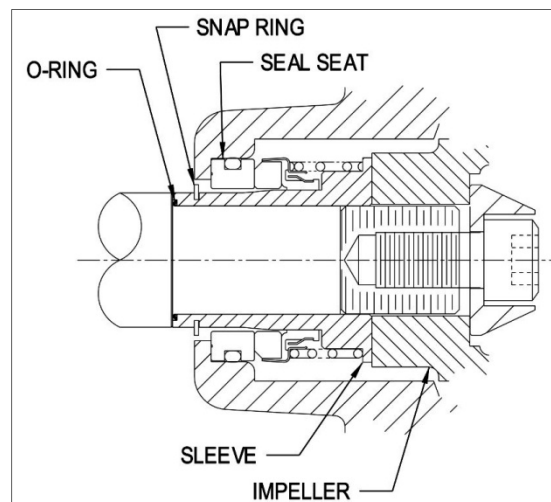
After heating the bearings slide the bearings on the appropriate shaft end. When installing the bearings onto the shaft only press against the inner bearing race. The inboard bearing should be installed with the shielded side toward the impeller. The outboard bearing should have the integral retaining ring on the bearing O.D. toward the drive-end of the shaft.

After installation of bearing, ensure that bearings are tight against shaft shoulders.

Secure the outboard bearing on the shaft with the bearing retaining ring. Slide the shaft and assembled bearings into the bearing housing until the retaining ring contacts the bearing housing.

SEAL INSTALLATION

A new seal assembly should be installed anytime the old seal is removed. The wear pattern on the old seal can cause premature failure if reused. Refer to figures 1 and 2. Thoroughly clean the shaft where the mechanical seal will be installed, and the seat of the seal housing. Place the sleeve o-ring over the shaft, past the threads and up against the shaft shoulder. Lubricate the stationary seat bore and stationary seat o-ring with P-80, 30 wt. motor oil, or liquid dish detergent and a little water. **DO NOT USE GREASE OR SILICONE LUBRICANTS.**

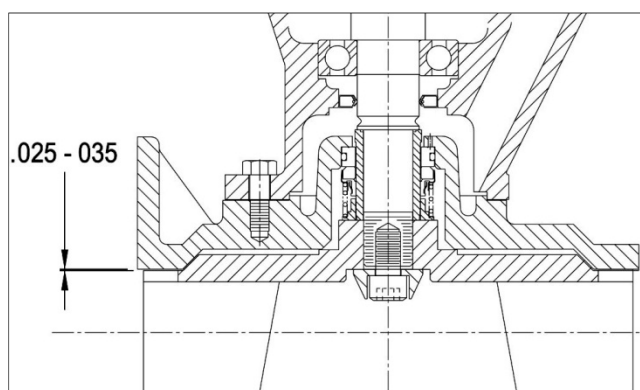


Remove the plastic, u-shaped seal-setting spacer from the cartridge seal assembly.

Carefully slide the cartridge seal assembly over the shaft, with the stationary seat towards the bore. By hand only, carefully press on the flanged end of the cartridge seal sleeve until the stationary seat bottoms in the stationary seat bore. Install impeller according to instructions.

IMPELLER

The shaft and impeller threads must be completely clean before re-installing the impeller. Apply anti-seize compound to the external shaft threads. **Do not use anti-seize compounds on the lockscrew threads!** Screw the impeller onto the shaft until tight. A clearance of .025 to .035 between the impeller and the seal plate is recommended for optimum pump efficiency. Measure this clearance between the impeller and the rotating assembly with the rotating assembly sitting on the impeller with the shaft oriented vertically. Add or remove impeller adjusting shims as required to achieve the correct clearance. Apply Loctite 2760®, or equivalent thread locking compound, to impeller screw and install impeller washer and screw.



Torque the impeller screw to a minimum of 175 foot pounds, maximum of 235 foot pounds. Do not allow the shaft to rotate while tightening the lockscrew

INSPECTION COVER AND WEAR PLATE

Re-grease o-ring when installing and use 2760 Loctite® (red), or equivalent, on the wear plate studs. Installation is the reverse of removal.

