INSTALLATION AND START-UP INFORMATION

Optimum performance of the pump is dependent upon the entire liquid system and will be obtained only with the proper selection, installation of plumbing and operation of the pump and accessories.

DISCHARGE CONDITIONS: OPEN ALL VALVES BEFORE STARTING SYSTEM to avoid deadhead overpressure condition and severe damage to the pump or system. Install a Pulsation Dampening device on the discharge head or in the discharge line as close to the head as possible. Be certain the pulsation damper (Prrr-o-lator) is properly precharged for the system pressure (see individual Data Sheet).

A reliable Pressure Gauge should be installed near the discharge outlet of the high pressure manifold. This is extremely important for adjusting pressure regulating devices and also for proper sizing of the nozzle or restricting orifice. The pump is rated for a maximum pressure; this is the pressure that is read at the discharge manifold of the pump, NOT AT THE GUN OR NOZZLE.

Use PTFE thread tape or pipe thread sealant (sparingly) connect accessories or plumbing. Exercise caution not to wrap tape beyond the last thread to avoid tape from becoming lodged in the pump or accessories. This condition will cause a malfunction of the pump or system.

PRESSURE REGULATION: All systems require both a primary pressure regulating device (i.e., regulator, unloader) and a secondary pressure safety relief device (i.e., pop-off valve, safety valve). The primary pressure device must be installed on the discharge side of the pump. The function of the primary pressure regulating device is to protect the pump from over pressurization, which can be caused by a plugged or closed off discharge line. Over pressurization can severely damage the pump, other system components and can cause bodily harm. The secondary safety relief device must be installed between the primary device and pump. This will ensure pressure relief of the system if the primary regulating device fails. Failure to install such a safety device will void the warranty on the pump.

When the high pressure system is left running with the trigger gun off, the by-pass liquid can be routed to drain or to the pump inlet. If routed to the pump inlet, the by-pass liquid can quickly develop excessive heat and result in damage to the pump. An AUTO SHUT-OFF ASSEMBLY may also be used. A THERMO VALVE installed in the by-pass line is recommended to protect the pump. An AUTO SHUT-OFF ASSEMBLY may also be used. Liquid can be routed to drain or to the pump inlet. If routed to the pump inlet, the by-pass liquid can quickly develop excessive heat and result in damage to the pump. An AUTO SHUT-OFF ASSEMBLY may also be used.

A worn nozzle will result in loss of pressure. Do not adjust pressure regulating device to compensate. Replace nozzle and reset regulating device to the pop-off valve, safety valve). The primary pressure device must be installed on the discharge side of the pump. The function of the primary pressure regulating device is to protect the pump from over pressurization, which can be caused by a plugged or closed off discharge line. Over pressurization can severely damage the pump, other system components and can cause bodily harm. The secondary safety relief device must be installed between the primary device and pump. This will ensure pressure relief of the system if the primary regulating device fails. Failure to install such a safety device will void the warranty on the pump.

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All systems require both a primary pressure regulating device (i.e., regulator, unloader) and a secondary pressure safety relief device (i.e., pop-off valve, safety valve). Failure to install such relief devices could result in personal injury or damage to the pump or to system components. CAT PUMPS does not assume any liability or responsibility for the operation of a customer's high pressure system.

WARNING

All systems require both a primary pressure regulating device (i.e., regulator, unloader) and a secondary pressure safety relief device (i.e., pop-off valve, safety valve). Failure to install such relief devices could result in personal injury or damage to the pump or to system components. CAT PUMPS does not assume any liability or responsibility for the operation of a customer's high pressure system.

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CAUTION: Before commencing with service, shut off drive (electric motor, gas or diesel engine) and turn off water supply to pump. Relieve all discharge line pressure by triggering gun or opening valve in discharge line.

After servicing is completed, turn on water supply to pump, start drive, reset pressure regulating device and secondary valve, read system pressure on the gauge at the pump head. Check for any leaks, vibration or pressure fluctuations and resume operation.

SERVICING THE VALVES

Disassembly

NOTE: Usually the valve assembly will remain together while being removed.

1. Remove the hex Valve Plugs (top discharge, bottom inlet).
2. Examine the O-Ring under the Valve Plug for cuts or distortion and replace if worn. Lubricate new O-Rings before installing.

