Pioneer Prime Series
Operation & Maintenance Manual
(Enclosed Bracket Style)

Manual #1001

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Operation and Maintenance Manual
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INTRODUCTION

Thank you for purchasing a Pioneer end-suction centrifugal pump. This is a heavy duty pump intended for use with non-volatile, non-flammable liquids with specified entrained solids, except as approved by the factory.

WARNING!!!

This manual provides installation, operation and maintenance instructions for your Pioneer Pump, whether of vacuum-assisted self-priming or conventional configuration. It 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 that 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 applications not addressed in this manual are performed only after establishing that neither operator safety nor pump integrity are compromised by the installation.

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 NPSHA (net positive suction head available).

INSPECTION

INSPECTION

All equipment is inspected at the factory prior to shipment. However, you should inspect all equipment upon arrival for shipping damage and item shortages from the packing slip. Report any damage or shortages to the carrier and **Pioneer Pump, Inc.**

RECORDING MODEL & SERIAL NUMBERS

Please 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.

Pump Model: _____
Pump Serial Number: _____
Engine/Motor Serial #: _____
Engine/Motor Model Mgf: _____

WARRANTY INFORMATION

LIMITED WARRANTY: Seller warrants for two years from the date of shipment Seller's manufactured products to the extent that Seller will replace those having defects in materials or workmanship when used for the purpose and in the manner which Seller recommends. If Seller's examination shall disclose to its satisfaction that the products are defective, and an adjustment is required, the amount of such adjustment shall not exceed the net sales price of the defective products and no allowance will be made for labor or expense of repairing or replacing defective products or workmanship or damage resulting from the same. Seller warrants the products which it sells of other manufacturers to the extent of the warranties of their respective makers. Where engineering design or fabrication work is supplied, buyer's acceptance of Seller's design or of delivery of work shall relieve Seller of all further obligation, other than as expressed in Seller's product warranty. **THIS IS SELLER'S SOLE WARRANTY. NO OTHER WARRANTIES, WRITTEN OR ORAL, EXPRESS OR IMPLIED, INCLUDING THE WARRANTIES OF FITNESS FOR A PARTICULAR PURPOSE AND MERCHANTABILITY, ARE MADE OR AUTHORIZED. NO AFFIRMATION OF FACT, PROMISE, DESCRIPTION OF PRODUCT OF USE OR SAMPLE OR MODEL SHALL CREATE ANY WARRANTY FROM MANUFACTURER, UNLESS SIGNED BY THE PRESIDENT OF THE MANUFACTURER.** Seller neither assumes, nor authorizes any person to assume for it, any other obligation in connection with the sale of its engineering designs or products. This warranty shall not apply to any products or parts of products which (a) have been repaired or altered outside of Seller's factory, in any manner; or (b) have been subjected to misuse, negligence or accidents; or (c) have been used in a manner contrary to Seller's instruction or recommendations. Seller shall not be responsible for design errors due to inaccurate or incomplete information supplied by Buyer or its representative.

INSTALLATION

FOUNDATION/BASE PLATE/SKID

Pioneer pumps are available in trailer mounted, skid mounted or conventional channel base mounted configurations, or bare pumps may be mounted by a third party. Typically a channel base mounted unit is intended for a permanent installation, and the following recommendations for permanent installations should be followed.

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 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. For portable trailer or skid mounted, engine driven units, it is important that the pump / engine assembly be level so as to assure proper fuel feed and distribution of engine lubricants. Trailer mounted units can be leveled using the tongue jack and blocking under the lower wheel. Wheels should be properly chocked so as to prevent rolling of the trailer. Skid mounted units should be leveled by preparing the ground or blocking under the skid. For portable electric units accurate leveling is not particularly important except as required for proper piping alignment.

GROUT

If a base mounted pump 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

Insure 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.

INSTALLATION

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. Avoid changing pipe size except to reduce a larger suction pipe diameter to the pump suction flange size using 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.

DISCHARGE PIPING

Use a concentric taper on the discharge side to increase from pump discharge flange size to a larger discharge pipe diameter, or maintain discharge piping the same size as the discharge size of the pump. The decision of what size discharge pipe to use in an economic one, a balance between the higher cost of larger piping versus the higher energy requirements imposed by pipe friction. Otherwise, the only detrimental effects of discharge piping size choice derive from the pump running too near shut-off or too far out on its curve. The discharge size should be adequate to maintain reasonable velocities and reduce friction losses. All valving and additional fittings should be the same size as the discharge line.

SUCTION & DISCHARGE PIPE FLANGES

All piping is to be supported, braced and lined up square before connection to the pump flanges. In fixed or permanent installations a flexible fitting is recommended on both suction and discharge, to eliminate any piping strains being transmitted to the pump. Portable installations still require support of discharge and suction piping or hose near the pump so as to avoid undue forces being carried by the pump flanges. Supporting the piping or hoses with the pump flanges can result in rubbing and wear between rotating and stationary portions of the pump, possible breakage of the case or brackets or failure of seals or couplings.

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. Refer to the Hydraulic Institute Handbooks or other Hydraulic Data books for detailed sump design information.

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 necessary 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 halves to ensure that they 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.

If the pump is equipped with an SAE bracket and flywheel coupling for direct mounting of the pump to the engine bell housing, alignment between crankshaft and pump shaft is automatically attained due to the register fits between the bell housing and pump bracket.

ROTATION

Before the pump is started, correct rotation must be confirmed. If the rotation is not correct, then interchange any two of the leads on a three (3) phase driver. For a single-phase driver refer to the wiring diagram. Engine rotation should be confirmed with the engine supplier.