ROTATING ASSEMBLY

Re-grease o-ring and install rotating assembly into volute. Installation is the reverse of removal. Upon installation, the clearance between the suction cover and impeller needs to be verified. After sliding the rotating assembly back into the volute, evenly tighten rotating element bearing

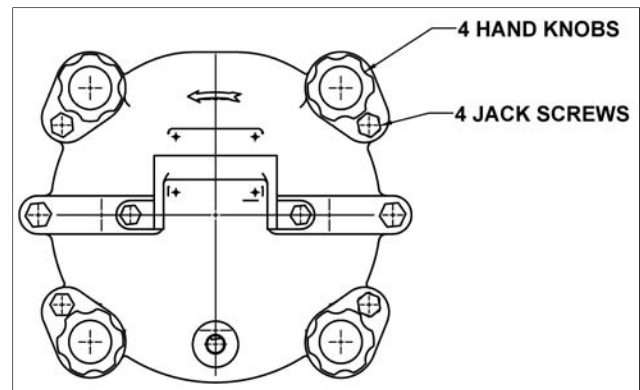
housing fasteners until impeller lightly contacts wear plate. Note: the shaft will not rotate. Tighten bearing housing jack screws until .010" to .020" increase in clearance is achieved. .010" to .020" is the desired clearance between the impeller and wear plate.

This can be determined by taking measurements of the gap between the pump casing and the bearing housing when the impeller is making contact with the wear plate, then re-measure the same gap until the above increase in clearance is achieved at each corner of the bearing housing.

Rotate shaft, making sure there isn't any impeller/wear plate contact or rubbing. Tighten the jack screws at each corner of the bearing housing (not too tight), then tighten the jackscrew lock nuts to maintain setting position. Rotate shaft to verify the shaft is free to rotate without the impeller rubbing on the wear plate after adjustment. If the impeller continues to rub on the wear plate, repeat adjustment procedure above until the shaft rotates freely.

INSPECTION COVER AND WEAR PLATE ADJUSTMENT (ES3 THROUGH ES6)

The wear plate clearance can be opened on the ES- series without removing the rotating assembly by loosening the four (4) hand knobs and tightening the four (4) jack screws. Then re-tighten the hand knobs. The adjustment distance can be measured by comparing the before and after gap between the adjustment flange and the volute casing.



PRESSURE RELIEF VALVE

The suction cover is equipped with a pressure relief valve to provide additional safety for the pump and operator. Make sure the relief valve is set to 80 psi

DANGER!!!

It is recommended that the pressure relief valve assembly be replaced at each overhaul, or any time the pump overheats and activates the valve. Periodically, the valve should be removed for inspection and cleaning.

LUBRICATION

Proper lubrication is essential to maintain performance and to help ensure trouble free operation.

Seal Assembly

Prior to starting the pump, remove the seal vent plug and fill the seal cavity with approximately 1 quart of ISO VG 32 viscosity grade 32 Turbine oil, so that the oil level is halfway in the level sight gauge.

Bearings

The bearing housing was lubricated at the factory and should be maintained at the middle of the sight gauge. Use an ISO viscosity grade 32 Turbine oil and fill through the air vent hole at the

top right of the bearing frame (figure 4). Under normal use drain and refill bearing housing at least once every 12 months.

CAUTION!!!

Over-filling of oil can result in premature failure of bearings.

PUMP STORAGE

Pumps are adequately prepared for outside storage prior to shipment, but use the following list of additional suggestions for extended storage longer than four (4) weeks.

- 1) Store the unit off the ground so no water will accumulate around the equipment.
- 2) Protect unit from blowing sand and dirt.
- 3) Stack no other items on top of pump/equipment.
- 4) Protect unit from the entry of any animals.
- 5) Periodically rotate shaft to lubricate bearings and protect bearings from brinelling.
- 6) Protect unit with approved drying agents.
- 7) Ensure all bare metal areas are coated with rust preventative.
- 8) Inspect unit every four (4) weeks and replace drying agents (Silica Gel) as required or a minimum of ever six (6) months.
- 9) Keep an inspection record showing dates of inspection with any maintenance preformed and condition of drying agents.
- 10) Before installation ensure that all rust protection has been removed. Also, remove any foreign material that may have accumulated during storage.
- 11) Before installation remove all drying agents (Silica Gel).