NOTE: On Models 43HS, 45, 56, 57, 59, 60, 70 there is an extended Valve Plug with O-Ring and Back-up-Ring. Install the Back-up-Ring, then the O-Ring into the groove at the end of the Valve Plug (refer to Tech Bulletin 058).
3. Grasp Spring Retainer by tab at the top with pliers and remove from valve chamber.
4. To separate the valve assembly, insert a screwdriver into the side of the Retainer and press on the back side of the Valve to begin separation, then between the Retainer and Valve Seat to separate completely.
5. If the valve assembly separates during removal, remove the Spring and Valve with a needle nose pliers.
6. Using a reverse pliers, remove the Valve Seat from the manifold chamber.

Reassembly

1. Examine Spring Retainers for internal wear or breaks in the structure and replace as needed.
2. Examine Springs for fatigue or breaks and replace as needed.
3. Examine Valves and Seats for grooves, pitting or wear and replace as needed.
4. Examine Seat and Valve Plug O-Rings for cuts or wear and replace as needed. Lubricate and install new O-Ring onto outside diameter of Seat and Valve Plugs.

NOTE: Inlet and discharge valve parts are interchangeable. Two Valve Kits are needed for complete valve change.
5. Grasp new Valve Assembly by tab at top with pliers and push into valve chamber. Be certain Valve Assembly is completely seated in valve chamber.

NOTE: For certain applications apply liquid gasket to the O-Ring crevices and seal surfaces (refer to Tech Bulletin 053).

NOTE: For Corrosion Resistant Models remember to install the Coil Spring between the Valve Plug and Retainer (refer to Tech Bulletin 046).

6. Apply Loctite 242 to the threads of the Valve Plug, thread into manifold port and torque per chart.
SERVICING THE SEALS

Disassembly
1. Remove the Manifold Head as described in SERVICING THE PLUNGERS section.
2. Place Manifold Head on work surface with crankcase side up.
3. On 5PFR and 7PFR plunger pumps prior to May of 1989, remove Snap Ring and Lo-Pressure Seal from each Seal Case. Discard Snap Rings (refer to Tech Bulletin 054).
4. On 5PFR and 7PFR plunger pumps after May of 1989, remove Lo-Pressure Seal from each Seal Case.
5. On 15PFR plunger pumps, remove Snap Ring and Lo-Pressure Seal from each Seal Case.
6. Remove Seal Case from each seal chamber. Remove O-Ring from outside diameter of Seal Case.
7. Hi-Pressure Seal Models: The Hi-Pressure Seal is generally easily removed from the manifold without any tools. If extremely worn a reverse pliers may be used.
8. V-Packing Models: The Female Adapter, V-Packings and Male Adapter are easily removed from manifold without any tools. If extremely worn a reverse pliers may be used.

Reassembly
V-Packing Models:
1. Lubricate seal chamber in the manifold.
   NOTE: For certain applications apply liquid gasket to the O-Ring crevices and seal surfaces (refer to Tech Bulletin 053).
2. Insert Male Adapter with notches down and “v” side up and press completely into chamber by hand.
3. Lubricate V-Packings and install one at a time with grooved side down.
4. Install Female Adapter with grooved side down.
5. Examine Seal Case O-Ring and replace if worn. Lubricate new O-Rings before installing.
6. Thread Seal Case into manifold and tighten with special seal case tool. Torque per chart.
Hi-Pressure Seal Models:

1. Lubricate seal chamber in manifold.
   
   **NOTE:** For certain applications apply liquid gasket to the O-Ring crevices and seal surfaces (refer to Tech Bulletin 053).

2. Carefully square Hi-Pressure Seal into position by hand with the **grooved side down** (metal back facing out).
   
   **NOTE:** When alternate materials, the fit of the special materials may be snug and require gently driving the LPS into position with a cylinder of the same diameter to assure a square seating and no damage to the LPS.

3. Examine Seal Case O-Ring and replace if worn. Lubricate new O-Ring before installing.

4. Secure Hi-Pressure Seal into position by threading Seal Case into manifold. Tighten Seal Case with special seal case tool. Torque per chart.

Lo-Pressure Seal - All Models:

1. Examine Lo-Pressure Seals for wear or broken springs and replace if necessary.

2. Install Lo-Pressure Seal into each seal case with **garter spring down**.

3. On 5PFR and 7PFR plunger pumps **do not use** Snap Ring (refer to Tech Bulletin 054).

4. On 15PFR plunger pumps **install Snap Ring** into each Seal Case.

5. Install the Seal Retainer with new Wick onto each plunger rod with **tab down and wick out**.

6. Rotate Crankshaft by hand so the two outside plungers are extended equally.

7. Lightly lubricate the Ceramic Plunger, then carefully slide the Manifold Head over the Ceramic Plunger, supporting it from the underside to avoid damage to the plungers or seals. Press the Manifold Head into the Crankcase until flush.