PRIMING

Pioneer pumps are available with a fully automatic vacuum priming system. If this priming device is not supplied on your pump model you will need either a flooded suction or a foot valve

and some other means of evacuating air from the pump case and suction line. With a flooded suction use a bleed valve at the top of the volute to allow trapped air to escape. If you are using a foot valve, then fill the suction line and pump case with water and use a bleed valve for trapped gas as above. If a hand primer is to be used it will be necessary to have an air tight check valve or closeable control valve on the discharge line to prevent the entry of air from the discharge side. Rotating the pump shaft will release trapped gas in the impeller.

If the pump is used with a flooded suction condition and your pump has a fully automatic vacuum priming system, you can close the isolation (failsafe) valve at the top of the priming chamber. This will isolate the vacuum pump inlet line from the pumpage and allow the vacuum pump to "coast" (extending the life of the vacuum pump and reducing the horsepower requirements on the driver).

OPERATION

PRE-START

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) If vacuum assisted, check the vacuum pump oil level as well as the oil level in the backplate/bracket reservoir.

7) Oil levels should also be checked and maintained during pump operation.

8) Follow the instruction on all tags, labels and decals attached to the equipment.

STARTING

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 which 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.

STARTING

Any centrifugal pump must be primed before starting unless it is of a self-priming design. See preceding section on priming, and ensure suction pipe is filled with water. With discharge valve closed, start the pump and slowly open valve. Throttle the flow gradually to fully open.

Avoid any abrupt changes in the discharge flow rate to prevent pressure surges in the piping. If the design pressure is not achieved shut the pump down immediately. Ensure that pump is adequately primed and restart.

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

Before Starting

Check the fuel level and oil levels in the engine, check the oil level in the vacuum pump and/or grease & oil in the pump bearing housing and seal chamber (backplate/bracket reservoir).

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.

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. Also, review section on Vacuum Pump venting.

WARNING!!!

Use lifting and moving equipment in good repair and with adequate capacity to prevent injuries to personnel or damage to equipment. Attach lifting equipment to the lifting device fitted to the pump. If chains or cable are wrapped around the pump to lift it 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.

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

MAINTENANCE

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

This manual provides installation, operation and maintenance instructions for your Pioneer Auto Prime Pump. The manual will also 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 this manual cannot anticipate or warn of every situation that could occur. Because of this the owner is responsible that only safe procedures be used, if not addressed in this manual. If any question regarding the pump is not covered adequately please contact **Pioneer Pump, Inc.**

WARNING!!!

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

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.

DISASSEMBLY

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) Pump is drained.

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.

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, effecting 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. For vacuum assisted, self-priming pumps removing the vacuum chamber and discharge check valve will simplify access to the inside of the pump case. The following instructions assume that a complete disassembly of the pump is required.

MAINTENANCE

(Parts names in bold type refer to pages A2017A, A2143A, A2144A, A2167A, A2168A, A2169A, A2170A, A2171A, A2172A, A2173A, A2174A, A2175A, A2176A, A2177A, A2184A, A2187A, A2183A, A2178A, A1459A and A638A as well as specific pages noted)

PRIMING CHAMBER (Pioneer Prime only)
Figures A2017A & A2169A

Disconnect and remove suction piping and air tubing from the **priming chamber/suction spool** assembly. While supporting the assembly with a sling, remove the nuts and bolts connecting the suction spool to the pump suction flange.

VACUUM PUMP (Pioneer Prime only)

The **vacuum pump** can be removed or left in place for maintenance of vacuum pump or bearing frame at the discretion of maintenance personnel

NOTE: When part names are referenced throughout these instructions they are highlighted and correspond to the part names on parts the parts illustrations, figures A638A, A2189A

VACUUM PUMP PERFORMANCE SPECIFICATIONS / FEATURES (Pioneer Prime)

This mechanically operated diaphragm vacuum pump is designed to deliver a maximum air removal rate of 50 CFM and a maximum vacuum of 25 to 26.5 inches of mercury while running at a nominal 1100 rpm.

It is specifically designed for pump priming and repriming and is tolerant of small amounts of liquid passing through it. Routine maintenance is simple and can be performed on site without special tools. No auxiliary lubrication or water separation systems or filters are required.

Power consumption is minimal. At maximum air removal rate and under moderate vacuum no more than 2 h.p. is required. Once the pump is primed and the airflow to the vacuum pump is stopped power consumption is approximately ½ h.p.

VACUUM PUMP OPERATING SPEED (Pioneer Prime only)

As with most mechanical devices the replacement interval for the wear components is largely a function of speed. When operated at 1000 to 1200 rpm an average replacement interval for the **actuator seal** is approximately 4000 hours. Higher speeds will reduce this interval, and lower speeds will increase it. Operation in excess of 1400 rpm for significant periods should be avoided. If the pump being primed is to operate in excess of 2300 rpm for an extended period, then a different vacuum pump pulley ratio should be considered. While priming speed will increase or decrease directly with increasing or decreasing vacuum pump speed, actuator seal life changes very approximately as the cube of operating speed change. So, it is not advantageous to increase operating speed in order to obtain a small reduction is priming speed.

Other vacuum pump components, such as the **inlet/outlet valves, neck seal** and **actuator valve** will require replacement over a much longer interval and should simply be inspected whenever other maintenance is performed.

NOTE: The vacuum pump pulley ratio is designed to operate the vacuum pump at 1100 rpm when the driver is running at 1800 rpm.

VACUUM PUMP BELT TENSION (Pioneer Prime only)

The vacuum pump is driven by a toothed timing belt connected to a pulley on the main pump shaft. This pulley and belt system is sized for considerably higher horsepower than the vacuum pump requires, and therefore, belt tension can be kept at a minimum. The belt should be just tight enough so that it does not have any slack. Belt tension is adjusted by adding or subtracting "motor base shims" between the vacuum pump base and the mounting surface.