TROUBLE SHOOTING

An ongoing record of performance will assist in any troubleshooting and/or analysis of problems. A pressure gauge can be installed on the suction and discharge side of the pump to monitor any changes in differential pressure. Differential pressure is useful in monitoring and diagnosing any possible degradation in pump performance.

Symptom	Possible Causes	Symptom	Possible Causes
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No Discharge	1,2,3,4,5,7,8,9,10,17,18,19,20,37,49	Vibration and noise	2,4,9,10,14,15,17,26,27,28,29,30,31,32,33,34,35,36,39,40,41,42,43,44,48,49
Reduced Capacity	2,3,4,5,7,8,9,10,11,17,19,20,21,38,9,40,47,49	Seal: excessive leakage, short life, seal housing overheating	22,23,25,33,34,35,36,41,44,45,46
Reduced Pressure	5,7,8,11,13,18,19,38,39,40,47,49	Bearings: over heating, short life, noise	26,27,28,29,30,31,32,33,34,35,36,41,42,43,44
Loss of Prime	2,3,4,7,10,11,20,21,22,23,49	Pump overheating, seizes	1,8,9,14,33,34,35,36,41,42,43,44
Power consumption excessive, driver runs hot	6,12,13,17,18,19,24,33,34,35,36,37,38,41,42,43,44	Corrosion, erosion, pitting, oxidation or other loss of material	7,8,11,14,15,16
Pump Fails Prime	1,4,5,10,20,21,49,50,51		

1. Pump not primed
2. Suction line not filled
3. Air pocket in suction line
4. Suction inlet or foot valve obstructed, insufficiently submerged, or too small
5. System head higher than pump design head
6. System head lower than pump design head
7. Insufficient NPSH
8. Parallel pump application is incorrect
9. Suction pressure to vapor pressure below minimum
10. Suction lift too high
11. Excess vapor in pumpage
12. Specific gravity of pumpage different than design
13. Viscosity of pumpage different than design
14. Operation at below rated capacity
15. Cavitation
16. Electrolysis
17. Impeller obstructed
18. Wrong rotation direction
19. Low speed
20. Air leak into suction line
21. Air leak through mechanical seal
22. Seal fluid contaminated, hot or insufficient
23. Seal fluid system not vented
24. High speed
25. Mechanical seal insufficient
26. Bearing housing excessively cooled
27. Low oil pressure (oil lube bearings)
28. Improper or poor lubrication
29. Lubrication defective
30. Dirt in lubricant/bearing housing
31. Moisture in lubricant/bearing housing
32. Lubricant excess
33. Pipe strain
34. Temperature growth
35. Misalignment
36. Coupling improperly installed
37. Impeller installed backwards
38. Wear rings worn
39. Impeller damage
40. Improper balance (after repair)
41. Bent shaft
42. Excessive thrust
43. Rotational element dragging
44. Worn or incorrectly installed bearings
45. Mechanical seal not properly set, O-rings damaged or hardened
46. Shaft scored at seal
47. Volute O-ring
48. Foundation not rigid or settle
49. Suction line collapsed
50. Not enough liquid in casing
51. Suction check valve contaminated or damaged

Conditions and terms of sale

CONTROLLING PROVISIONS: These terms and conditions shall control with respect to any purchase order or sale of Seller's products. No waiver, alteration or modification of these terms and conditions whether on Buyer's purchase order or otherwise shall be valid unless the waiver, alteration or modification is specifically accepted in writing and signed by an authorized representative of Seller.