8. Replace two (2) Lockwashers, two (2) Socket Head Screws for (4) Flange Nuts and torque per chart.

---

**SERVICING THE PLUNGERS**

**Disassembly**

1. Using an M8 allen wrench on the 5PFR pumps, a M14 hex tool on the 7PFR pumps, or a M17 hex tool on the 15PFR pumps, remove the two (2) Socket Head Screws, and two (2) Lockwashers or four (4) Flanged Nuts.

2. Rotate Crankshaft by hand to start separation of Manifold head from Crankcase.

3. Insert two flat head screwdrivers on opposite sides to further separate Manifold Head from Crankcase or support the underside of the Manifold Head and tap lightly with a mallet on the backside of the Manifold Head.

   **CAUTION:** KEEP MANIFOLD PROPERLY ALIGNED WITH CERAMIC PLUNGERS WHEN REMOVING TO AVOID DAMAGE TO EITHER PLUNGERS OR SEALS.

4. Remove Oil Pan and slide out Seal Retainer with Wick.

5. Using an M12 hex tool on the 5, 7 and 15PFR pumps, or an M11 hex tool on the OEM 5, and 7PFR pumps, loosen the Plunger Retainer about three to four turns.

6. Push the Ceramic Plunger back towards the Crankcase to separate it from the Plunger Retainer and proceed with un-threading the Plunger Retainer by hand.

7. Remove the Plunger Retainer, O-Ring, Back-up-Ring and Gasket. Stud may stay on Plunger Rod or come off with Plunger Retainers.

8. Remove the Ceramic Plunger, Keyhole Washer and Barrier Slinger from Plunger Rod.

**Reassembly**

1. Visually inspect Crankcase Oil Seals for deterioration or leaks. Contact CAT PUMPS for assistance with replacement. See SERVICING THE CRANKCASE section.

2. Examine Barrier Slingers and Keyhole Washers for damage. Slide onto Plunger Rod with **concave side away from Crankcase**.

3. Examine Ceramic Plunger for scoring, scale build-up, chips or cracks and replace as needed.

4. Slide Ceramic Plunger over each Plunger Rod.

   **NOTE:** Ceramic Plunger can only be installed in one direction (front to back). Do not force onto rod.

5. Examine O-Ring and Back-up-Ring on Plunger Retainer and replace if cut or worn. Lubricate O-Rings for ease of installation and to avoid damage to the O-Rings.
6. Install new Gasket, then O-Ring, then Back-up-Ring onto each Plunger Retainer.

**NOTE:** OEM models have a longer Plunger Retainer Stud.

7. Apply Loctite 242 to exposed threads of Stud and thread Plunger Retainer onto Plunger Rod. Torque per chart.

8. Install the seal Retainer with NEW Wick onto each rod with tab down and wick out.

**NOTE:** Do not lubricate wicks at initial start-up. Operate for 10 to 15 minutes to allow grease from LPS to penetrate the plunger surface, then lubricate as needed.

9. Rotate Crankshaft by hand so the two outside plungers are extended equally.

10. Lightly lubricate the Ceramic Plungers, then carefully slide the Manifold Head over the Ceramic Plungers supporting it from the underside to avoid damage to the Ceramic Plungers or Seals. On the high pressure V-Packing models or larger manifolds, it may be necessary to gently tap with a soft mallet until the manifold is flush with the crankcase.

11. Replace two (2) Lockwashers, two (2) Socket Head Screws or four (4) Flanged Nuts and torque per chart.

**SERVICING THE CRANKCASE SECTION**

1. While Manifold, Plungers and Seal Retainers are removed, examine Crankcase Oil Seals for leaking and wear.

2. Check for any signs of leaking at Bearing Covers, Rear Cover, Drain Plug or Bubble Gauge.

3. Check oil level and for evidence of water in oil.

4. Rotate Crankshaft by hand to feel for smooth bearing movement.

5. Examine Crankshaft Oil Seals externally for drying, cracking or leaking.

6. Consult CAT PUMPS or your local distributor if crankcase service is evidenced.

*See Section I of the Plunger Pump Service Video for additional information.*
**INLET CONDITION CHECK-LIST**

**Review Before Start-Up**

Inadequate inlet conditions can cause serious malfunctions in the best designed pump. Surprisingly, the simplest of things can cause the most severe problems or go unnoticed to the unfamiliar or untrained eye. REVIEW THIS CHECK-LIST BEFORE OPERATION OF ANY SYSTEM. Remember, no two systems are alike, so there can be no ONE best way to set-up a system. All factors must be carefully considered.