VACUUM PUMP VENTING (Pioneer Prime only)

WARNING!!!

If the pump is operated in an enclosed space and the pumpage may contain potentially hazardous fumes make certain that an exhaust hose is securely connected to the vacuum pump exhaust nozzle and routed outside the enclosed space. Failure to do so may result in injury or death.

Before starting the vacuum pump check the following:

1) Oil level in the vacuum pump crankcase should be in the center of the oil level site glass. A 30wt, non-detergent motor oil should be used.

2) Make certain that the drive pulley is secured to the shaft. Verify the tightness of the screws on the pulley bushing.

3) Make certain that the belt guard is securely in place. **WARNING!!! Do not operate the pump without all guards in place. Injury or death could result.**

4) Make certain that the suction hose between the vacuum pump and the priming chamber is tight to the suction nozzle and has no leaks. Air leaks will cause the vacuum pump to run hotter than normal, shortening the actuator seal, neck seal and valve lives.

VACUUM PUMP DISASSEMBLY FOR MAINTENANCE (Pioneer Prime only)

To replace the **exhaust valve** remove the capscrews securing the **exhaust nozzle** to the **upper housing**, and lift off the housing. The exhaust valve is now exposed. It is not necessary to remove the **valve stud** when replacing the exhaust valve - simply pull the exhaust valve off over the head of the valve stud. When installing a new exhaust valve lubricate the head of the valve stud with motor oil or liquid dish soap, then just push the exhaust valve on over the head of the valve stud. Reattach the exhaust nozzle to the upper housing. Snug the screws, but do not over tighten, or the threads in the aluminum housing may be damaged.

Replacing the **inlet valve** is the same as described above. Remove the nuts and washers securing the **inlet nozzle/valve carrier** to the studs in the **lower housing**. Remove and replace the inlet valve per the instructions for **exhaust valve** replacement. When reattaching the inlet nozzle/valve carrier check the condition of the **inlet nozzle/valve carrier gasket**, and replace as necessary.

In order to check or replace the **actuator seal, actuator valve or neck seal** remove the **housing bolts, nuts and washers**, and lift the **upper housing** off. The actuator valve is now exposed and can be removed and reinstalled exactly as the inlet and exhaust valves. To replace the actuator seal remove the **cotter pin** and **castle nut** securing the **actuator** to the **actuator shaft** (when reinstalling the castle nut, torque to 50 ft-lbs). Rotate the crankshaft so that the actuator moves to "top dead center" position. Work the actuator seal out of the groove in the **lower housing**. The actuator has two threaded holes on the top to enable attachment of a "gear puller" for removal of the actuator. Pioneer Pump, Inc. can supply a puller specifically designed for this task if a suitable puller cannot be found. The easiest way to remove the actuator seal is to clamp the actuator in a vice, and pull the actuator seal up out of the groove. If the seal is to be discarded it is easier to partially cut it with a utility knife and then pull it out of the groove. To install a new actuator seal, thoroughly lubricate the inside diameter of the actuator seal and the groove in the actuator.

Note: the actuator seal must be installed with the taper on the outside diameter parallel to that of the lower housing (the larger diameter at the top of the actuator).

Now, work one edge of the actuator seal into the groove in the actuator much the same as you would a bicycle tire when installing it on the rim. Secure the assembly in a vice, and using a blunt instrument, such as a wrench handle, work the other edge of the actuator seal into the groove. Again, liberal lubrication is necessary to perform this installation. It takes some effort,

but you'll get the hang of it! See **Figure A2188A** for instructions on reinstalling the actuator onto the actuator shaft. Apply LocTite™ 262 or equivalent thread locker to the threads of the actuator screw. Tighten the castle nut to 13 foot pounds. While tightening, make certain to align one of the slots in the castle nut with the cotter pin hole through the actuator threads.

For the following procedures refer to figure A2189A

To service the **neck seal** and other components requires further disassembly. With the actuator removed, remove the nuts and washers from the studs securing the lower housing to the **pedestal**. Apply a little lubricant to the exposed portion of the actuator shaft. Now lift the lower housing off the pedestal - the neck seal should come off with the lower housing. The neck seal can now be removed from the counterbore in the bottom of the lower housing. To install a new neck seal, lubricate the inside diameter of the seal, push the seal into the counterbore of the lower housing, and remount the lower housing onto the pedestal - the neck seal, if lubricated properly, will slide over the end of the actuator shaft.

To further disassemble, remove the capscrews securing the **pedestal** to the **crankcase**, and lift the pedestal off over the actuator shaft. Take care to support the actuator shaft so that it doesn't strike the side of the crankcase and mar its surface finish. Rotate the crankshaft to bring the actuator shaft to its top dead position. Now one of the **retaining rings** at one end of the **fulcrum pin** can be removed, and the fulcrum pin can be pulled out of the **connecting rod small-end bearings** and **actuator shaft bearings**. Slide the **connecting rod** as far to one side as possible, and with a pair of plyers, remove the **oil flinger** from the **crank shaft**. Remove the **bearing cap fasteners** from both the **drive-end** and **opposite drive-end**, and remove the bearing caps. Push the crankshaft far enough out the opposite drive-end to access the **bearing locknut**. Remove the bearing locknut and **bearing washer**. Now the crankshaft can be pulled out of the drive-end of the crankcase, and the opposite drive-end **crankshaft roller bearing** should remain in the crankcase. The drive-end crankshaft roller bearing may slide off the crankshaft by hand or may have to be removed with a gear puller. The connecting rod can now be lifted out the top of the crankcase.