DELIVERY: Seller will make every effort to complete delivery of products as indicated on Seller's acceptance of an order, but Seller assumes no responsibility or liability, and will accept no backcharge, for loss or damage due to delay or inability to deliver caused by acts of God, war, labor difficulties, accident, delays of carriers, by contractors or suppliers inability to obtain materials, shortages of fuel and energy, or any other causes of any kind whatever beyond the control of Seller. Seller may terminate any contract of sale of its products without liability of any nature, by written notice to Buyer, in the event that the delay in delivery or performance resulting from any of the aforesaid causes shall continue for a period of sixty (60) days. Under no circumstances shall Seller be liable for any special or consequential damages or for loss, damage, or expense (whether or not based on negligence) directly or indirectly arising from delays or failure to give notice of delay.

SELLER'S LIABILITY: Seller will not be liable for any loss, damage, cost of repairs, incidental or consequential damages of any kind, whether based upon warranty (except for the obligation accepted by Seller under "Warranty" above), contract or negligence arising in connection with the design, manufacture, sale, use or repair of the products or of the engineering designs supplied to Buyer.

RETURNS: Seller cannot accept return of any products unless its written permission has been first obtained, in which case same will be credited subject to the following: (a) All material returned must, on its arrival at Seller's plant, be found to be in first-class condition; if not, cost of putting in saleable condition will be deducted from credit memoranda. (b) A handling charge deduction of twenty percent (20%) will be made for all credit memoranda issued for material returned. (c) Transportation charges, if not prepaid, will be deducted from credit memoranda.

CANCELLATION OR ALTERATION: Cancellation or alteration of an order by Buyer may not be made without advance written consent of Seller and shall be subject to a cancellation charge. The cancellation charge will be a minimum of fifteen percent (15%) or actual cost incurred by Seller at the time of cancellation or alteration, whichever is greater.

SHIPMENTS: All products sent out will be carefully examined, counted and packed. The cost of any special packing or special handling caused by Buyer's requirements or requests shall be added to the amount of the order. No claim for shortages will be allowed unless made in writing within (10) days of receipt of a Shipment. Claims for products damaged or lost in transit should be made on the carrier, as Seller's responsibility ceases, and title passes, on delivery to the carrier.

SPECIAL PRODUCTS: Orders covering special or non-standard products are not subject to cancellation except on such terms as Seller may specify on application.

QUOTATIONS: All quotations are subject to approval, acceptance and correction at the home office. Any errors in quotations resulting in orders will be corrected and re-submitted to the customer for their acceptance or refusal. All quotations are valid for 45 days from the date on the quotation.

PRICES AND DESIGNS: Prices and designs are subject to change without notice. All prices are **F.O.B. Point of Shipment**, unless otherwise stated.

TAXES: The amount of any sales, excise or other taxes, if any, applicable to the products covered by this order, shall be added to the purchase price and shall be paid by Buyer unless Buyer provides Seller with an exemption certificate acceptable to the taxing authorities.

TERMS OF SALE: For value received, Buyer agrees to honor all terms of the sale, as outlined on the reverse hereof, including, but not limited to the following:

- ◆ 3% 10, net 30 days unless otherwise specified in writing.
- ◆ Buyer agrees and understands that payments will be considered past due if payment is not received within thirty (30) days of the invoice date.
- ◆ Buyer agrees that all past due payments shall bear interest at the rate of 1.5% per month (18% per annum) until paid in full.
- ◆ Buyer agrees that it is the intention of Buyer and Seller to conform strictly to all usury laws now in force and effect in the state of purchase.
- ◆ Buyer further agrees not to suffer or permit any charge, lien, security interest, adverse claim or encumbrance of any and every nature whatsoever against the equipment until the indebtedness secured thereby is satisfied in full.
- ◆ Minimum invoice amount will be no less than \$25.00 plus transportation.

USE OF EQUIPMENT: Buyer agrees to maintain and use the equipment solely in the conduct of its own business, in a careful and proper manner, and in conformity with all applicable permits, licenses, statutes, ordinances, regulations and laws.

INSURANCE: Buyer shall have and maintain at all times with respect to all equipment insuring against risk of fire, theft and other risks as Seller may require, until the indebtedness secured thereby is satisfied in full.