**INLET SUPPLY** should exceed the maximum flow being delivered by the pump to assure proper performance.
- Open inlet shut-off valve and turn on water supply to avoid starving the pump. **DO NOT RUN PUMP DRY.**
- Temperatures above 130°F are permissible. Add 1/2 PSI inlet pressure per each degree F over 130°F. Elastomer or RPM changes may be required. See Tech Bulletin 002 or call CAT PUMPS for recommendations.
- Avoid closed loop systems especially with high temperature, ultra-high pressure or large volumes. Conditions vary with regulating/unloader valve.
- Low vapor pressure liquids, such as solvents, require a booster pump and C.A.T. to maintain adequate inlet supply.
- Higher viscosity liquids require a positive head and a C.A.T. to assure adequate inlet supply.
- Higher temperature liquids tend to vaporize and require positive heads and C.A.T. to assure adequate inlet supply. When using an inlet supply reservoir, size it to provide adequate liquids to accommodate the maximum output of the pump, generally a minimum of 6-10 times the GPM (however, a combination of system factors can change this requirement); provide adequate baffling in the tank to eliminate air bubbles and turbulence; install diffusers on all return lines to the tank.

**INLET LINE SIZE** should be adequate to avoid starving the pump.
- Line size must be a minimum of one size larger than the pump inlet fitting. Avoid tees, 90 degree elbows or valves in the inlet line of the pump to reduce the risk of flow restriction and cavitation.
- The line MUST be a FLEXIBLE hose, NOT a rigid pipe, and reinforced on one side only. Avoid 90 degree elbows or valves in the inlet line of the pump to reduce the risk of flow restriction and cavitation.
- The simpler the inlet plumbing the less the potential for problems. Keep the length to a minimum, the number of elbows and joints to a minimum (ideally no elbows) and the inlet accessories to a minimum.
- Use pipe sealant to assure air-tight, positive sealing pipe joints.

**INLET PRESSURE** should fall within the specifications of the pump.
- Acceleration loss of liquids may be increased by high RPM, high temperatures, low vapor pressures or high viscosity and may require pressurized inlet and C.A.T. to maintain adequate inlet supply. **DO NOT USE C.A.T. WITH SUCTION INLET.**
- Optimum pump performance is obtained with +20 PSI (1.4 BAR) inlet pressure and a C.A.T. for certain applications. With adequate inlet plumbing, most pumps will perform with flooded suction. Maximum inlet pressure is 60 PSI (4 BAR).
- After prolonged storage, pump should be rotated by hand and purged of air to facilitate priming. Disconnect the discharge port and allow liquid to pass through pump and measure flow.

**INLET ACCESSORIES** are designed to protect against overpressurization, control inlet flow, contamination or temperature and provide ease of servicing.
- A shut-off valve is recommended to facilitate maintenance.
- Installation of a C.A.T. is essential in applications with stressful conditions such as high temperatures, booster pump feed or long inlet lines. **Do not use C.A.T. with negative inlet pressure.**
- A stand pipe can be used in some applications to help maintain a positive head at the pump inlet.
- Inspect and clean intake filters on a regular schedule to avoid flow restriction.
- A pressure transducer is necessary to accurately read inlet pressure. (Short term, intermittent cavitation will not register on a standard gauge.)
- All accessories should be sized to avoid restricting the inlet flow.
- All accessories should be compatible with the solution being pumped to prevent premature failure or malfunction.
- Optional inlet protection can be achieved by installing a pressure cutoff switch installed before the pump. Surprisingly, the simplest of things can cause the most severe problems or go unnoticed to the unfamiliar or untrained eye. **Review this check-list before operation of any system.** Remember, no two systems are alike, so there can be no one best way to set-up a system. All factors must be carefully considered.