Inspect the **connecting rod small-end bearings** for uneven or excessive wear. If the inside diameter of the installed connecting rod small-end bearings exceeds 0.628" they should be replaced. The old bearings will have to be pressed out using a suitable mandrel. After the new bearings are pressed in they must be finish reamed to a diameter of 0.6255 to 0.6260.

Inspect the **connecting rod large-end bearing** for excessive or uneven wear. If the inside diameter exceeds 2.007" the bearing should be replaced. Again, a suitable mandrel will be necessary in order to press out the old bearing and press in the new bearing. Be sure to install the large-end connecting rod bearing with the joint to one side or the other - not at top or bottom. This bearing requires no finishing after machining.

The **actuator shaft bearing** should be inspected, replaced and finish reamed exactly as the connecting rod small-end bearings.

If the **drive-end bearing cap lip seal** is to be replaced it should be pressed into the counterbore on the inside of the bearing cap with the lip pointing toward the crankcase.

To reinstall the **crankshaft** into the **crankcase** first mount the **drive-end crankshaft roller bearing** onto the shaft. If it does not slide on by hand heat it uniformly in an oven or on a hot plate to approximately 200°F, and then quickly slide it onto the shaft and securely up against the shaft shoulder. Now set the **connecting rod** into the crankcase, and insert the crankshaft through the drive-end opening of the crankcase, through the connecting rod. Now slide the **opposite drive-end roller bearing** onto the crankshaft (it may also require heating). Install the **bearing lockwasher** with the tabs pointing away from the bearing. Make certain that the tab on the inside diameter of the washer engages the slot on the shaft. Install the **bearing locknut** with the beveled side toward the bearing. Using a suitable spanner wrench tighten the nut. Bend one of the tabs on the outside diameter of the washer down into one of the slots on the outside diameter of the bearing locknut.

Reinstall the **opposite drive-end bearing cap**. Make certain that the **bearing cap o-ring** is mounted on the "nose" of the bearing cap. Reinstall the **drive-end bearing cap**. Now, push the shaft toward the opposite drive-end as far as it will go, mount a dial indicator against the end of the **crankshaft**, then pull the shaft as far toward the drive-end as possible. The end-play should be between 0.002" and 0.010". If end-play exceeds the upper limit remove the drive-end bearing cap and install **bearing shims** as necessary to obtain the proper end-play. Be certain to install the bearing cap o-ring on the drive-end bearing cap "nose" for final installation.

Check the **actuator shaft guide bushing** for excessive or uneven wear. If it's installed inside diameter exceeds 1.385 it should be replaced. Again, a suitable mandrel is necessary to press it out of the **pedestal** and reinstall a new bushing. It will be necessary to remove the **actuator shaft lip seal** in order to remove and reinstall the **actuator shaft guide bushing**. A new actuator shaft lip seal should be installed after the new actuator shaft guide bushing is in place. The actuator shaft lip seal is to be installed with the lip pointing downward. After installation, the inside diameter of the actuator shaft guide bushing should be wiped with grease.

The remainder of the reassembly is the opposite of the disassembly procedure. Be sure to mount the **pedestal o-ring** over the "nose" of the bottom end of the **pedestal** before reinstalling the **pedestal**.

PRIMING VALVE SERVICING (Pioneer Prime only)

Figures A1459A, A1784A

The **priming valve** system, housed inside the priming chamber, is adjusted at the factory and should rarely require service. It is possible, after extended use, that wear of the holes in the **upper arm, lower arm, link** or **pins** could necessitate slight adjustment of the **stem washer** to upper arm clearance. Furthermore, it may become necessary to adjust the **valve spring** tension. The procedures for both of these adjustments are delineated in figure A1784A. The only other potential service requirement is replacement of the **stem o-ring**. To replace this o-ring, remove the elbow attached to the outlet of the priming chamber. This will expose the internal valve components. Grasping the lower end of the valve stem, remove the nut and washer located on top of the **valve washer**. Remove the valve washer and valve spring. The valve stem can now be removed through the bottom side of the **priming chamber lid**. Cut the old stem o-ring to remove it, and simply "roll" a new o-ring into place. Reassembly is the opposite of disassembly.

DISCHARGE CHECK VALVE (Pioneer Prime only)
Figures A2017A, A2170A & Fig. 17

Support the **check valve** with a sling and remove the nuts, bolts, and gasket between the check valve and pump discharge flange. If the check valve disc (3) needs to be replaced, remove the top cover (2) and insert new disc. The top cover gasket (4) should be replaced at this time.

SUCTION COVER AND WEAR RING Figure A2171A

Support the **suction cover** using a suitable sling. Remove the capscrews between the suction cover and **volute**. Inspect the **suction cover o-ring** for cuts or compression set and replace as necessary. If the **suction wear ring** shows grooves or uneven wear it should be replaced. Minor irregularities can be dressed with a fine file and crocus cloth. Wear rings may be reworked by light machining, if proper equipment is available, to correct minor irregularities. After the removal of any stock, the ring must remain within allowable clearances for maximum performance. (Consult factory for clearances for specific models)
When the pump performance drops below acceptable limits the **suction wear-ring** should be replaced. This ring can be removed by drilling two holes, of diameter slightly less than wear-ring thickness, axially through the ring 180° apart. The ring can now be collapsed and removed.

Tap new ring into place evenly around circumference with chamfer toward suction flange. Anti-seize lubrication should be applied to the "OD" of the ring prior to installation in suction cover. Make sure wear ring is installed tight against the bottom of the suction cover bore. For pumps employing an integral suction cover / volute see the following procedure.

VOLUTE REMOVAL
Figure A2172A

Support the **volute,** and remove the capscrews attaching the volute to the backplate. Inspect the **volute o-ring** for cuts or compression set, and replace as necessary.