FIGURE 1

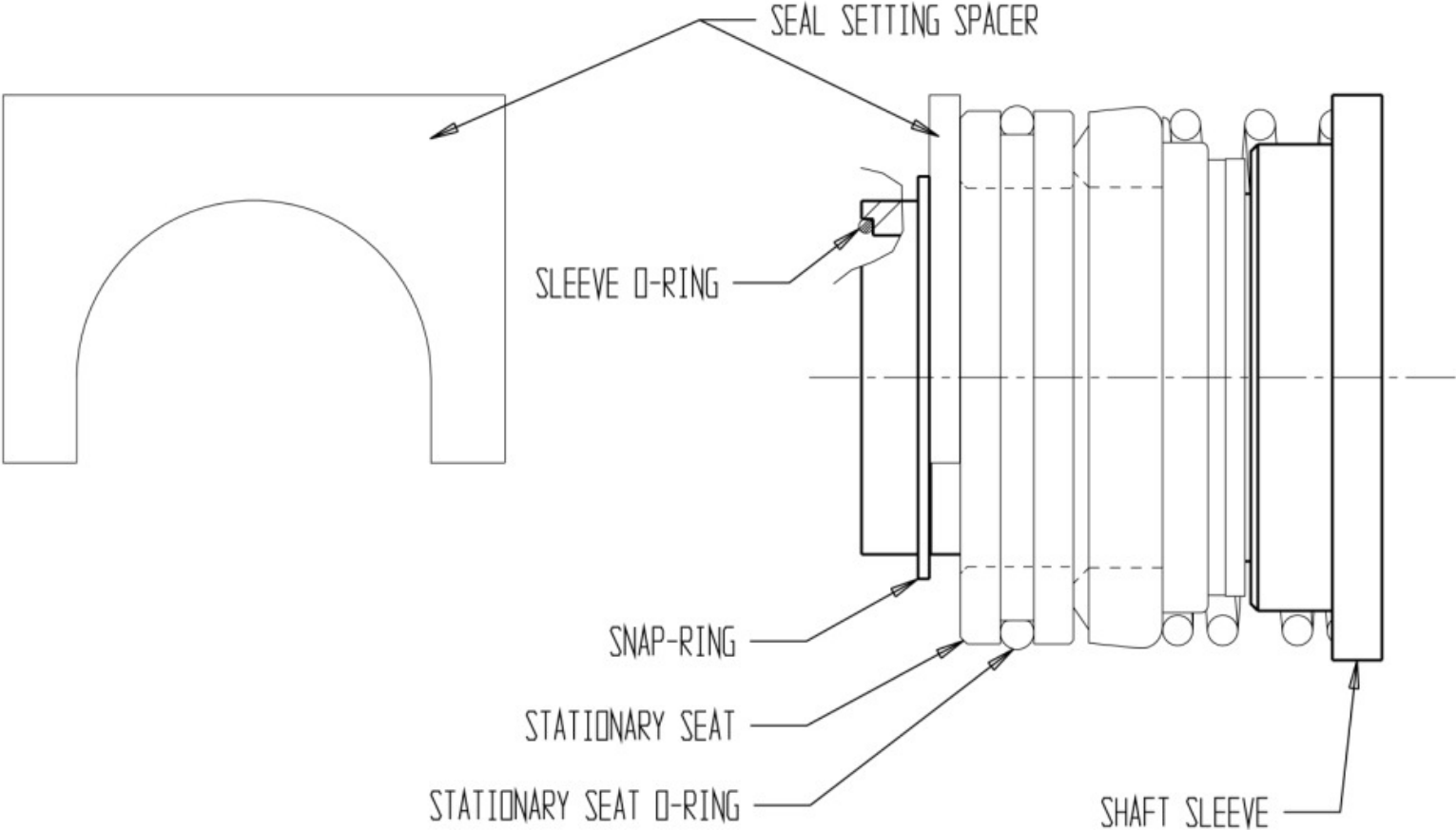


FIGURE 2