**BY-PASS TO INLET** Care should be exercised when deciding the method of by-pass from control valves.
- It is recommended the by-pass be directed to a baffled reservoir tank, with at least one baffle between the by-pass line and the inlet line to the pump.
- Although not recommended, by-pass liquid may be returned to the inlet line of the pump if the system is properly designed to protect your pump. A PRESSURE REDUCING VALVE must be installed on the inlet line (**between the by-pass connection and the inlet to the pump**) to avoid excessive pressure to the inlet of the pump. It is also recommended that a THERMAL VALVE be used in the by-pass line to monitor the temperature build-up in the by-pass loop to avoid premature seal failure.
- A low-pressure, flexible cloth braid (not metal braid) hose should be used from the by-pass connection to the inlet of the pump.
- Check the pressure in the by-pass line to avoid overpressurizing the inlet.
- The by-pass line should be connected to the pump inlet line at a gentle angle of 45° or less and no closer than 10 times the pump inlet port diameter e.g. 1-1/2” port size = 15” distance from pump inlet port. 

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**TORQUE CHART**

<table>
<thead>
<tr>
<th>Pump Item</th>
<th>Thread</th>
<th>Tool Size [P/N]</th>
<th>in. lbs.</th>
<th>ft. lbs. Nm</th>
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<td><strong>Pump Model</strong></td>
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**Bulletin Information**

- The by-pass line should be connected to the pump inlet line at a gentle angle of 45° or less and no closer than 10 times the pump inlet port diameter e.g. 1-1/2” port size = 15” distance from pump inlet port.
FILTER

**LENGTH OF LINE OF EACH VALVE OR FITTING.**

Materially affect the total line loss, add to the total line length, the equivalent pressure loss created by valves, fittings and elevation of lines. Arriving at a total line pressure loss, consideration should then be given to pressure loss created by valves, fittings and elevation of lines. The above values shown are valid at all pressure levels.

---

**WATER LINE PRESSURE LOSS**

**PRESSURE DROP IN PSI PER 100 FT OF HOSE**

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<th>Water GPM</th>
<th>Steel Pipe—Nominal Dia.</th>
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**RESISTANCE OF VALVES AND FITTINGS**

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<tr>
<th>Nominal Pipe Size Inches</th>
<th>Inside Diameter Inches</th>
<th>Gate Valve</th>
<th>Globe Valve</th>
<th>Angle Valve</th>
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<td>5.55</td>
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<td>3.09</td>
<td>6.61</td>
<td>14.70</td>
<td>3.66</td>
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<td>6.00</td>
<td>21.60</td>
</tr>
</tbody>
</table>

**TYPICAL RESERVOIR TANK**

RECOMMENDED 6 TO 10 TIMES SYSTEM CAPACITY

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**HANDY FORMULAS TO HELP YOU**

**How do I calculate the torque for my hydraulic drive system?**

\[ \text{Torque} = 3.6 \times (\text{GPM} \times \text{PSI}) \]

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**AVOID CAVITATION DAMAGE**

One or several of the conditions shown in the chart below may contribute to cavitation in a system resulting in premature wear, system downtime and unnecessary operating costs.

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**CONDITION**

- Inadequate inlet line size
- Water hammering
- Liquid acceleration/deacceleration
- Rigid Inlet Plumbing
- Excessive elbows in inlet plumbing
- Excessive liquid temperature
- Agitation in Supply Tank
- High Viscosity Liquids
- Clogged Filters

**SOLUTION**

- Increase line size to the inlet port or one size larger
- Install C.A.T. Tube
- Move pump closer to liquid supply
- Use flexible wire reinforced hose to absorb pulsation and pressure spikes
- Keep elbows to a minimum and less than 90°
- Use Thermo Valve in bypass line
- Do not exceed pump temperature specifications
- Substitute closed loop with baffled holding tank
- Adequately size tank for frequent or high volume bypass
- Pressure feed high temperature liquids
- Properly ventilate cabinets and rooms
- Check all connections
- Use PTFE thread tape or pipe thread sealant
- Size tank according to pump output — Minimum 6-10 times system GPM
- Baffle tank to purge air from liquid and separate inlet from discharge
- Verify viscosity against pump specifications before operation
- Elevate liquid temperature enough to reduce viscosity
- Lower RPM of pump
- Pressure feed pump
- Increase inlet line size
- Perform regular maintenance or use clean filters to monitor build up
- Use adequate mesh size for liquid and pump specifications
One of the most important steps in a high pressure system is to establish a regular maintenance program. This will vary slightly with each system and is determined by various elements such as the duty cycle, the liquid being pumped, the actual specifications vs rated specifications of the pump, the ambient conditions, the inlet conditions and the accessories in the system. A careful review of the necessary inlet conditions and protection devices required before the system is installed will eliminate many potential problems.