INTEGRAL VOLUTE & SUCTION COVER Figure A2173A

Support the **volute** ,and remove the capscrews between the volute and **backplate**. If the **suction wear ring** shows grooves or uneven wear it should be replaced. Minor irregularities can be dressed with a fine file and crocus cloth. Wear rings may be reworked by light machining, if proper equipment is available to correct minor irregularities. After the removal of any stock, the ring must remain within allowable clearances for maximum performance. When the pump performance drops below acceptable limits the **volute wear ring** should be replaced. This ring can be removed by drilling two holes, of the proper size, axially, through the ring 180° apart. The ring can now be collapsed and removed.

Tap new ring into place evenly around circumference with chamfer toward suction flange. Anti-seize lubrication should be applied to o.d. of ring prior to installation in volute, make sure wear ring is installed tight against shoulder.

NOTE: Any further disassembly of this pump requires the draining of oil from the integral seal oil reservoir. Remove the pipe plug at the bottom of the **pump bracket** and drain oil.

IMPELLER REMOVAL

Figure A2174A

Remove the **impeller screw** and **impeller washer** at the center of the **impeller**. Utilizing a properly sized gear puller, evenly pry between the back shroud of the impeller and the **backplate**. Take care not to lose the **impeller shims** inside the impeller bore or the **impeller key**. As the impeller is being removed from the **shaft** ensure that the **seal spring** is not lost or damaged. Inspect the impeller and replace or repair if warranted.

SEAL REMOVAL (Rotating Element)

Figure A2175A

Once the **impeller** is removed the **rotating assembly** of the seal (bellows, spring and retainer) can slide off of the **shaft** as a unit. Apply a light coat of oil to the shaft to help free the rotating assembly. If the seal is to be reused, take care to protect this assembly from damage.

BACKPLATE REMOVAL

A2176A

The **backplate** can now be removed by removing the capscrews attaching the **bracket** and the backplate. Slide the backplate straight off of the **shaft** to prevent any damage to the **seal seat** or the surface of the shaft. The seal seat can now be pressed out of the backplate bore taking care not to break the seat. The entire **seal assembly** can now be inspected for any damage that will require replacement.

BEARING HOUSING/ BRACKET

Figures A2177A, A2183A

If the frame **bearings** require servicing it will be necessary to remove the **bearing housing** from the driver and the pump end from the bearing housing. Remove the coupling guard as necessary. Supporting the bearing housing with a hoist and sling remove bolts holding the housing to the baseplate. Now the bearing housing can be moved away from the driver for further servicing. Loosen the setscrews holding the **timing belt pulley** (Pioneer Prime only) to the bearing housing **shaft**. Remove the ¼-20UNC socket head screw from the **wedge key** in the pulley. Insert a 5/16-18UNC capscrew into the threads of the wedge key, and tighten until the key is loose. Reinstall the ¼-20UNC socket head screw until the threads just engage the non-visible half of the wedge key, and grasping the head of the screw, pull the key out. Slide the pulley off the end of the shaft.

On the pump-end of the **bearing housing** remove the capscrews and the **bracket capscrew seals** (washers) connecting the **bracket** and the bearing housing. Later models may use **bracket seal o-rings** rather than bracket capscrew seals. Gently slide the bracket off the **shaft** to protect the **bracket lip seals**. Later models may have drain slot and a **dowel pin** on the side of the bracket facing the pump-end bearings. If these are present, note their positions for reassembly. On the drive-end of the bearing housing, remove the capscrews holding the **bearing cap** or the **SAE bracket** to the housing. Gently slide the bearing cap or the SAE bracket off of the shaft to protect the lip seal if it is to be re-used.

Note: Changes have been made which will alter the following disassembly and reassembly procedures relative to earlier models.

In newer models a rotating **labyrinth seal** has been added between the pump-end bearing and the bracket to protect the bearings. In the event of both a mechanical seal and bracket lip seal leak, this device will prevent contamination of the bearings. To accommodate the labyrinth seal, the pump-end bearing has been moved back on the shaft. If a new shaft is ordered for an earlier pump model that is not equipped with the labyrinth seal it is necessary to make up this gap between the bearing and bracket so that the **wave spring** will still serve to pre-load the pump-end bearing. In such cases a **bearing spacer** can be provided along with the new shaft. This bearing spacer will fit in the pump-end of the bearing housing where the **labyrinth seal carrier** would fit on later models. If the pump is equipped with the labyrinth seal, lubricate the exposed portion of the pump-end of the shaft and remove the shaft assembly, including **shaft, bearings and the bearing locknut and washer** from the drive-end of the bearing housing. This operation may require placing a block of wood against the impeller-end of the shaft and tapping with a hammer or using a standard press against the impeller end of the shaft.
If the bearings are to be re-used, the shaft should be pressed out rather than tapped out with a hammer. The labyrinth seal carrier and labyrinth seal may come out with the shaft or may stay in the housing depending upon the tightness of the carrier fit to the housing. If the labyrinth carrier and labyrinth seal remain in the housing, they can be pushed out after the shaft and bearings have been removed, or they can be pulled off the shaft if they came out with the shaft. If the pump is an earlier model that has had a prior shaft replacement, there may be a bearing spacer in the frame bore in place of the labyrinth seal carrier. This spacer will remain in the bearing housing bore when the shaft is removed. It can be left in place or removed at the discretion of the service mechanic. Whether a spacer or labyrinth carrier was installed, there will be a wave spring between the outer race of the pump-end bearing and the spacer or labyrinth carrier. Do not lose this spring. If your pump was not equipped with this spring, then contact the factory to acquire one. With the shaft and bearing assembly out of the housing the bearings can be inspected and replaced.

CAUTION!!!