CAT PUMPS are very easy pumps to service and require far less frequent service than most pumps. Typically, only common tools are required, making in-field service convenient, however, there are a few custom tools, special to certain models, that do simplify the process. This service manual is designed to assist you with the disassembly and reassembly of your pump. The following guide will assist in determining the cause and remedy to various operating conditions. You can also review our FAQ or SERVICE sections on our WEB SITE for more facts or contact CAT PUMPS directly.

<table>
<thead>
<tr>
<th>PROBLEM</th>
<th>PROBABLE CAUSE</th>
<th>SOLUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low pressure</td>
<td>• Worn nozzle. • Belt slippage. • Air leak in inlet plumbing. • Pressure gauge inoperative or not registering accurately. • Relief valve stuck, partially plugged or improperly adjusted. • Inlet suction strainer (filter) clogged or improperly sized. • Abrasives in pumped liquid. • Leaky discharge hose. • Inadequate liquid supply. • Severe cavitation. • Worn seals. • Worn or dirty inlet/discharge valves.</td>
<td>• Replace with properly sized nozzle. • Tighten belt(s) or install new belt(s). • Tighten fittings and hoses. Use PTFE liquid or tape. • Check with new gauge. Replace worn or damaged gauge. • Clean/adjust relief valve. Replace worn seats/valves and o-rings. • Clean filter. Use adequate size filter. Check more frequently. • Install proper filter. • Replace discharge hose with proper rating for system. • Pressurize inlet and install C.A.T. • Check inlet conditions. • Clean inlet/discharge valves or install new valve kit.</td>
</tr>
</tbody>
</table>

| Pulsation | • Faulty Pulsation Dampener. • Foreign material trapped in inlet/discharge valves. | • Check precharge. If low, recharge, or install a new dampener. • Clean inlet/discharge valves or install new valve kit. |

| Water leak | • Under the manifold • Worn V-Packings, Hi-Pressure or Lo-Pressure Seals. • Worn adapter o-rings. | • Install new seal kit. Increase frequency of service. • Install new o-rings. |
| Into the crankcase | • Humid air condensing into water inside the crankcase. • Excessive wear to seals and V-Packings. | • Install oil cap protector. Change oil every 3 months or 500 hours. • Install new seal kit. Increase frequency of service. |

| Knocking noise | • Inadequate liquid supply. | • Check liquid supply. Increase line size, pressurize or install C.A.T. |
| Inlet supply | • Broken or worn bearing. | • Replace bearing. |
| Bearing | • Loose pulley on crankshaft | • Check key and tighten set screw. |

| Oil leak | • Worn crankcase oil seals. • Worn crankshaft oil seals or o-rings on bearing cover. • Loose drain plug or worn drain plug o-ring. • Loose bubble gauge or worn bubble gauge gasket. • Loose rear cover or worn rear cover o-ring. • Loose filler cap or excessive oil in crankcase. | • Replace crankcase oil seals. • Remove bearing cover and replace o-rings and/or oil seals. • Tighten drain plug or replace o-ring. • Tighten bubble gauge or replace gasket. • Tighten rear cover or replace o-ring. • Tighten filler cap. Fill crankcase to specified capacity. |

| Pump runs extremely rough | • Restricted inlet or air entering the inlet plumbing • Stuck inlet/discharge valves. • Leaking V-Packings, Hi-Pressure or Lo-Pressure seals. | • Correct inlet size plumbing. Check for air tight seal. • Clean out foreign material or install new valve kit. • Install new seal kit. Increase frequency of service. |

| Premature seal failure | • Scored plungers. • Over pressure to inlet manifold. • Abrasive material in the liquid being pumped. • Excessive pressure and/or temperature of pumped liquid. • Running pump dry. • Starving pump of adequate liquid. • Eroded manifold. | • Replace plungers. • Reduce inlet pressure per specifications. • Install proper filtration at pump inlet and clean regularly. • Check pressure and inlet liquid temperature. • DO NOT RUN PUMP WITHOUT LIQUID. • Increase hose one size larger than inlet port size. Pressurize and install C.A.T. • Replace manifold. Check liquid compatibility. |