Any work on the shaft and bearing assembly should be performed by experienced personnel in a properly equipped shop. We recommend that the **bearings** be replaced any time they are removed from the **bearing housing**. Clean the bearing housing and the shaft and other components except the bearings, with cleaning solvent and a soft cloth. Inspect all parts and blow components dry with compressed air. If the **bearings** are to be replaced, the old bearings can be removed using a suitable gear puller. It is recommended that pump-end and drive-end **lip seals** also be replaced at this time.

WARNING!!!

When using cleaning solvent be sure to have adequate ventilation, as most solvents are toxic and flammable. Follow all precautions pertaining to the solvent and keep area free from excessive heat, sparks and flame.
Rotate the bearings by hand and check for any roughness or wear. If any roughness, wear or discolored areas are present, replace the bearings. Also, check the fit between the bearings and

shaft for a tight press fit and between the bearings and the housing for a snug slip fit. If the fits are not correct then replace the bearings, shaft or the bearing housing as indicated by wear. If bearings are to be replaced use a bearing puller to remove then from the shaft.

BEARING HOUSING REASSEMBLY
Figures A2177A & A2178A

After all components have been inspected, repaired, and or replaced ensure all parts are clean and ready for assembly as indicated above. Use extreme caution, during assembly, to protect all parts from dirt and damage. The bearings should be installed using the bearing manufacturer's recommended installation procedure.

CAUTION!!!

If heat is used to install the **bearing** use an induction heater, electric oven or hot plate. Do not use a direct flame. Heat the bearings to a uniform temperature of 220° F (105° C) maximum, and slide each bearing onto the **shaft** until firmly seated against the shaft shoulder. Once the bearing is removed from the heat it must be placed over the shaft and seated against the shoulder very quickly or it will seize to the shaft in the wrong position. After the bearings have cooled; ensure that they are still seated against the shaft shoulder. If they are not seated use a sleeve, of the correct size, and a press to seat bearing. This sleeve and press can be used if heating the bearing is not practical, but only press against the inner race of the bearing.

If a single drive-end bearing is to be used in conjunction with a new shaft, make sure that the **shaft bearing spacer** is installed on the drive-end of the shaft before the bearing is installed. Heat the shaft bearing spacer just as with the bearing, and slide it over the shaft and firmly against the shaft shoulder. If an older shaft is to be used, a shaft bearing spacer will not be needed. The older, single bearing shaft design can be identified by the length of the bearing step at the drive-end of the shaft – it will be wide enough to accommodate only one bearing. If double angular contact bearings are to be used, a shaft bearing spacer will not be used. If an earlier, single drive-end bearing pump is to be retrofitted to a double angular contact drive-end bearing arrangement, be sure to remove the **bearing spacer** which is mounted in the drive-end bore of the bearing housing.

With the **Drive-End bearing** firmly seated against the shaft shoulder (or drive-end bearing spacer) install the **bearing lockwasher** and the **bearing locknut**. Refer to **A2178A** for the correct orientation. Ensure that the washer tab on the inside diameter is engaged in the slot in the shaft and the tab pointed toward the bearing. After the bearing nut has been tightened, bend one of the tabs on the outside diameter of the washer to engage one of the slots in the nut.

Check that the **bearing housing** is clean and that the bearing bores are free of any burrs or nicks. Ensure that the **bearing housing spacer** (not used with double drive-end bearings) is installed in the drive end bore of the housing. Wait for bearing to cool, then, from the drive-end of the bearing housing, slide the shaft/bearing assembly into the drive-end of the housing. Press the drive-end of the **shaft** until the **drive-end bearing** contacts the housing or bearing spacer shoulder.

Apply a light coat of oil or grease to the **drive-end lipseal** that is installed in the **bearing housing cover** or **SAE bracket**. Slide the bearing housing cover or SAE bracket over the drive end of the shaft taking care to protect the lip seal. Secure the housing cover to the bearing housing using the capscrews.

The following procedures are most easily performed with the bearing housing in a vertical position, pump-end up.

For pumps to be equipped with the Labyrinth bearing protector, install as follows. Lubricate the pump-end bore of the bearing housing with a film of grease or motor oil. Install the **labyrinth carrier o-ring** into the shallower of the two grooves in the outside diameter of the **labyrinth seal carrier.** Lubricate this o-ring with grease or motor oil. Place the **wave spring** over the shaft and up against the outer race of the **pump-end bearing.** Place the labyrinth seal carrier into the bearing housing bore with the four small holes facing the bearing.
Press the labyrinth seal carrier into the bore until it contacts the wave spring. Lubricate the o-rings at the inside diameter and outside diameter of the **labyrinth seal** with motor oil or hose assembly lube. **DO NOT USE GREASE OR SILICONE LUBRICANT** for this step. Press the seal into the bore of the labyrinth seal carrier. Be sure to orient the labyrinth seal with the notch at the bottom.

If the pump is to be assembled without the labyrinth seal bearing protector, then the pump-end **bearing spacer** must be installed to take up the room where the labyrinth seal carrier would ordinarily go. After the shaft and bearings are installed into the bearing housing and the bearing cap or SAE bracket is installed, place the wave spring against the outer race of the pump-end bearing. Slide the bearing spacer into the pump-end bore of the bearing housing and up against the wave spring. If an earlier style shaft is used, it will not be necessary to use the pump-end bearing spacer. Again, the earlier shaft can be identified by checking the bearing step at the drive-end of the shaft; if it is wide enough for only one bearing, then this is the older style shaft.

Apply a coat of oil or grease to the **pump-end bracket lip seals**. If new bracket lip seals are to be installed, make sure they are pressed into the bracket bore with the lips both faced toward the impeller (tandem arrangement). Press one of the lip seals in from either side of the bracket until it is flush with the face of the bracket bore. Press the second lip seal in from the opposite side until it is either flush with the face of the bracket bore or firmly seated against the first lip seal. Slide the **bracket** over the pump-end of the **shaft,** protecting the lip seals. Check that the **bracket drain plug** is located in the bottom position. Secure the bracket to the **bearing housing** using capscrews and new **bracket capscrew seals**. Newer pumps will not use bracket capscrew seals but, instead, use small **bracket seal o-rings**. If the bracket is a newer style which uses these o-rings it can be identified as such by the presence of o-ring counterbores on the backside of each bracket mounting hole (the side of the bracket that faces the bearing housing). These o-rings are most easily installed by inserting the bracket capscrews through the holes and then sliding the o-rings over the capscrew threads and up against their counterbores.

Moving the shaft in both axial directions should produce a total endplay between 0.002"and 0.010". Use **bearing shims** to obtain the proper endplay.

BEARING HOUSING TO DRIVER REASSEMBLY Figures A2177A, A2183A, A2187A

For Pioneer Prime pumps slide the **timing belt sprocket** onto the pump shaft and all the way up against the shaft shoulder. Assemble the two halves of the **wedge key** so that there is approximately ¼" gap between the two halves with the ¼-20UNC socket head screw installed. Place the assemble wedge key into the shaft keyway, and slide it into the pulley keyway so that the key is approximately flush with the outer face of the pulley. Tighten the ¼-20UNC socket head screw until the key is firmly locked into the keyway. Tighten the sprocket set screws to the pump shaft. See the section on **vacuum pump maintenance** for servicing and installation details. Install the **shaft key** and **flexible coupling hub** onto the pump shaft, but do not secure. Position the bearing housing assembly into its running location and align to the driver as per the alignment section in this manual.

After the **bearing housing** assembly and driver have been aligned, secure the bearing housing assembly to the baseplate, then recheck alignment. Check that the coupling hub is secured to the **shaft** and install the coupling guard.

NOTE: For SAE bracket equipped bearing frames, coupling alignment is attained by simply bolting the bearing frame SAE bracket to the engine bellhousing.

FLYWHEEL COUPLING INSTALLATION / SAE BRACKET EQUIPPED PUMPS
Figure A2184A

Pioneer pumps purchased with SAE brackets and Flywheel couplings are shipped with the coupling mounted to the shaft in the correct axial location for engines with bell housings and flywheels manufactured to SAE standard dimensions.

CAUTION!!!

If the pump is to be mounted to the engine by other than Pioneer Pump, Inc. factory personnel, the assembler must take full responsibility to verify that the pump shaft does not bear against or make any contact with the engine crankshaft or flywheel and that the flywheel coupling is mounted in such a position so as not to transmit any axial thrust to the flywheel. Failure to verify this could result in severe engine damage.

Bolt the aluminum drive ring of the flywheel coupling to the flywheel register, and torque the fasteners (grade 8) to 372 in-lbs. Place the notched key (provided by Pioneer) into the taperlock bushing, and position the rubber element and taperlock bushing on the shaft as shown on illustration A2184A (refer to the preceding caution). Torque the taperlock bushing screws to 430 in-lbs.

BACKPLATE REASSEMBLY
Figure A2176A

With the driver and **bearing housing** assemblies now in their final position, the **backplate** can be installed. Install a new **bracket o-ring** over the register of the **pump-end bracket** and ensure it is against the face of the bracket. Slide the **backplate** over the shaft and secure it to the bracket with capscrews from the bracket side.

SEAL REASSEMBLY Figure A2175A

Always handle all seal parts with extreme care to prevent damage. Be especially cautious not to contaminate the precision finished mating faces as even fingerprints can shorten seal life. If required, clean the faces with a non-oil based solvent and a clean, lint-free cloth. Use a concentric pattern while wiping to prevent scratching the faces.

You should carefully inspect all seal parts for any damage or wear. Any scoring or grooves in the mating faces could cause the seal to leak so it should be refurbished and mating faces relapped or replaced with a new complete **seal assembly**.

Clean the **shaft** and remove any nicks, cuts or burrs. Lubricate the outside diameter of the **mechanical seal stationary seat** o-ring and inside diameter of the bellows with 30 wt. to 80 wt. motor oil or hydraulic hose assembly lube and apply a drop of light lubricating oil to the seal faces.

Slide the **stationary seat** over the shaft and carefully press into the bore of the **backplate.** Ensure that it is squarely seated into the backplate. Alternately, the seat can be installed into the backplate counterbore before the backplate is installed, but extreme caution will be required when installing the backplate to avoid bumping the stationary seat against the shaft surface and chipping it. Now slide the **mechanical seal rotating assembly** over the **shaft** up to the stationary seat with the polished face (primary ring) of the rotating element toward the polished face of the seat. Slide the spring over the outside of the seal assembly up to the retainer flange. Compress the spring, by hand, to make sure that the mechanical seal rotating assembly is firmly seated against the mechanical seal stationary seat.

IMPELLER REASSEMBLY Figure A2174A

Inspect the **impeller** for any cracks or badly worn areas. Replace if necessary. Install the **impeller key** into the shaft keyway, and slide impeller over the **shaft**. Ensure that the **seal spring** is in place over the outside diameter of the impeller hub. Temporarily install the impeller lockscrew, and tighten it enough to ensure that the impeller is fully bottomed against the end of the shaft. With the impeller firmly against the shaft end, measure the gap between the back vanes of the impeller and the face of the **backplate**. If necessary, remove the impeller and place **impeller shims** (0.005, 0.010 and 0.015 thick) in the bore of the impeller until the gap is between 0.020" and 0.035." Each time the impeller is installed on the shaft make sure the seal spring is in place over the outside diameter of the impeller hub. Once the desired gap between the back vanes and backplate is attained, remove the **impeller screw** and apply #262 red loctite™ or equivalent to the impeller screw threads. Reinstall the **impeller washer** and **impeller screw** and tighten (See torque specs, page 17).

VOLUTE REASSEMBLY Figures A2173A, A2172A, A2171A

For a one-piece **volute** and suction cover, inspect the **suction wear-ring** and review the wear ring section in this manual if replacement is required. Slide a new **o-ring** over the register of the **backplate**. Make sure the o-ring is up against the face of the backplate. Lubricate the o-ring with grease. Position the volute, with the discharge nozzle in the same orientation as the piping, and secure with capscrews.

For separate volute and **suction cover**, check on the wear ring section in this manual for replacement, if required. Place a new **o-ring** over the register of the suction cover, lubricate with grease and seat it against the cover face. Secure to **volute** with appropriate capscrews.

DISCHARGE CHECK VALVE REASSEMBLY

Figures A2170A and 17

Refer to the **discharge check valve** parts illustration if any repairs are to be made. Install the **gasket** and secure to the discharge nozzle with bolts and nuts. Ensure that the check valve is installed for the correct flow direction.

PRIMING CHAMBER REASSEMBLY

Figure A2169A

Refer to the **Priming Chamber / Valve** section if any repairs or adjustments are required. Install the gasket and use nuts and bolts to attach the priming chamber, with spool, to the suction flange of the pump.

LUBRICATION – BEARING FRAME

The lubrication of the ball bearings and will depend on speed, power load, ambient temperature, contamination, moisture, intermittent or continuous service and other factors. These regreasing recommendations are general in nature and are to be used with good judgment and consideration of the pump service. The following is a suggested lubrication interval chart:

Pioneer Frame Size	2200 RPM	1800 RPM	1200 RPM
8.5 AK Frame	5,000 hrs.	7,500 hrs.	10,000 hrs.
12.5 AK Frame	2,500	3,500	5,000

To lubricate the ball bearings, remove the plastic covers from the zerk fittings. Ensure that the zerk fitting and the end of the grease gun are clean. Use only a hand-operated grease gun with ball bearing grease as shown below, or equal:

Texaco Starplex Moly 2
Mobile MobiLux No. EP2
Shell Alvania EP2
Chevron SRI

LUBRICATION – SEAL OIL RESERVOIR

See Figure A2174A

This pump is provided with a seal oil reservoir that permits this unit to run dry. The reservoir supplies lubrication and cooling to the outboard side of the mechanical seal without any liquid in the pump. Monitor the oil level sight gauge and add oil as indicated. During normal operation it is suggested to change this oil every three (3) months. If the sight gauge shows indication of

contamination or discoloration, change oil more frequently. Use turbine oil with an ISO rating of 32 or lower. If you have unusual pumping conditions consult **Pioneer Pump, Inc.** Fill and/or drain oil by removing the bracket plugs. The capacity of this reservoir varies with the size of the pump, but is generally 2.5 quarts to 5 quarts.
Oil used in the reservoir should be ISO VG 32 Turbine Oil or Automatic transmission oil, equivalent to one of the following manufacturer's products:

Chevron Turbine oil GST 32
Mobile DTE 797
Shell Turbo T oil 32

TORQUE VALUES

SIZE UNC	MATERIAL		
	304 SS	GRADE 5 BOLTS	GRADE 8 BOLTS
¼	3.0 lb-ft	9 lb-ft	13 lb-ft
5/16	7.0 lb-ft	19 lb-ft	27 lb-ft
3/8	13 lb-ft	34 lb-ft	48 lb-ft
7/16	20 lb-ft	54 lb-ft	77 lb-ft
1/2	31 lb-ft	83 lb-ft	117 lb-ft
9/16	45 lb-ft	120 lb-ft	170 lb-ft
5/8	63 lb-ft	165 lb-ft	234 lb-ft
3/4	112 lb-ft	293 lb-ft	415 lb-ft
7/8	180 lb-ft	474 lb-ft	670 lb-ft
1	270 lb-ft	710 lb-ft	1000 lb-ft
1 1/4	540 lb-ft	1421 lb-ft	2000 lb-ft

The above values are general in nature.

PARTS ORDER

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 VIN (Vehicle Identification Number)

SPARE PARTS

Spare parts should be kept on hand to reduce downtime. Service of a particular pump determines the quantity and range of spares. At a minimum the following parts should be stocked.

Suction wear ring
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.

TROUBLESHOOTING

Symptom	Possible Causes	Symptom	Possible Causes
No Discharge	1,2,3,4,5,7,8,9,10,17,18,19,20, 37	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
Reduced Capacity	2,3,4,5,7,8,9,10,11,17,19,20,21,38 39,40,47	Seal: excessive leakage, short life, seal housing overheating	22,23,25,33,34,35,36,41,44, 45,46
Reduces Pressure	5,7,8,11,13,18,19,38,39,40,47		
Loss of Prime	2,3,4,7,10,11,20,21,22,23	Bearings: over heating, short life, noise	26,27,28,29,30,31,32,33,34, 35,36,41,42,43,44
Power consumption excessive, driver runs hot	6,12,13,17,18,19,24,33,34,35,363 7,38,41,42,43,44	Pump overheating, seizes	1,8,9,14,33,34,35,36,41,42,43, 44
		Corrosion, erosion, pitting, oxidation or other loss of material	7,8,11,14,15,16

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 with foreign material
18. Rotation direction wrong
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 lubrication/bearings
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. Worn wear rings
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 settled

STORAGE

STORAGE

This is adequately prepared for outside storage prior to shipment, but use the following list of additional suggestions for extended storage.

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 a rust preventive.

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 and 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).